Department of Defense
Legacy Resource Management Program

Climate Adaptation Guide for Cultural Resources

A Guide to Incorporating Climate Considerations into Integrated Cultural Resources Management Plans

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Cover photo: Quarters 5, Fort Shafter, Honolulu, Hawaii, 2020 (Source: U.S. Department of Defense)

Executive Summary

Department of Defense Instruction (DoDI) 4715.16, Cultural Resources Management, establishes the requirement for DoD to prepare Integrated Cultural Resources Management Plans (ICRMPs). The content for ICRMPs is found in Enclosure 6 of DoDI 4715.16. Also, *DoD Directive 4715.21, Climate Change Adaptation and Resilience* (2018), as well as the *DoD Climate Adaptation Plan* (2021), requires that all operations, planning activities, business processes, and resource allocation decisions include climate change considerations. Therefore, this guidance document presents as methodology for considering and integrating climate change risks into cultural resources management and the potential ways to improve resiliency for cultural resources. This guide then presents ways to integrate these climate adaptation strategies into the ICRMP. This document is a DoD Legacy Program work product and, as such, does not represent official policy, position, or opinions of the DoD.

Louisiana National Guard troops drive through floodwaters from the industrial canal as Hurricane Gustav strikes the Gulf Coast on Sept. 1, 2008 (Source: Stephen Morton/Getty Images)

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Acronyms and Abbreviations

ACAT	Army Climate Assessment Tool
ACHP	Advisory Council on Historic Preservation
ACRH	Army Climate Resilience Handbook
AD	Army Directive
AEP	Annual Exceedance Probability
AFB	Air Force Base
AHPA	Archaeological and Historic Preservation Act
AIRFA	American Indian Religious Freedom Act
AR	Army Regulation
ARPA	Archaeological Resources Protection Act of 1979
ASA IE&E	Assistant Secretary of the Army for Installations, Energy, and Environment
CAP	Climate Adaptation Plan
CFR	Code of Federal Regulations
Climate R&D	Climate Research and Development
CRC	Coastal Resiliency Center
CRM	Cultural Resources Managers
DA	Department of the Army
DCAT	DoD Climate Assessment Tool
DLA	Defense Logistics Agency
DoD	Department of Defense
DoDI	Department of Defense Instruction
EESI	Environmental and Energy Study Institute
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EWN	Engineering With Nature
FEMA	Federal Emergency Management Agency
FGHN	Foreign Government/Host Nation
FGS	Final Governing Standards
FPO	Federal Preservation Officer
FY	Fiscal Year
GSA	General Services Administration
HARB	Homestead Air Reserve Base
ICRMP	Integrated Cultural Resources Management Plan
IDP	Installation Development Plan
INRMP	Integrated Natural Resources Management Plan

JBLE	Joint Base Langley-Eustis
LED	Light-Emitting Diode
LOE	Line of Effort
MCBCP	Marine Corps Base Camp Pendleton
MCBH	Marine Corps Base Hawaii
NAGPRA	Native American Graves Protection and Repatriation Act of 1990
NAVFAC	Naval Facilities Engineering Systems Command
NDAA	National Defense Authorization Act
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NNBF	Natural and Nature-Based Features
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRHP	National Register of Historic Places
OEBGD	Overseas Environmental Baseline Guidance Document
OPNAVINST	Chief of Naval Operations Instruction
PM	Policy Memorandum
RPA	Real Property Asset
SECNAVINST	Secretary of the Navy Instruction
SFB	Space Force Station
SHPO	State Historic Preservation Officer
THPO	Tribal Historic Preservation Officer
UFC	Unified Facilities Criteria
U.S.	United States
USACE	U.S. Army Corps of Engineers
USC	United States Code
USGAO	U.S. Government Accountability Office
USGCRP	U.S. Global Change Research Program

PART 1
CLIMATE ADAPTATION PLANNING FOR ICRMP

1. INTRODUCTION

Department of Defense (DoD) installations provide the environment for the training and testing of our military forces. Significant risks or the exposure to danger, harm, or loss from climate-driven changes in the environment could compromise buildings, infrastructure, and training grounds at these installations, and, therefore, compromise training and the ability of DoD to execute its military mission. The DoD manages more than 1,700 military installations worldwide. Sea-level rise will affect installations in coastal areas. Large rain events are causing serious erosion and changing hydrologic patterns. For example, in 2018, Hurricane Michael damaged every building on Florida's Tyndall Air Force Base (repair estimate $4.7 billion) and Hurricane Florence dropped 36 inches of rain, flooding three North Carolina Marine Corps installations (repair estimate $3.6 billion) (Aftergood 2019). Climate change poses a risk to national security (DoD 2014). For this guide, risk is defined as the chance of danger, harm or loss from a hazard, while a hazard is the source of the danger. Climate-related hazards include wildfire, heat, drought, sea level rise, etc.

The installations and land managed by DoD are integral to the military's mission of keeping our nation secure. As such, there is an operational need to ensure that current and future climatic changes do not compromise the ability of installations to serve their essential operational, training, and testing functions. Even though extreme weather events and divergent climatic patterns are affecting DoD installations, the DoD has a responsibility for cultural resource stewardship. There are numerous statutes, regulations, or other DoD guidance that set out the cultural resources management responsibilities of DoD installations (see Chapter 3). The DoD manages several types of cultural resources, including historic buildings and structures, archeological resources and sites, objects, historic districts and landscapes, ethnographic resources, sacred sites, and burial sites. The built infrastructure required

An airplane hangar at Tyndall Air Force Base is damaged from Hurricane Michael in Panama City, Florida on October 11, 2018 (Source: David Goldman/AP)

to support the military mission on DoD installations is extensive and many of these facilities are historic. DoD's Cultural Resources Program is designed to support the military's combat readiness mission while maintaining the long-term sustainability of its historic properties. Therefore, cultural resource management needs to adapt to the broad range of climate-related changes to protect historic properties.

The need for an Integrated Cultural Resources Management Plan (ICRMP) is established under *Department of Defense Instruction (DoDI) 4715.16, Cultural Resources Management*. The primary purpose of an ICRMP is to provide cultural resources managers with a guide to ensure compliance with applicable cultural resources management laws and regulations. The ICRMP describes the fundamental requirements of cultural resources management, including identification and evaluation of cultural resources, consultation with concerned parties, consideration of impacts, and decisions about how to treat resources.

ICRMPs integrate the entirety of the installation's Cultural Resources Management Program with ongoing mission activities and identifies compliance actions necessary to maintain the availability of mission essential properties and areas. An ICRMP integrates the complex array of overlapping legal responsibilities into a coherent and efficient overall program. It integrates cultural resources responsibilities with the many other programs and activities that may interact with cultural resources and stakeholders. These plans help ensure compatibility between the installation's military mission, other planned activities, and the management of its cultural resources; therefore, the ICRMP is the logical place to include strategies to manage cultural resources for changing climatic conditions.

1.1 Purpose of This Guide

Understanding climate risks and vulnerabilities, and getting a start on adapting to these changes, will greatly improve the chance for sustaining the capacity of ranges and installations to meet their mission now and into the future.

The guide consists of two major sections. Part I includes:

- Overview of climate hazards to military installations and mission;
- Climate change and cultural resources management requirements;
- Brief primer on climate change;
- Introduction to adaptation;
- Sources of adaptation-related information and expertise;
- Summary of climate and adaptation considerations for individual ICRMP program elements; and
- Review of options for incorporating climate concerns into ICRMPs.

Part II offers a step-by-step method for carrying out the ICRMP adaptation planning process and integrating the outcomes into the ICRMP. The appendices provide additional sources of adaptation-related information, and a set of detailed worksheets that support installation-level ICRMP climate adaptation planning and ICRMP integration.

Climate adaptation planning is an iterative process because of continual climatic changes and associated resource impacts. Climate adaptation planning consists of four major components:

- Assess climate hazards,
- Develop adaptation responses,
- Implement adaptation actions, and
- Monitor and adjust actions as needed.

This guide will help cultural resources managers (CRM) draw from and apply strategies to preserve, reduce, or mitigate impacts on cultural resources to best support their particular installation's hazards and needs. The guide is designed to help military CRM identify and assess climate hazards and vulnerabilities. Best management practices and options are included so that CRMs can prepare for and reduce climate-related risks to ensure that DoD installations can continue to meet their missions. Finally, this guide provides instruction on developing climate-informed ICRMPs to balance risks to cultural resources and military mission, integration of strategies, and a mechanism for adjusting management, as necessary.
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1.2 Methodology Used to Develop This Guide

The writers of this guide conducted research at several federal, state, local, and foreign agencies, including their associated websites. The writers also reviewed the National Park Service (NPS) Cultural Resources Climate Change Strategy, National Oceanic and Atmospheric Administration (NOAA) Climate Change Strategy, United Nations Sendai Framework for Disaster Risk Reduction Strategies, Scotland's and the United Kingdom's climate change risk assessment, and other national and international examples for relevance to DoD installations and cultural resources management.

The writers reviewed studies, procedures, strategies, and management tools developed by other agencies for relevance to DoD cultural resources management. Agencies that have recently been conducting studies and implementing management strategies, include General Services Administration (GSA), NPS, National Capital Planning Commission (Washington D.C.), Department of Commerce, NOAA, Department of Agriculture, Department of Transportation, the City of Norfolk, California State Parks, Historic Hawaii Foundation, the City of Chicago, and the City of Denver. Some of the management plans provided strategies and methodology for addressing climate change. Very few plans addressed cultural resources, specifically, with the exception of protecting a town's historic district or cultural identity. However, many plans addressed coastal flooding and sea level rise. Most city plans focused on reducing greenhouse gas emissions.

DoD has already begun to address climate hazards in its Natural Resources Management Program. The DoD *Integrated Natural Resources Management Plan (INRMP) Implementation Manual 4715.03* specifically calls for installations to address climate considerations when updating or revising their INRMPs. The National Wildlife Federation and DoD developed a guide—*Climate Adaptation for DoD Natural Resource Managers*—to help installation managers with implementing this policy guidance. The INRMP adaptation planning process described in this guide is based on a general adaptation framework known as Climate-Smart Conservation (Stein et al. 2019). The pertinent research, approaches, and conclusions from this work have been integrated into this guide.

A Climate Change Bibliography of selected references that provide additional and more in-depth information on climate change and cultural resources is provided in Appendix A.

A brief questionnaire was prepared and submitted to specific DoD installations to gather information about current climate-related issues and types of cultural resources on DoD installations. The data collected from

the questionnaire is used throughout this guidance manual and a summary of the data is included in Appendix B.

Worksheets to assist with developing adaptation strategies and incorporating information into the ICRMP are provided in Appendix C. In order to test and refine the methodology in this guide for integrating climate change considerations into ICRMPs, a case study was conducted at one installation. A summary of this case study is included in Appendix D.

1.3 How to Use This Guide

The guide consists of two major sections. The first section, Part I, Chapters 1 – 4, provides an overview and the foundation for climate change and cultural resources management considerations, and includes other topics, such as:

- Climate Hazards to the Military Mission
- Climate-Related Risks to DoD Cultural Resources
- Cultural Resources and the Implications for Military Mission and Readiness
- Cultural Resources Adaptation Strategies and Options
- Existing Guidance
- Pathways for Addressing Climate in the ICRMP.

Chapter 1 is the introduction to the guide. Chapter 2 provides an overview of current regulations, guidance, and a summary of climate-related vulnerabilities and hazards. Chapter 3 provides a brief summary of cultural resources regulations, climate hazards to cultural resources, and why adapting cultural resources management for climate vulnerabilities is important for maintaining the military mission. Chapter 4 provides guidance and tools to assess climate change risk, links potential climate change hazard impacts to DoD cultural resources, determines appropriate strategies for addressing the risks and impacts, and assesses the feasibility of climate change and resiliency strategies. In general, Part I provides the basic understanding of the general principles of climate adaptation and will help CRMs draw from and apply those elements in this guide that can best support their particular needs.

The second section, Part II, includes Chapters 5 and 6. Chapter 5 provides instruction on how to integrate climate adaptation strategies into installation ICRMPs. Chapter 6 provides a summary and lessons learned from the case study to test the worksheets and process. Chapter 7 lists the references used to develop this guide.

Finally, a series of appendices offer sources of climate-related information and expertise, along with a set of worksheets and detailed instructions for using the forms. These worksheets support and integration. These worksheets are intended to be illustrative rather than prescriptive. They can be used as is, or further tailored or modified to meet particular installation needs. The appendices include, as stated above, additional resources for integration including the annotated bibliography, installation questionnaire, and the worksheets.

Installation managers will have various numbers and types of resources to manage, which may require differing levels of detail and analysis to meet their planning objectives. An increasing number of adaptation practitioners and service providers can assist individual installations and Services, and this guide can be used to augment their efforts. Importantly, the material covered in this guide can help prepare installation personnel to ask the right questions of contractors or other adaptation practitioners (whether internal or external) to ensure that the services provided are consistent with best practices in the field and within DoD.

2. CLIMATE HAZARDS TO THE MILITARY MISSION

The overall goal for understanding and preparing for climate change is to create resilient installations. The term 'military installation resilience' is defined in *John S. McCain National Defense Authorization Act for Fiscal Year 2019, Public Law 115–232* (see below) as "the capability of a military installation to avoid, prepare for, minimize the effect of, adapt to, and recover from extreme weather events, or from anticipated or unanticipated changes in environmental conditions, that do, or have the potential to, adversely affect the military installation or essential transportation, logistical, or other necessary resources outside of the military installation that are necessary in order to maintain, improve, or rapidly reestablish installation mission assurance and mission-essential functions."

These next three chapters provide the basis for understanding the responsibilities and vulnerabilities of climate change to mission and installation resources. These chapters provide information to assist the CRM in developing an adaptation planning effort that is well tailored to meeting the specific installation-level needs and concerns. It will also assist with identifying management goals, objectives, and target cultural resources and assembling a planning team and engage with key internal and external stakeholders.

Adaptation are actions to prepare for and adjust to changing climate conditions, thereby reducing negative impacts or taking advantage of new opportunities. The planning effort may also include mitigation efforts to reduce the amount and speed of future climate change by limiting emissions or removing carbon dioxide from the atmosphere.

2.1 Climate Change Regulations and Guidance

DoD installations are required to assess and consider climate change in mission planning and operations. Key DoD and Service Acts, Executive Orders (EOs), directives, and guidance are summarized below. These regulations were current at the time that this guidance was developed, but regulations are periodically updated or superseded. Priorities can shift over the years as administrations change. The bibliography in Appendix A contains additional references and resources.

National Defense Authorization Act for Fiscal Year 2018. Public Law 115–91— December 12, 2017. In Section 335 - Report on Effects of Climate Change on Department of Defense, the US Congress concluded "that climate instability will lead to instability in geo-politics and impact American military operations around the world.'' Congress also stated that "climate change is a direct threat to the national security of the United States and is impacting stability in areas of the world both where the United States Armed Forces are operating today, and where strategic implications for future conflict exist," and that the U.S. military must be prepared for climate change. The law required the Secretary of Defense to prepare a report within one year on vulnerabilities to military installations and combatant commander requirements resulting from climate change over the next 20 years. The report included a list of the ten most vulnerable military installations within each service based on the effects of rising sea tides, increased flooding, drought, desertification, wildfires, and thawing permafrost. Mitigation measures to ensure the continued operational viability and to increase the resiliency of the identified vulnerable military installations. Also, a discussion of climate-change related effects

on the DoD from increased in the frequency of humanitarian assistance and disaster relief missions and the theater campaign plans is included.

John S. McCain National Defense Authorization Act for Fiscal Year 2019, Public Law 115–232, 13 August 2018. In Section 2805, subpart (c) - Incorporation of Changing Environmental Condition Projections in Military Construction Designs And Modifications – required the Secretary of Defense to amend section 3–5.6.2.3 of United Facilities Criteria (UFC) 2–100–01 and UFC 2–100– 02 to provide that projections from reliable and authorized sources, such as the National Academies of Sciences (for land use change projections and climate projections) and the U.S. Global Change Research Office and National Climate Assessment (for climate projections) among others, will be considered and incorporated into military construction designs and modifications in order to anticipate changing environmental conditions during the design life of existing or planned new facilities and infrastructure. Subpart (d) - Inclusion of Consideration of Energy and Climate Resiliency Efforts in Master Plans for Major Military Installations.— Section 2864 of title 10, United States Code, is amended— (1) in subsection (a)(2)— (A) in subparagraph (C), by striking ''and'' at the end; (B) in subparagraph (D), by striking the period at the end and inserting ''; and''; and (C) by adding at the end the following new subparagraph: ''(E) energy and climate resiliency efforts.''; and (2) in subsection (d), by adding at the end the following new paragraph: ''(3) The term 'energy and climate resiliency' means anticipation, preparation for, and adaptation to utility disruptions and changing environmental conditions and the ability to withstand, respond to, and recover rapidly from utility disruptions while ensuring the sustainment of mission-critical operations.''

EO 13653, 1 November 2013, *Preparing the United States for the Impacts of Climate Change.* In response to President Obama's 2013 Climate Action Plan, this EO put a new focus on federal climate change adaptation and resilience efforts by requiring all agencies, including the DoD, to develop climate change adaptation plans. Agencies were required to identify their climate change-related risks on missions and operations and to describe their plans to address those hazards. The EO also created a new federal organizational structure to coordinate climate change adaptation and resilience activities, including establishing a Council on Climate Preparedness and Resilience that consisted of high-level officials from federal departments and agencies.

President Donald Trump issued EO 13783, *Promoting Energy Independence and Economic Growth*, which rescinded EO 13653 on 28 March 2017 (*Federal Register*, 2017-03-31). In suspending the order, the executive branch told all federal agencies to stop considering climate preparedness in decision-making. On 20 January 2021, President Joe Biden issued EO 13990, *Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis*, which reinstated EO 13653 (*Federal Register*, 2021-01-25).

EO 14008, 27 January 2021, *Tackling the Climate Crisis at Home and Abroad.* This EO requires the DoD to submit an action plan to the newly created National Climate Task Force and the Federal Chief Sustainability Officer that describes steps the agency can take with regard to its facilities and operations to bolster adaptation and increase resilience to the impacts of climate change. A key requirement of the task is a description of each agency's climate vulnerabilities, particularly in the area of installation, building and facility energy, and water efficiency.

DoD Directive 4715.21, Climate Change Adaptation and Resilience (2018). This directive requires military mission planning and execution to include:

- Identifying and assessing effects of climate change on the DoD mission.
- Taking those effects into consideration when developing plans and implementing procedures.
- Anticipating and managing any risks that develop as a result of climate change to build resilience.

The ***DoD Climate Change Adaptation Roadmap*** (DoD 2014) provides a guide to integrate the expectations of the Commander in Chief as laid out in Obama's EO 13653. The DoD Climate Change Adaptation Roadmap identified four areas where adaptation (also known as climate preparedness and resilience) is essential:

- Plans and operations include the activities dedicated to preparing for and carrying out the full range of military operations. Also included are the operating environments in the air, on land, and at sea, both at home and abroad, that shape the development of plans and execution of operations.
- Training and testing, including access to land, air, and sea that replicates the operational environment is essential to readiness.
- Built and natural infrastructure.
- Acquisition and supply chain, including fielding and sustaining equipment.

The roadmap noted that climate change posed an immediate risk to the United States (U.S.) national security and presented two DoD responses—adaptation and mitigation—as recommended by the administration. The authors defined adaptation as efforts to plan for the changes that are occurring or expected to occur and mitigation as efforts that reduce greenhouse emissions. The roadmap established three goals:

1. identify and assess the effects of climate change on the DoD,
2. integrate climate change considerations across the DoD and manage associated risks, and
3. collaborate with internal and external stakeholders on climate change challenges.

Updated UFCs. DoD UFC 1-200-02, *High Performance and Sustainable Building Requirements (December 2020)*, requires that building design solution must be responsive to government-provided projection of climate change and determination of acceptable risk. The UFC provides minimum requirements and guidance for planning, designing, constructing, renovating, and maintaining high performance and sustainable buildings that will enhance DoD mission capability by reducing total ownership costs.

DoD UFC 2-100-01, *Installation Master Planning* (September 2020), directs installations to incorporate climate resilience analysis to ensure mission sustainment over the intended lifespan of the infrastructure and assets. It also provides instruction on the use of the Climate Change Planning Handbooks, and DoD Hazard Datasets such as DoD Regional Sea Level Database and the DoD Climate Assessment Tool (DCAT).

DoD UFC 3-201-01, *Civil Engineering* (revised December 2022) revised and added flood design requirements that incorporate climate-based data, such as the DoD Regional Sea Level Rise projections in compliance with National Defense Authorization Act (NDAA) Fiscal Year (FY) 19.

DoD UFC 3-201-02, *Landscape Architecture* (revised February 2021) directs all DoD projects to design plantings for climate resiliency. States DoD projects must

consider potential climate change effects and address the effects through strategic land use planning, modifications, and design interventions.

DoD UFC 3-400-02, *Engineering Weather Data* (September 2018) directs installation planners to request engineering weather data from Air Force's 14th Weather Squadron that focuses on climatic variables of temperature, humidity, precipitation, and winds.

DoD Climate Adaptation Plan. As required by EO 14008, *The DoD Climate Adaptation Plan (CAP)* was released in October 2021. The DoD CAP was developed to ensure that the military forces of the U.S. retain operational advantage under all conditions. The DoD CAP lays out how operations, planning activities, business processes, and resource allocation decisions will include climate change considerations. To achieve the DoD's strategic outcomes, the plan contains "lines of efforts" (LOE), a term that better reflects the scope and scale of the DoD's activities and a term commonly used in DoD planning efforts. Five LOEs were established for this plan. The first LOE centers on the integration of climate-informed decision-making using actionable science into all department processes. The second LOE focuses on training and equipping a climate-ready force by focusing on operating under the most extreme and adverse conditions and integrating climate adaptation concepts into existing major exercises and contingency planning. The third LOE is the intend to ensure built and natural infrastructure are in place for successful mission preparedness, military readiness and operational success in changing conditions and will leverage the DCAT to develop comprehensive installation resilience plans. Under the fourth LOE, the DoD intends to insert climate change considerations into supply chain management to both reduce vulnerabilities and create opportunities to leverage the DoD's purchasing power to advance key technologies essential to clean energy transformation. And finally, the fifth LOE is the DoD intends to enhance adaptation and resilience through collaboration.

2.2 Climate-Related Hazards to Military Mission

Potential climate change impacts on installation mission activities (including training, testing, industrial operations, and logistical and deployment support) are diverse. Field training exercises are conducted to replicate real-world combat requirements. Field training exercises range from hours to days to weeks in duration and are inherently subject to the effects of the prevailing climate and weather conditions. Adapting to variability of climate is part of realistic training; however, personnel safety concerns and short-term effects on training and operations can result from training on lands and waters that are experiencing ambient or extreme weather events.

Extreme heat events can require reductions in personnel activity levels and can damage roads and other training infrastructure. Extreme heat and drought events and/or high fire risk conditions can also preclude use of pyrotechnics, weapons simulators, and live-fire training with tracers to reduce chance of wildfires (Department of the Army [DA] 2013). In addition, personnel at DoD installations, especially those in the southeast and southwest, could lose significant training and testing time due to extreme heat (Pinson et al. 2021).

Extreme storm events and associated lightning, wind, and flooding risks can temporarily limit access to training lands and other training features such as water crossings. Soil saturation and increased erosion from extreme precipitation events can limit off-road transit by military vehicles and personnel. Engineering procedures in support of river crossings and bridging

operations are affected by precipitation extremes caused by climate-related changes to hydrologic cycles. Air operations (including combat support training, flight training, personnel transport, and logistical support) are also affected by prevailing weather and climate conditions. Adverse conditions can significantly disrupt air operations and training activities. For example, higher temperatures affect aircraft lift capacity and performance (DA 2013).

While isolated extreme events may only have minimal and short-term impacts on operational and training requirements, the cumulative impact of temperature and storm-related extremes that result from climate change will affect the ability of installations to sustain operational pace and could potentially reduce scheduling flexibility.

The built infrastructure required to support military missions on DoD installations is extensive. Built facilities include airfields, port facilities, and support infrastructure comparable to small cities, including commercial buildings, medical facilities, public safety facilities, housing, communication networks, roads, bridges, railways, and supporting utilities (e.g., power, water, sewer). In addition, most installations

Live Fire Exercise, Sockeye Wildlife, 2015 (Source: Staff Sgt. Charlene Moler)

Wildfire, Fort Carson, 2017 (Source: AKARNG)

are highly interdependent on civil regional public utilities, transportation, and communications networks (DA 2013).

Sea level rise and increased storm surge is expected to alter harbor topography, bathymetry, currents, and salinity, which may impact access to ports. Logistical support activities for military contingency operations are dependent on reliable access to port facilities. The land-based elevation of some installations is largely at or just above sea level. Coastal installations and facilities, if not subject to some level of inundation, would also be subject to increased groundwater salinity, a higher water table, and increased frequency of periodic flooding. These effects would require increased stormwater pumping and drainage capacity, maintenance for corrosion control, and flood protection. Increased temperature and precipitation can raise maintenance costs for vehicles and aircraft due to corrosion effects and impacts of ambient weather conditions on delicate electronic systems. Anticipated increases in cooling degree days and/or anticipated decreases in heating degree days would also alter energy usage. Generally, the change in cooling degree days is expected to be greater than the change in heating degree days, which could result in increased direct costs. Implementation of energy conservation

Minnesota Army National Guard Responds to Flooding, 2019 (Source: MNARNG)

standards and building or retrofitting of energy-efficient construction will be an increasing priority for the DoD (DA 2013).

The DoD conducts training in realistic field environments to achieve and sustain proficiency in mission requirements. Similarly, the DoD conducts testing in realistic field environments in anticipation of the military's use of weapons, equipment, munitions, systems, or their components. As such, access to the land, air, and sea space that replicate the operational environment is critical to military readiness. Climate effects on DoD's training and testing are manifested in an increased number of suspended, delayed, or canceled outdoor training and testing events and increased operational health surveillance and health and safety risks to DoD's personnel.

Climate change has been identified by the DoD as a critical national security threat and a threat multiplier. Improvements to master planning and to infrastructure planning and design are recognized as vital for reducing current and future vulnerability to climate hazards on installations, missions, and operations worldwide. For climate change, vulnerability results from a flaw, condition, or weakness due to exposure, sensitivity, or adaptive capacity that can allow a threat or failure to occur.

2.3 Top Four Climate-Related Hazards for Military Installations

Different climate events and climate changes have different effects on the military mission and operations. Exposure to climate hazards is broadly similar across the Departments within continental U.S., Alaska, and Hawaii. The Department of Air Force installations are often located in areas where long-term aridity or recurring short-term drought are anticipated to increase, driving more wildfire risk. Army installations have a similar pattern of exposure but are more frequently located in areas where exposure to heat, drought, and riverine flooding increase with time. The Navy has a significant exposure to coastal and riverine flooding, but there is great variability: some installations are highly exposed, and some are not.

This section will describe the top four climate-related hazards affecting DoD installations, which have been identified in a recent climate risk survey of DoD installations worldwide and from the questionnaire completed by targeted installations for this project (a summary of the results of the questionnaire is provided Appendix B). The top four climate hazards are also defined in *DoD Installation Exposure to Climate Change at Home and Abroad* (Pinson et al. 2021) and are from:

- Drought
- Flooding
- Heat
- Land Degradation

Drought. Drought represents a drier climate condition than is typical for a given location and time of year. It may be the result of a lack of precipitation, a temperature-driven increase in evapotranspiration, or some combination of both factors. These changes may have a sharp and sudden onset and

may last months to years. Droughts may end gradually or suddenly with large precipitation events. Drought may affect installation mission and readiness by reducing surface water supply quantity and quality. Drought-induced drying and killing of vegetation can make the land surface vulnerable to erosion when disturbed, potentially limiting vehicle maneuvers, low-level rotary wing flight operations, and other training and testing activities, while also making the landscape more susceptible to wildfire. Clear skies and higher temperatures increase the likelihood of heat risk during field activities and energy demand for cooling (Pinson et al. 2021).

Drought can negatively impact U.S. military installations in various ways, particularly in the southwest. For example, dry conditions resulting from drought impact the water supply in areas dependent on surface water. Additionally, droughts dry out vegetation, increasing wildfire potential and severity. Specific to military readiness, droughts can have broad implications for installation infrastructure and can impair testing activities. Loss of vegetation and reduced soil moisture can make the land surface vulnerable to erosion when disturbed, potentially limiting vehicle maneuvers, low-level rotary wing flight operations, and other training and testing activities. Drought conditions have caused significant reduction in soil moisture at several Department of Air Force installations resulting in deep or wide cracks in the soil, at times leading to ruptured utility lines and cracked road surfaces (Pinson et al. 2021). In addition, energy consumption at military installations may increase to provide additional cooling for facilities (Pinson et al. 2021). The U.S. Army Public Health Center has found that drought can contribute to heat-related illnesses, including heat exhaustion and heat stroke.

Several DoD sites in the Washington, D.C. area (including Joint Base Anacostia Bolling, Joint Base Andrews, U.S. Naval Observatory/ Naval Support Facility, and Washington Navy Yard) periodically experienced drought conditions, including extreme conditions in 2002 followed by severe conditions through 2018. In addition, Naval Air Station Key West experienced drought in 2015 and 2011, ranging from extreme to severe, respectively. These examples highlight that drought conditions may occur in places not typically perceived as drought regions (Pinson et al. 2021).

A result of drought is the increased chance and severity of wildfires. Wildfires are

Wildfire, 2011 (Source: U.S. Air Force, Photo credit: Staff Sgt. Gina Chiaverotti-Paige)

uncontrolled fires that originate on or cross onto undeveloped areas, regardless of the cause (human or natural). Wildfire poses a significant risk to military installations, can impact the timing and type of training and testing activities on a given installation, and can divert military resources to firefighting activities. There are numerous examples of live-fire activities igniting wildfires during dry conditions with both on- and off-installation impacts. Managing smoke from wildfires both on- and off-installation is a significant concern: exposure to smoke outdoors (or even indoors if building air is unfiltered) can cause or exacerbate existing health problems (e.g., asthma, bronchitis, and cardiovascular problems). Wildfires pose a significant and increasing threat to structures and communities intermingled with or immediately adjacent to vegetated areas (Pinson et al. 2021).

Wildfire has three key components: climatological conditions favorable for ignition and spread; the presence of wildland vegetation, especially dense and multi-canopied vegetation; and a natural or human source of ignition. The term "wildlands," encompasses all undeveloped areas including military ranges, grasslands, shrublands, barren lands, woodlands, and forests (Pinson et al. 2021). Routine military training and testing activities can be a significant ignition source, making wildfires a constant concern on many military installations. As a result, the DoD spends considerable resources on claims, asset loss, and suppression activities due to wildfire. While fire is a key ecological process with benefits for both sound land management and military capability development, other climatic factors including increased wind and drought can lead to an increased severity of wildfire activity. This could result in infrastructure and testing/training impacts (Pinson et al. 2021).

In March 2018, two related wildfires broke out in Colorado during an infantry and helicopter training exercise for an upcoming deployment. The cause was later determined to be from live fire training, gusty winds, and dry conditions, which allowed the fire to spread. The fire burned about 3,300 acres and resulted in the evacuation of 250 residences and the destruction of three houses (Pinson et al. 2021).

A wildfire in November 2017 burned 380 acres on Vandenberg Space Force Station (SFB) in southern California. While no structures were burned, the fire prompted evacuation of some personnel. Firefighters from the U.S. Forest Service, Santa Barbara County, and other localities assisted the Vandenberg SFB Fire Department in managing the fire. The Canyon wildfire at Vandenberg SFB in September 2016 burned over 10,000 acres and came very close to two Space Launch Complexes. A scheduled rocket launch had to be delayed, and several facilities on the south part of the installation were operating on generators due to the loss of electrical power lines (Pinson et al. 2021).

In the questionnaire completed by 40 specific DoD installations to gather information about current climate-related issues for this guide, drought, combined with wildfire and dust storms, was one of the top five climate hazards on DoD installations, with the greatest risks to Army installations (see Appendix B).

Flooding. Coastal flooding results when ocean water inundates land that is not typically inundated during the annual tidal cycle. Coastal flooding most commonly occurs in response to storm events when onshore winds push seawater up against the coast (storm surge), so that the water surface is elevated, and salt water is pushed inland. Sea-level rise exacerbates coastal flooding. This is especially problematic for relatively flat coastal plains where small increases in sea surface elevation allow for large increases in areas that are flooded (Pinson et al. 2021).

The change in the elevation of the sea is not globally uniform. The elevation at a particular location is influenced by multiple factors, including coastal and sea floor topography, the presence of currents, and whether or not the land surface itself is rising or falling. While in most populated coastal regions, net sea levels are rising relative to coastal elevations, some areas are currently experiencing net sea-level declines. Coastal inundation and erosion are threats to military installations located along the shorelines. Due to local variability, projected impacts due to sea-level change must be determined locally at each specific installation. Projected changes in sea level, coupled with coastal storms, are likely to increase the area subject to damage during storm events (Pinson et al. 2021).

The potential impacts of sea-level change include infrastructure loss or damage, degradation of mission capabilities, loss of training and testing lands, loss of transportation facilities and means, habitat damage, loss of life, and salinization of shallow aquifers. Where sea levels rise, coastal river elevations may also increase, increasing riverine flood risk in coastal areas (Pinson et al. 2021). Vulnerabilities to installations include coastal and riverine flooding. Coastal flooding may result from storm surge during severe weather events. Over time, gradual sea level changes magnify the impacts of storm surge and may eventually result in permanent inundation of property. Increasing coverage of land from nuisance flooding during high tides, also called "sunny day" flooding, is already affecting many coastal communities. Joint Base Langley-Eustis (JBLE) Air Force Base (AFB), Virginia, has experienced 14 inches in sea level rise since 1930 due to localized land subsidence (the sudden sinking or gradual downward settling of the ground's surface) and sea level rise. Flooding at JBLE-Langley, which has a mean sea level elevation of three feet, has become more frequent and severe (Pinson et al. 2021).

Naval Station Norfolk, in Portsmouth, Virginia, is the largest naval base in the world, 2017 (Source: Harvard Business Review)

Increases in precipitation, especially increases in the magnitude and/or frequency of extreme precipitation events, are projected in most portions of the U.S. under a warming climate. The most important consequence of excess precipitation is flooding. Flooding can occur when rivers overflow their banks or when precipitation is so heavy that the existing drainage/flood runoff system is overwhelmed. Flooding may be a slow-moving event, such as the gradual downstream movement of a spring runoff flood peak, or very rapid, as when extreme quantities of precipitation fall in one area over a short time period producing a flash flood. Compound flood events, such as a stalled tropical storm dropping rain on previously saturated ground, can also produce floods. Development (including impervious surfaces), insufficient stormwater systems, wildfire, and deteriorated flood infrastructure can amplify flood risk (Pinson et al. 2021).

In addition to damaging infrastructure, equipment, materiel, vehicles and aircraft, floodwaters may disrupt access to and from installations; cause utility closure; contribute to land degradation; impact training and

testing activities, including use of rangelands; and damage off-installation housing and support systems (Pinson et al. 2021). Naval Base Coronado experiences isolated and flash flooding during tropical storm events, particularly in El Niño years. Upland areas at the installation are subject to flash floods, and the main installation has experienced worsening sea level rise and storm surge impacts that include access limitations and other logistic related impairments (Pinson et al. 2021).

Navy Region Mid-Atlantic and the greater Hampton Roads area are one of the most vulnerable to flooding military operational installation areas in the U.S. Sea level rise, land subsidence, and changing ocean currents have resulted in more frequent nuisance flooding and increased vulnerability to coastal storms. As a result, and to better mitigate these issues, the Mid-Atlantic Region has engaged in several initiatives and partnerships to address the associated challenges (Pinson et al. 2021).

At Naval Base Guam, recurrent flooding limits capacity for a number of operations and activities including Navy Expeditionary Forces Command Pacific, submarine squadrons, telecommunications, and a number of other specific tasks supporting mission execution. Additionally, recurrent flooding impacts operations and activities of contingency response groups at Andersen Air Force Base, as well as mobility response, communications, combat, and security forces squadrons (Pinson et al. 2021).

In the questionnaire completed by specific DoD installations to gather information about current climate-related issues for this guide, flooding, which includes coastal and riverine flooding, sea-level rise, and increased precipitation and storm surge events, was the top climate hazard on DoD installations, with the greatest risks to Navy and Department of the Air Force installations (see Appendix B).

Heat. Rising temperatures pose a direct and measurable risk to human health. Small increases in average temperatures can result in significant increases in the frequency of temperature extremes, as well as contribute to increases in precipitation intensity and quantity, reductions in winter snowpack, increases in global mean sea level, increases in evapotranspiration, and changes to other processes. The rate of warming varies by geography, with higher rates of warming in Alaska, the Northwest, the Southwest, and the Northern Great Plains, with the least warming in the Southeast. Warming rates may also vary by season. The rate of warming in the last decade appears to be accelerating, with the most recent average rate of 0.512°F per decade based on satellite observations (Pinson et al. 2021).

Climate change is anticipated to increase heat-related health problems, with even small climate changes resulting in increases in illness and death. Increases in temperature are anticipated to have significant effects on military training and testing, including an increase in the number of "black flag" (suspended outdoor activities) or fire hazard days (limiting live-fire activities); increases in the need for operational health surveillance; higher rates of heat-related mortality and morbidity; and reassessment of weapons system operations and deployment (including changes to soldier readiness due to changes in the availability or timing of days when conditions are suitable) (Pinson et al. 2021). Service members are subject to heat stress, and their performance decreases with increased heat. Specific types of activities, or duration of these activities, may have to be suspended during certain temperature conditions. An NBC news report found at least 17 heat deaths during military training in the past decade and a 60 percent surge in heat-related injuries, primarily heat exhaustion and heat stroke, over the same period (Hasemyer 2019). Higher temperatures

Effects to aircraft, 2011 (Source: Petty Officer 2nd Class Jonathan Chandler)

also significantly increase the opportunity for vector-borne diseases: higher winter temperatures reduce winter vector mortality rates, while higher spring-fall temperatures extend the length of the breeding season, allowing for multiple reproductive cycles (Pinson. et al. 2021).

Higher temperatures also affect pilot readiness by limiting time in the cockpit while on the ground and by affecting aircraft lift on takeoff and landing. The destructive effects of high temperatures and humidity on the performance of aircraft are exacerbated in many places around the world under climate change. These effects, for both rotary and fixed wing aircraft, include reductions in take-off weight because of reduced lift and longer take-off and landing distances. Military operations will be at higher risk of disruption or outright failure, particularly in those locations where longer over-water distances need to be traversed (HSToday 2020).

In the questionnaire completed by 40 specific DoD installations (less than 3% of the total number of DoD installations) to gather information about current climate-related issues for this guide, rising temperatures, combined with heat, was one of the top five climate hazards on DoD installations, with the greatest risks to Department of the Air Force installations (see Appendix B).

Land Degradation. Land degradation refers to long-term changes in land use, land cover, soil moisture, permafrost, and other processes that result in soil loss, reduced soil fertility, coastal erosion, land subsidence, a reduced ability of the land to support native plants and animals and reduced agricultural yields (Pinson et al. 2021). Heat and drought can be causes of or components of land degradation, so overlap of these hazards are acknowledged.

In the Arctic, increased air temperatures result in an increase in soil temperature, leading to significant increases in the depth of annual permafrost thaw or permanent permafrost loss. Permafrost presents risks for critical built infrastructure. Soil strength, ground subsidence, and stability are primarily affected by the phase change of ground ice to water at or near 0°C. Soil thermal regime changes can result from human activity, infrastructure emplacement, or systemic shifts related to weather. Such subsidence may be rapid and catastrophic (days), very slow and systematic (decades), or somewhere

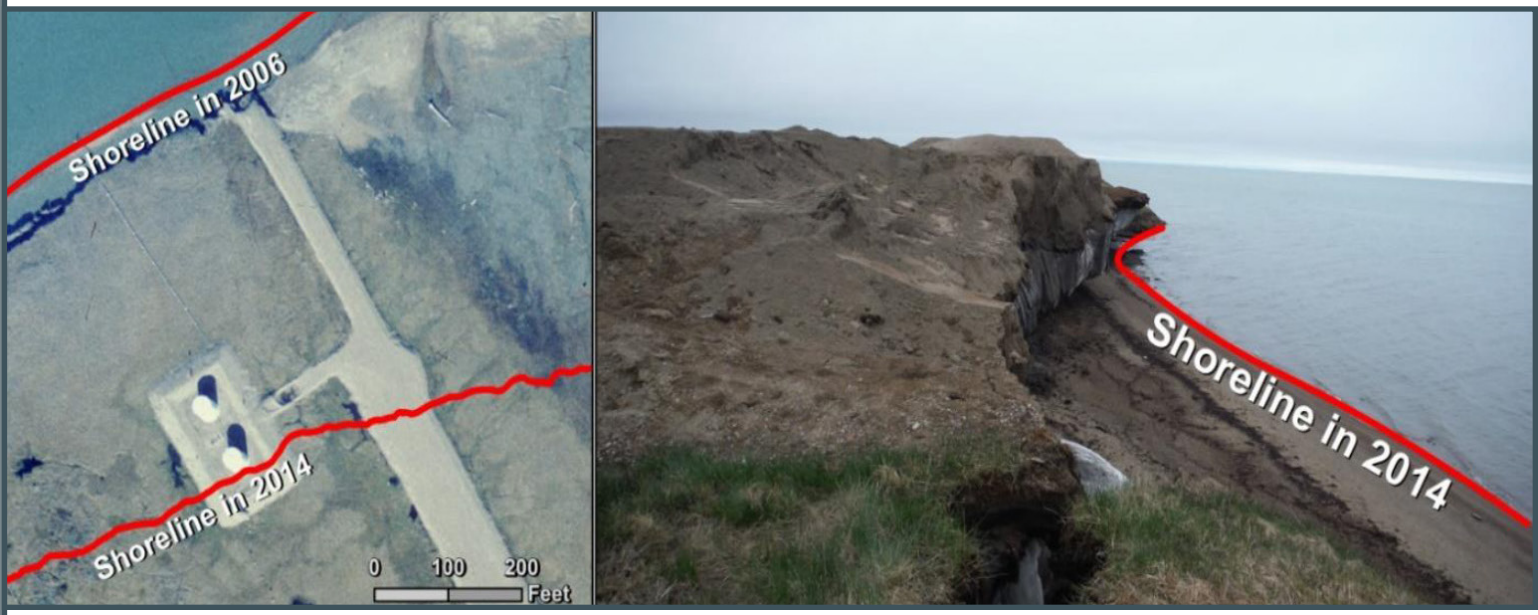
in between. Whether rapid or slow, thawing permafrost decreases the structural stability to foundations, buildings, and transportation infrastructure and requires costly mitigation responses that disrupt planning, operations, and budgets. In addition, thawing permafrost exposes coasts to increased erosion (Pinson et al. 2021).

Permafrost underlays about 85 percent of Alaska; it is thickest north of the Brooks Range and gradually diminishes southward. Permafrost thaw is relevant to DoD training and testing needs. Thermokarst, which is a type of landscape that results from thawing permafrost, increases wetland areas, and creates more challenging terrain. In Fort Greeley, Alaska, Army training ranges are built on, or are being planned in, permafrost-dominated areas. Predicting where this phenomenon occurs and how permafrost might change is vital to maintaining training operations and assessing impending environmental management challenges (Pinson et al. 2021).

Land degradation is a significant problem for installations. Many kinds of degradation result in loss of vegetative cover, increasing erosion from extreme precipitation events that can limit off-road transit by military vehicles and personnel. Bare ground, when dry, may become a significant dust source that restricts air and ground travel, fouls machines of all types, penetrates building interiors, and poses health challenges.

Soil susceptibility to erosion is at the heart of the issue of land degradation. Soil loss can result from many processes, but chief among these are precipitation intensity (how fast precipitation falls) and land use (how dense the vegetation is and therefore its ability to protect the ground surface from erosion). Both of these variables affect the ability of raindrops to dislodge soil particles, and surface runoff to transport these particles to stream channels (Pinson et al. 2021).

Wildfire is included under land degradation because of the profound landscape changes that can occur after wildfires if burn conditions are severe enough. In the immediate years post-wildfire, land areas subject to high-intensity burns are susceptible to large, damaging mass-wasting and other erosion events with each rainfall. Susceptibility can last from years to decades. Post-wildfire runoff, often bulked with debris and ash, poses a life-safety risk in excess of what would be expected for a given precipitation event. Wildfire, by destroying



Extensive erosion at the former Point Lonely Short-Range Radar Station in the North Slope Borough of Alaska, 2014 (Source: U.S. Air Force)

vegetation cover, weakening surface soils, and increasing soil direct heating and drying by the sun, is a significant accelerator of land degradation in many regions (Pinson et al. 2021).

The DoD Climate Change Adaptation Roadmap identifies two areas of climate change concern related to energy: (1) changing building heating and cooling demand, which impacts installation energy intensity and operation costs, and (2) disruption to and competition for reliable energy supplies. Rising temperatures are expected to affect both energy demand and supply. Warmer winter temperatures may reduce demand for heating, although cold extremes are anticipated to continue to occur resulting in spikes in demand for energy for heating. Higher summer temperatures are anticipated to drive up energy demand for cooling residential, municipal, industrial, agricultural, and other buildings. This rising demand is anticipated to strain the U.S. energy grid at the same time that transmission is reduced due to reductions in power line transmission and transformer capacities, higher surface water temperatures in waters used to cool power plants and nuclear reactors, reduced renewable and thermoelectric energy generating capacity, and at least regional reductions in water available for power generation, including hydropower and biofuels (Pinson et al. 2021).

In the questionnaire completed by 40 specific DoD installations to gather information about current climate-related issues for this guide, land degradation, including melting permafrost, increased energy demands, and the increase in the number of wildfires, was one of the top five climate hazards on DoD installations, with the greatest risks to Army and Department of Air Force installations (see Appendix B).

Other Climate Hazards. Other climate hazards are from the increase in number and severity of weather events, such as tornadoes, hurricanes, and ice storms. The intensity and frequency of tropical storms in the Atlantic Ocean, Caribbean, and Gulf of Mexico have risen noticeably over the past 20 years, with six of the 10 most active hurricane seasons occurring since the mid-1990s. These trends are closely related to variations in sea surface temperature in the tropical Atlantic, leading the U.S. Global Change Research Program to conclude that hurricane activity has "increased substantially since the 1950s and '60s in association with warmer Atlantic Sea surface temperatures." These storms produced intense rain and high winds that resulted in property damage, flooding, and downed trees (U.S. Government Accountability Office [USGAO] 2019).

Tornados, severe hail and windstorms, blizzards, and hurricanes result in damage to facilities and infrastructure, and delay training, testing programs, and space launches. For example, Tyndall Air Force Base in Florida was heavily damaged in 2018 when Hurricane Michael hit as a powerful Category 5 storm. Several stealth-fighter jets were at the installation for maintenance and could not be moved out in time before the storm hit. Damage was estimated to be close to $5 billion. Later the same year, Camp Lejeune reported that 70 percent of the camp houses had received some damage from Hurricane Florence. Damage from this storm was estimated to be around $3 billion (USGAO 2019).

In the questionnaire completed by 40 specific DoD installations to gather information about current climate-related issues for this guide, the increase in number and severity of tornadoes, hurricanes, and ice storms, was the number two climate hazard on DoD installations, with the greatest risks to Department of the Air Force and Marine Corps installations (see Appendix B).

2.4 Climate Change Hazards and Effects on DoD Installation Mission Requirements

Climate change has a direct effect on the environment. The changes to the environment have an effect on military infrastructure and readiness. Table 2-1 provides examples of the relationship between climate phenomena, impacts of changing climate on humans, infrastructure, and the environment, and the implications of these effects on the DoD mission at military installations. Potential mission impacts are those effects on DoD installation facilities and functions, including training, testing, and industrial operations. Effects include both direct and indirect on humans, the built infrastructure, and the natural environment.

Table 2-1. Example Relationships of Climate to Effects on DoD Installation Mission Requirements

Climate Change Hazards	Potential Effects of Hazards	Potential Mission Impacts
Drought	– Increases in extent and duration of droughts – Increased wildfire risk – Altered burn regimes – Loss of vegetative cover – Impacted soil function and resilience (desertification) – Soil loss – Increased dust – Impacts to air quality – Infrastructure damage – Water supply constraints – Impacted groundwater and surface water quality – Protected species stress – Decreased stream flows for navigation and energy generation – Erosion	– Reduced land carrying capacity for vehicle maneuvers – Increased maintenance costs for roads, runways, and utilities – Limits on low-level rotary wing flight operations – Increased regulatory constraints on training land access due to impacts to threatened and endangered species, water quality, air quality, or additional compliance needs to replace infrastructure – Reduced live-fire training – Reduced water availability and greater competition for limited water resources

Climate Change Hazards	Potential Effects of Hazards	Potential Mission Impacts
Flooding	– Loss of coastal land – Damage to physical infrastructure (roads, targets, ranges) and protected ecosystem resources – Land subsidence – Saltwater intrusion – Habitat loss & damage – Contribute to land degradation	– Degradation or loss of coastal infrastructure and critical port facilities – Increased infrastructure damage and associated reinforcement and repair costs – Impacts to coastal training – Increased regulatory constraints on training land access due to impacts to water quality and endangered species, or additional compliance to replace infrastructure – Impacts on supply chain from potential transportation interruptions – Disrupt access to and from installations – Cause utility closure – Damage to housing and support systems
Heat	– Increased number of cumulative days with temperatures >95°F – Melting permafrost – Increased incidences of heat stress – Changes in incidence/ distribution of vector-borne diseases – Vegetation transition (species and biome shifts) – Wildfire risk – Soil warming and increased evapotranspiration; increases in precipitation intensity and quantity – Electrical grid stress – Degradation of equipment performance	– Shift in viable test/training missions – Loss of testing capabilities, or limitations on testing which result in increased costs, prolonged delivery schedules, and lower confidence assessments/higher risk acceptance – Potential loss of cold weather training venues – Reduced soldier activity levels – Higher rates of heat related mortality and morbidity – Reduced military vehicle access – Reduced airlift capacity – Reduced live-fire training – Change in operational parameters for weapons and equipment development and testing – Increased maintenance costs – Increased energy costs for building and industrial operations will continue to stress energy resources – Installations that are dependent on the commercial power grid and vulnerable to disruptions due to severe weather may also experience physical attacks and cyber-attacks, exploiting that vulnerability – Permafrost thaw threatens to undermine roads and structural foundations

Climate Change Hazards	Potential Effects of Hazards	Potential Mission Impacts
Land Degradation	– Increases in extent and duration of droughts – Increased wildfire risk – Altered burn regimes – Loss of vegetative cover – Impacted soil function and resilience (desertification) – Soil loss – Increased dust – Impacts to air quality – Infrastructure damage – Water supply constraints – Impacted groundwater and surface water quality – Protected species stress – Decreased stream flows for navigation and energy generation – Erosion	– Reduced land carrying capacity for vehicle maneuvers – Increased maintenance costs for roads, runways, and utilities – Limits on low-level rotary wing flight operations – Increased regulatory constraints on training land access due to impacts to sensitive species, water or air quality, or additional compliance needs to replace infrastructure – Reduced live-fire training – Reduced water availability and greater competition for limited water resources
Increasing storm frequency and intensity	– Increases in number and severity of extreme precipitation events – Increased flooding – Water quality issues – Soil and vegetation loss – Impacts on soil function and carbon/ nutrient cycling – Transportation infrastructure damage	– Impacts to soldier safety – Reduced access to military water crossings and river operations – Reduced off-road maneuver capacity – Increased maintenance costs – Increased flood control/erosion prevention measures – Increased transportation infrastructure damage

2.5 Regional Weather Variations

There are and will continue to be regional climate variabilities that result in regionally specific vulnerabilities, as discussed below.

Northeast Region. The northeast has high populations in urban areas. This region is particularly susceptible to impacts on built infrastructure, communication and transportation networks, and human safety from extreme weather events including flooding, ice storms, heavy snowfall, heat waves, nor'easters, and tropical cyclones. The extent to which climate change will alter patterns of these extreme events is relatively uncertain, but any increase would tax the region's capabilities to mitigate effects and, by extension, would impact facilities in the region. Impacts on military installations could include flooding of facilities and transportation networks, disruption of transportation networks that would affect deployment activities and ability of personnel to reach work sites, damage to buildings, power lines, and communications networks, and risks to personnel safety (DA 2013).

Southeast Region. Model projections indicate increased extreme precipitation events across all areas of the Southeast Region. Extreme weather events (characterized by tornadoes, hurricanes, and other storm events) would have a major

relationship to installation vulnerabilities. Indirect effects of climate change related to sea level rise, increased storm surge, and changes in chemical properties of ocean waters (e.g., increased acidification) and fresh water (e.g., salt intrusion) also factor significantly into potential vulnerabilities of DoD installations in this region (DA 2013). Localized sea level rise rates are higher than the global average due to vertical land motion (sinking) and oceanographic effects in this area (U.S. Global Change Research Program [USGCRP] 2018).

Great Plains Region. Seasonal temperature increases in the Great Plains Region are predicted to be greater in summer than winter, which are projected to result in increased frequency of extreme heat events and heat waves (number of consecutive days >95°F). Seasonal changes in temperature will increase the number of cooling degree days at a proportionally higher percentage than the projected decrease in heating degree days. Precipitation is expected to be greater in the northern states of the Great Plains Region and lower in the southern latitudes, with greater decreases in precipitation from east to west. Installations in the Southern Plains Region currently are subject to extreme weather events including lightning storms, hail, and tornadoes. Potential changes in these extreme weather events are likely to influence installation vulnerabilities. Changes in patterns of tropical cyclones may influence monsoonal precipitation patterns particularly for Texas installations. Sea level rise could impact facilities and the mission of installations on the Gulf Coast (DA 2013).

Southwest Region. The Southwest Region is characterized by high topographical diversity, extensive coastal areas, and continental interior regions. Climate in the region is a complex interaction of mountain ranges, coastal zones, oceanic circulations, and subtropical weather systems. The region is represented by some of the hottest and driest desert regions in the U.S., some of the wettest regions in the U.S., and a Mediterranean-like climate along the southern Pacific coast. This complexity makes generalizing climate and climate impacts across the region difficult (DA 2013).

Important climate factors identified in the Southwest Region include drought, heat waves, winter storms, and floods. The forecast for the Southwest Region generally predicts hotter and drier conditions across the region, with slightly lower temperature increases in coastal areas compared to inland areas. Heating degree days are expected to decrease across the region with the greatest decrease in higher altitude regions. Cooling degree days will increase with the greatest increase in the hottest areas such as southern California and Arizona. Extreme temperatures, drought affecting water availability, and alteration of burn regimes resulting from the interaction of climate change and non-native invasive grasses are likely to have the greatest effects on the Southwest Region DoD installations. Extreme high temperatures can affect aircraft lift capacity and performance, which will be an increasingly important factor under future climate outlooks, particularly for air operations conducted from installations located in interior desert environments. Water is also a limiting resource across much of the region, and many installations are located in the most arid areas of the southwest.

Northwest Region. Climate patterns in the Northwest Region are spatially diverse, caused by the predominant west to east progression of weather systems off the Pacific Ocean and the interaction with the north-south oriented Coastal and Cascade Ranges. Climate west of the Cascade Range is characterized by high precipitation with a strong seasonal pattern and peak amounts of precipitation during late fall and winter seasons. Coastal regions record some of the

highest rainfall totals of the conterminous U.S., and the Cascade Range records some of the highest snow totals. The climate outlook for the Northwest Region indicates warmer temperatures across the region, with the largest increase in mean temperatures occurring west of the Cascades Range and in southwest Oregon and southern Idaho. Temperature increases in summer are projected to be higher than in other seasons. Heating degree days are expected to decrease across the region with the greatest decrease in eastern Idaho where the current number of heating degree days is highest. Cooling degree days are expected to increase across the region with the greatest increase in southern Idaho and Oregon and southeastern Washington (DA 2013).

Midwest Region. The climate of the Midwest Region is primarily influenced by its central location in the North American continent, lack of mountain ranges, and proximity to the Great Lakes. These characteristics allow incursions of cold arctic air masses from the north in winter and warm, humid air masses from the Gulf of Mexico in summer. The result of these influences is highly variable seasonal differences in usual weather and severe weather events. Midwest summers are typically warm and humid. The polar jet stream in winter brings frequent storm systems, clouds, windy conditions, and precipitation with significant snow events. The seasonal transition in spring and early summer from Arctic to subtropical influence results in a high frequency of severe thunderstorms, hail, and tornadoes. All seasons can have damaging high winds. Flood-producing rainstorms are frequent, but severe droughts do occur. Temperatures in the Midwest Region are projected to increase. Simulations show temperature increases in summer and winter to be slightly higher than in spring and fall. The intensity and incidence of extreme precipitation events is trending higher. The occurrence of very high snowfall seasons has decreased across the southern Midwest Region, but increased in Iowa, Minnesota, Wisconsin, and Michigan. The period of ice cover on the Great Lakes has been trending shorter (DA 2013).

Alaska. Alaska represents a large area with many different climates, ranging from temperate rainforest in the southeast to extreme cold and dry conditions in the Arctic. As such, the predicted changes in temperature and precipitation differ over the state, but overall, increases in mean temperatures are projected. Projections indicate that more changes would occur for the more northern areas and that the greatest temperature increases are projected for the winter months. Precipitation is also predicted to increase over all areas of the state with the largest increases occurring in the summer and fall, except for southeast Alaska where the largest increases would occur over the winter. Indirect effects of climate change related to sea level rise are difficult to assess due to the non-uniform uplift in many regions of the state (especially southeast Alaska). The combined impacts of the retreat of the Arctic Sea ice cover, thawing permafrost along the coast, and storm wave-induced erosion are significantly greater than for sea level rise alone. Increased temperatures will result in degradation of permafrost in interior Alaska and along much of the western and northern coasts, potentially damaging foundations, roads, pipelines, and communications structures (DA 2013).

3. CLIMATE HAZARDS TO DOD CULTURAL RESOURCES AND THE MILITARY MISSION

Federal lands, buildings, and other assets require management to ensure compliance with cultural resources statutes such as the National Historic Preservation Act (NHPA) and other federal laws. DoD's Cultural Resources Program has been designed to support the military's combat readiness mission while maintaining the long-term sustainability of its cultural resources. This chapter provides a brief summary of cultural resources regulations, a description of what are cultural resources, how climate change can impact cultural resources, and why adapting cultural resources management for climate vulnerabilities is important for sustaining the military mission and meeting stewardship responsibilities.

3.1 Cultural Resources Regulations

Cultural resources are protected under federal law. Table 3-1 summarizes key legislation, executive orders, and DoD policy on cultural resources management. The DENIX DoD Cultural Resources Policy and Legal page provides additional information.

Table 3-1. Cultural Resources Regulations

Law, Regulation, Order	Description
Antiquities Act of 1906	This was the first law to protect and preserve cultural resources on federal lands. This Act makes it illegal to remove cultural resources from federal land without a permit, establishes penalties for illegal excavation and looting, and allows the President to establish historical monuments and landmarks.
Historic Sites Act of 1935 (16 United States Code [USC] §§ 461 to 467)	This Act establishes a national policy to preserve historic sites, buildings, and objects for public use. The Act also authorizes the designation of national historic sites and landmarks and authorizes interagency efforts to preserve historic resources. The Act authorizes surveys of historic and archaeological sites, buildings, and objects to determine which are significant, and provides for the restoration, reconstruction, rehabilitation, preservation, and maintenance of historic or prehistoric properties of national significance.
National Historic Preservation Act of 1966 (NHPA)	The NHPA was signed into law on October 15, 1966. It establishes a national preservation program and a system of procedural protections, which encourage both the identification and protection of historic resources, including archeological resources, at the federal level and indirectly at the state and local level. NHPA directs roles and responsibilities for a federal historic preservation program. It authorizes several tools to carry out preservation activities, including: – The National Register of Historic Places (NRHP); – The Section 106 review process to ensure that federal agencies consider the effects of undertakings on historic properties listed or eligible for listing on the NRHP; – Section 110 (54 USC §306101, et seq.), for all federal agencies to establish their own historic preservation programs for the identification, evaluation, and protection of historic properties; and – The Advisory Council on Historic Preservation, an independent federal agency, advises the President and Congress on historic preservation matters. The Council and its staff also advise federal agencies on their roles in the national historic preservation program, especially their compliance with Section 106 of NHPA. It also created a specific role for state and local governments, Native American tribes, and Native Hawaiian organizations in carrying out the Act.

Law, Regulation, Order	Description
36 Code of Federal Regulations (CFR) 800 (Protection of Historic Properties)	36 CFR 800 (Protection of Historic Properties) governs the Section 106 process and outlines how federal agencies are to consult with State Historic Preservation Officers (SHPOs), Tribal Historic Preservation Officer (THPOs), Tribes, Native Hawaiian Organizations, and other interested parties; identify historic properties; determine whether and how such properties may be affected; and resolve any adverse effects.
EO 11593, "Protection and Enhancement of the Cultural Environment" (1971)	EO 11593 directs federal agencies to inventory the cultural resources in areas they control and to record to professional standards any cultural resource that may be altered or destroyed.
Archaeological and Historic Preservation Act (1974) (AHPA)	The AHPA addresses impacts on cultural resources resulting from federal activities and provides a funding mechanism to recover, preserve, and protect archaeological and historical data.
American Indian Religious Freedom Act of 1978 (AIRFA)	AIRFA protects First Amendment guarantees to religious freedom for Native Americans. It requires federal agencies to consult with Native Americans when a proposed land use might conflict with traditional religious beliefs or practices, and to avoid interference to the extent possible.
Archaeological Resources Protection Act of 1979 (ARPA)	ARPA establishes civil and criminal penalties for the unauthorized excavation, removal, damage, alteration, or defacement of archaeological resources prohibits trafficking in archaeological resources from public lands and directs federal agencies to establish educational programs on the importance of archaeology. Penalties are imposed for violations of ARPA. ARPA provides for criminal and civil penalties against those who excavate, remove, damage, or otherwise alter or deface archaeological resources, or attempt to do so, without an approved permit. For a felony ARPA offense, first-time offenders can be fined up to $20,000 and imprisoned for up to two years. Second-time felony offenders can be fined up to $100,000 and imprisoned for up to five years. In addition, Section 7 of ARPA enables federal or Native American authorities to prosecute violators using civil fines, in either conjunction with or independent of any criminal prosecution. Section 8(b) of the statute allows courts to use forfeiture of vehicles and equipment used in the violation of the statute as another means of punishment against convicted violators.
Native American Graves Protection and Repatriation Act of 1990 (NAGPRA)	NAGPRA establishes the rights of Native Americans to claim ownership of certain "cultural items," including human remains, funerary objects, sacred objects, and objects of cultural patrimony. It requires federal agencies and museums to identify holdings of such remains and work toward their repatriation. Excavation or removal of such cultural items requires consultation, as does discovery of these items during land-use activities. NAGPRA is another piece of federal legislation that concerns archaeological fieldwork and curation. Passed in 1990, NAGPRA lays out requirements for the treatment of Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony; and to repatriate them if Native American groups so desire. In the field, NAGPRA reinforces many aspects of ARPA. It requires documented consultation with Native American groups if any remains or objects that might be subject to NAGPRA are discovered inadvertently or are likely to be excavated during archaeological fieldwork. Civil penalties for noncompliance are assessed by the Secretary of the Interior and are determined by the archaeological value of the items involved, the damages (both economic and noneconomic) suffered by an aggrieved party, and by the number of violations that have occurred.

Law, Regulation, Order	Description
EO 13007 "Indian Sacred Sites" (1996)	EO 13007 directs federal agencies to accommodate Indian and Alaska Native tribes, enabling access to sacred sites in federal lands.
EO 13175 "Consultation and Coordination with Indian Tribal Governments" (2000)	EO 13175 establishes guidelines and standards by which federal agencies must improve and expand consultation with Indian tribes in regard to regulatory policies.
EO 13287, "Preserve America" (2003)	EO 13287 encourages the federal government to take a leadership role in the protection, enhancement, and contemporary use of historic properties and establishes new accountability for agencies with regard to inventories and stewardship.
DoD 4715.16, *Cultural Resources Management*	Dated September 18, 2008, DoD 4715.16 establishes DoD policy and responsibilities to comply with applicable Federal statutory and regulatory requirements, EOs, and Presidential memorandums for the integrated management of cultural resources on DoD-managed lands. Managing and maintaining cultural resources under DoD control in a sustainable manner through a comprehensive program that considers the preservation of historic, archaeological, architectural, and cultural values is mission supporting and results in sound and responsible stewardship. It also provides general and specific content for ICRMPS.
Army Regulation (AR) 200-1 *Environmental Protection and Enhancement*	AR 200-1 implements federal, state, and local environmental laws and DoD policies for environmental management, including cultural resources, to meet legal compliance requirements and to support the Army mission. AR 200-1 establishes environmental quality goals to protect and conserve natural and cultural resources. The regulation requires that Army installations develop ICRMPs for use as a planning tool, as well as other various requirements.
Secretary of the Navy Instruction (SECNAVINST) 4000.35A, *Department of the Navy Cultural Resources Program*	SECNAVINST 4000.35a establishes policy and assigns responsibilities within the Navy for fulfilling cultural resources management requirements. It established that protection of the nation's heritage is an essential part of the defense mission, and the Navy is committed to responsible cultural resources stewardship. SECNAVINST 4000.35a directs that preservation considerations should be incorporated into routine management of historic buildings, structures, districts, sites, ships, aircraft, and other cultural resources and that compliance with cultural resource protection requirements will be incorporated as appropriate into other planning processes, including but not limited to master planning, environmental planning, budgeting/programming, and facilities management.
Chief of Naval Operations Instruction (OPNAVINST) 5090.1E, Environmental Readiness Program 25 Jun 2021	OPNAVINST 5090.1E, Chapter 13, Cultural Resources Compliance And Management chapter provides Navy cultural resources implementing policy guidance and assigns responsibilities for fulfilling the cultural resources management and historic preservation compliance requirements. The Navy is required to maintain a preservation program for the identification, inventory, evaluation, maintenance, nomination to the NRHP when appropriate, and protection of historic properties in a manner that considers the preservation of their historic, architectural, archaeological, and cultural values. Navy policy is to incorporate cultural resources planning and management considerations in all aspects of planning, training, management, and implementation of the Navy's mission. Cultural resources management and compliance requirements apply to land and water areas under direct control of the Navy; Navy undertakings; and real property assets and historic properties owned, leased, or otherwise controlled or managed by the Navy.

Law, Regulation, Order	Description
Marine Corps Order (MCO) P5090.2, Chapter 8, Cultural Resources	MCO P5090.2 Chapter 8 establishes Marine Corps policy and assigns responsibilities in accordance with the statutes and regulations for the integrated management of cultural resources on Marine Corps lands or that may be affected by Marine Corps actions. This policy tiers off of the policies for cultural resources management outlined in DoDI 4715.16, *Cultural Resources Management* and SECNAVINST 4000.35A, *Department of the Navy Cultural Resources Program*. In addition, this policy incorporates the provisions of Federal legislation, EOs, DoD regulations and guidance that are appropriate to the management of cultural resources under the purview of the U.S. Marine Corps.
Air Force Manual 32-7003, *Environmental Conservation*	AFMAN 32-7003, Chapter 2 addresses the management of cultural resources on Air Force properties to meet Air Force mission requirements and comply with federal law and applicable state standards. It provides a framework for planning, implementing, and documenting cultural resources management programs. The primary objective of the Air Force Cultural Resources Program is to balance managing and preserving our nation's heritage, pursuant to applicable statutes and regulations, in concert with timely and efficient support of the Air Force military mission.

3.2 DoD Cultural Resources

Historic property, as defined by NHPA (54 USC § 300101 et seq), is any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the NRHP, as maintained by the Secretary of the Interior. Historic properties include artifacts, records, and remains that are related to, and located within, such properties. It also includes properties of traditional religious and cultural importance to an Indian Tribe, Native Alaskan, or Native Hawaiian Organizations that also satisfies National Register criteria. As per 36 CFR §60.3 buildings, districts, objects, sites, and structures are defined as follows:

- **Building.** A building is created principally to shelter any form of human activity, such as a house, barn, church, hotel, or similar construction. A building may also be used to refer to a historically related complex such as a courthouse and jail, or a house and barn.
- **Structure.** The term structure is used to distinguish it from buildings. Structures were usually constructed for purposes other than human shelter, such as a bridge, tunnel, earthworks, railroad grade, or similar construction. A structure may also be a large-scale engineering project.
- **Site.** A site is the location of a significant event, a prehistoric or historic occupation or activity, or a building or structure, whether standing, ruined, or vanished, where the location itself maintains historical or archeological value regardless of the value of any existing structure.
- **Object.** An object is a material thing of functional, aesthetic, cultural, historical, or scientific value that may be, by nature or design, movable yet related to a specific setting or environment.
- **District.** A district is a geographically definable area, urban or rural, possessing a significant concentration, linkage, or continuity of sites, buildings, structures, or objects united by past events or aesthetically by plan or physical development. A district may also comprise individual elements separated geographically but linked by association or history.

An archaeological resource, as defined by Section 3(1) of ARPA (16 USC 470bb[1]), includes "Any material remains of human life or activities that are at least 100 years old and that are of archaeological interest." Archaeological resources as defined by ARPA may also be cultural resources with independent protections from other laws such as the NHPA or NAGPRA. An archaeological site may well qualify as a cultural resource because it contains archaeological resources of interest but may not qualify for the NRHP as an historic property because it does not meet the criteria for inclusion in the NRHP. In such cases, the site would be protected from unauthorized removal of artifacts because it is on federal land.

A sacred site is defined in EO 13007 as "any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site." This EO envisions discrete locations on federal lands identified by authoritative representatives as sacred by virtue of established religious significance or ceremonial use, rather than addressing a generalized sense of sacredness throughout the landscape. Also, AIRFA (42 USC §1996) protects access to, and use of, these sites by those practicing a traditional religion, to the extent practicable.

Archaeological collections and associated records, as defined under 36 CFR §79: Curation of Federally Owned and Administered Archaeological Collections, include collections of material remains, such as artifacts, objects, specimens, and other physical evidence, which are excavated or removed during a survey, excavation, or other study of a prehistoric or historic resource. The regulation 36 CFR §79 specify in detail the levels of care an agency must continue to provide for these permanent collections. ARPA clearly designates archaeological collections and the associated records as subject to continuing stewardship responsibilities by federal agencies. The regulations incorporate responsibilities for long term care of archaeological collections derived from other statutes as well.

According to Section 2(3) of NAGPRA (25 USC 3001[3]), cultural items include human remains, associated and unassociated funerary remains, sacred objects, and objects of cultural patrimony. These types of cultural items can, and often are, found within archaeological sites. NAGPRA outlines a specific process to determine ownership of NAGPRA cultural items that are presently in the possession of, or under the control of, museums and Federal agencies, but ultimately NAGPRA cultural items belong to the closest culturally affiliated lineal descendant(s).

A National Historic Landmark (NHL), as defined by 36 CFR §65.3(h), is a district, site, building, structure, or object possessing national significance in American history, archeology, architecture, engineering, or culture. The Secretary of the Interior designates an NHL under authority from the Historic Sites Act of 1935. When the Secretary designates an NHL, it is automatically also considered to be a historic property for purposes of the NHPA and listed on the National Register of Historic Places as of the date of its NHL designation.

In accordance with DoDI 4165.70 *Real Property Management*, the DoD maintains data and information systems on federal real property. To aid in meeting reporting requirements under EO 13287, the database includes cultural resource data fields for

historic real property assets. The DoD uses the Historic Status Codes in table 3-2 as attributes of the real property database of record.

The installation questionnaire indicated that DoD manages all types of cultural resources. The most prevalent resources per the questionnaire (see a summary of the responses in Appendix B) include archaeological sites; historic buildings, structures, and infrastructure (i.e., roads, equipment, objects, landscaping, etc.); burial sites; and historic districts and landscapes.

Table 3-2. Historic Status Codes

(Source: Real Property Information Model 10.1 Addendum for Historic Status Codes)

Code	Code Title	Code Definition
DNE	Determined Not Eligible for Listing	An asset that has been evaluated using NRHP criteria and is determined not to meet the criteria of eligibility. This determination is carried out by the installation cultural resources staff in consultation with the State Historic Preservation Officer and Tribal Historic Preservation Officer, as appropriate, pursuant to 36 CFR 800.4 or 36 CFR Part 63. Assignment of the value DNE is appropriate for both new determinations and changes of eligibility from NREI or NREC to DNE. DNE is not the default Real Property Asset (RPA) Historic Status Code; the default value is Not Evaluated (NEV). DoD must have appropriate documentation to validate the RPA Historic Status Code value assigned to assets. Appropriate documentation to validate the RPA Historic Status Code DNE is documentation reflecting NRHP concurrence determinations of not eligible with the SHPO and THPO or evaluation in accordance with a program alternative pursuant to 36 CFR 800.14, as appropriate.
DNR	Designation Rescinded	An asset formerly assigned the Historic Status Code value of NHLI, NHLC, NRLI, or NRLC which has been determined by the Keeper of the NRHP to no longer meet the criteria for listing in the NRHP. The formal removal process should be initiated by the Federal Preservation Officer (FPO), in coordination with the SHPO or the THPO (as appropriate), and the Keeper of the NRHP or the Secretary of the Interior, pursuant to 36 CFR 60.15 or 36 CFR 65.9. The RPA Historic Status Code value of DNR is only determined by the Service FPO and installations will be advised when to assign this code. DoD must have appropriate documentation to validate the RPA Historic Status Code value assigned to assets. Appropriate documentation to validate the RPA Historic Status Code DNR is documentation reflecting NRHP delisting.
ELPA	Eligible for the purposes of a Program Alternative	An asset that is included within the scope of a program alternative developed and implemented pursuant to 36 CFR 800.14, Protection of Historic Properties. An example includes all Capehart-Wherry housing, determined eligible for the purposes of a 2002 Program Comment. The appropriate assignment of the RPA Historic Status Code value ELPA, is determined at the national level, and installations will be advised when to assign this code. ELPA assets are not required to be inspected every three years but shall be inspected on the regular five years schedule.
FHCR	Foreign Government/ Host Nation (FGHN) Historic and Cultural Resource	An asset of an FGHN that the responsible DoD Component manages as a historic real property asset. This real property asset meets the definition of "Historic and Cultural Resources" in accordance with section G.2 of DoDM 4715.05-V1, DoD "Overseas Environmental Baseline Guidance Document (OEBGD): Conservation," June 29, 2020. In consultation with the FGHN, the DoD Component's cultural resources staff or its delegated trusted agents are responsible for identifying and evaluating historic and cultural real property assets in accordance with definitions and other requirements in the relevant Final Governing Standards (FGS), or OEBGD where no FGS exists.

Code	Code Title	Code Definition
NAR	Not Assessed Routinely	An asset that is not routinely planned to be evaluated for NRHP eligibility. While not routinely assessed, these individual assets should be evaluated pursuant to 54 USC §306108 and 36 CFR Part 800 if there is a potential to affect historic properties. For purposes of physical inventory, assets assigned the Historic Status Code value NAR are not considered historic. The appropriate assignment of the RPA Historic Status Code value NAR is determined at the national level and Facility Analysis Category codes appropriate for NAR value assignment are provided. If an asset has been previously assigned a Historic Status Code value other than NEV, the value remains unchanged, and NAR should not be assigned. The value NAR should only be assigned to assets previously having a value of NEV.
NCE	Non-Contributing Element of a Historic Property	Assets within the designated boundaries of an NHL- or NRHP-listed or eligible property that have been evaluated and determined not to contribute to the historic significance of the property. This determination is carried out by the installation staff in consultation with the SHPO or THPO, and the Keeper of the NRHP or the Secretary of the Interior, as appropriate, pursuant to 36 CFR Part 63 or Part 65. DoD must have appropriate documentation to validate the RPA Historic Status Code value assigned to assets. Appropriate documentation to validate the RPA Historic Status Code NCE is documentation reflecting NRHP concurrence determinations of eligibility with the SHPO or THPO or evaluation in accordance with a program alternative pursuant to 36 CFR 800.14, as appropriate.
NEV	Not Evaluated	An asset that has not been evaluated NRHP eligibility. This is the default RPA Historic Status Code value.
NHLC	National Historic Landmark, Contributing Element	An asset that is identified as a contributing element of a larger property listed in the NRHP and also designated an NHL by the Secretary of Interior. The designation of an NHL is coordinated by the Secretary of Interior in consultation with the FPO, pursuant to 36 CFR Part 65. The RPA Historic Status Code value of NHLC is only determined by the Service FPO and installations will be advised when to assign this code. DoD must have appropriate documentation to validate the RPA Historic Status Code value assigned to assets.
NHLI	National Historic Landmark, Individual	An asset that is individually listed in the NRHP and also designated as an NHL by the Secretary of Interior. The designation of a NHL is coordinated by the Secretary of Interior in consultation with the FPO, pursuant to 36 CFR Part 65. The RPA Historic Status Code value of NHLI is only determined by the Service FPO and installations will be advised when to assign this code. DoD must have appropriate documentation to validate the RPA Historic Status Code value assigned to assets.
NREC	National Register of Historic Places Eligible, Contributing Element	An asset that is identified as a contributing element of a larger property or district determined eligible for inclusion in the NRHP. A NRHP-eligible asset is treated the same as an asset listed in the NRHP, pursuant to the NHPA, 54 USC §300101 et seq., and 36 CFR Part 800, Protection of Historic Properties. The evaluation of contributing elements is carried out by the installation cultural resources staff in consultation with the SHPO or the THPO, as appropriate, pursuant to 36 CFR 800.4 or 36 CFR Part 63. DoD must have appropriate documentation to validate the RPA Historic Status Code value assigned to assets. Appropriate documentation to validate the RPA Historic Status Code NREC is documentation reflecting NRHP concurrence determinations of eligibility with the SHPO or THPO, or evaluation in accordance with a program alternative pursuant to 36 CFR 800.14, as appropriate.

Code	Code Title	Code Definition
NREI	National Register Eligible, Individual	An individual asset that is determined to meet the NRHP criteria of eligibility. A NRHP-eligible asset is treated the same as an asset listed in the NRHP pursuant to the NHPA, 54 §300101 et seq., and 36 CFR 800, Protection of Historic Properties. The evaluation of individual assets is carried out by the installation cultural resources staff in consultation with the SHPO or the THPO, as appropriate, pursuant to 36 CFR 800.4 or 36 CFR Part 63. DoD must have appropriate documentation to validate the RPA Historic Status Code value assigned to assets. Appropriate documentation to validate the RPA Historic Status Code NREI is documentation reflecting NRHP concurrence determinations of eligibility with the SHPO or THPO, or evaluation in accordance with a program alternative pursuant to 36 CFR 800.14, as appropriate.
NRLC	National Register of Historic Places Listed, Contributing Element	An asset that is identified as a contributing element of a historic property listed in the NRHP. The formal evaluation and nomination process of contributing elements involves the review, approval, and signature of the FPO, the SHPO or the THPO (as appropriate), and the Keeper of the NRHP, pursuant to 36 CFR Part 60. DoD must have appropriate documentation to validate the RPA Historic Status Code value assigned to assets. Appropriate documentation to validate the RPA Historic Status Code NRLC is documentation reflecting the NRHP listing and identification of contributing assets.
NRLI	National Register of Historic Places Listed, Individual	An individual asset that has been listed in the NRHP. The formal evaluation and nomination process of individual assets involves the review, approval, and signature of the FPO, the SHPO or the THPO (as appropriate), and the Keeper of the NRHP, pursuant to 36 CFR Part 60. DoD must have appropriate documentation to validate the RPA Historic Status Code value assigned to assets. Appropriate documentation to validate the RPA Historic Status Code NRLI is documentation reflecting the NRHP listing.

A World War II bunker tumbled down a cliff on California beach, 2022 (Source: Yahoo News, Photo credit: National Park Service, Golden Gate National Recreation Area)

3.3 Climate-Related Hazards to DoD Cultural Resources

The DoD manages several types of cultural resources, including historic buildings and structures, archeological resources and sites, objects, historic districts and landscapes, ethnographic resources, sacred sites, and burial sites. The built infrastructure required to support the military mission on DoD installations is extensive. The DoD manages the world's largest specialized real property inventory, counting more than "485,612 facilities (buildings and structures), located on over 4,860 sites worldwide and covering over 25.7 million acres (Office of the Secretary of Defense FY 2022 Base Structure Report)." Built facilities include airfields, port facilities, and support infrastructure comparable to small cities, including commercial buildings, medical facilities, public safety facilities, housing, communication networks, roads, bridges, railways, and supporting utilities (e.g., power, water, sewer). Many of these facilities are historic (Van Citters et al. 2019).

These resources can be affected by the four primary climate change hazards:

- Drought
- Flooding
- Heat
- Land degradation

These four factors often have overlapping or similar impacts on cultural resources. For example, sea level rise is causing erosion on coastal sites and cemeteries. Melting ice and permafrost is also causing coastal erosion, as well as allowing millennia-old organic remains that had been preserved in ice to become exposed and rot. Increased rainfall, river flow, and downcutting (to cut down or downward by or as if by erosion) is eroding mud-brick ruins and buried archaeological sites.

Drought and rising temperatures will pose threats to wooden buildings as termites and other pests are able to survive at higher latitudes and altitudes. Desert sands are damaging traces of ancient civilizations, and increased lightning and fires are destroying historic buildings and archaeological sites, as well as facilitating the erosion of buried archaeological sites (Morgan et al. 2016).

Because cultural resources hold significance from both place and time, they are unique and nonrenewable. Once they are lost, they are gone forever, as is their value for research and discovery, provoking public introspection, keeping, and reawakening cultural memories, connecting individuals to their ancestors, and maintaining ties from generation to generation (English Heritage 2008).

Cultural resources have always been subject to environmental forces. The risks of climate change on cultural resources lie in the alteration and recombination of these environmental forces, which together are increasing the diversity and intensity of their impacts. Cultural resources, given their diversity of types, materials, and locations, interact with climatic changes in diverse ways, and some effects of climate change on cultural resources are being observed across the country—in coastal areas as well as interior lands. These include visible and sometimes dramatic effects, such as sea level rise, storm surges, and wildfires. But evidence is also beginning to indicate cultural resources are also vulnerable to other, more subtle processes including the impacts of more freeze/thaw cycles on stone materials or more rapid wetting and drying cycles on adobe buildings (NPS 2016).

Climate threats to historic and prehistoric buildings and structures can vary with structural materials, architecture, and location. For example, increased rainfall may lead to accelerated rates of mortar and masonry decay, while associated

ground heave and subsidence can lead to destabilization of foundations and pipes. Warmer, longer summers will facilitate new threats to wood structures as termites and other pests expand their range, and increased temperatures may increase growth of destructive mold and algae (Morgan et al. 2016).

Climate-related impacts on historic districts and landscapes include both the built environment and ecosystem (when it is part of the landscape). Changing water levels may exacerbate erosion of historic landscapes along a shoreline. Changes in temperature and precipitation patterns may stress building materials or favor different vegetation species or patterns of historic or culturally significant vegetation. Climate change may also lead to the introduction of new pests and may change soil fertility or water table levels. This then can affect character-defining features such as gardens and other vegetation. For historic districts and landscapes, character-defining features are key for assessing impacts. Natural and cultural components of the landscape and the relationships between them convey different aspects of the significance of the landscape and they will interact in different ways with climate change impacts (Morgan et al. 2016).

Archeological sites may be located anywhere where there has been previous human occupation on the ground surface or buried below the surface. Archeological resources are incredibly diverse; examples include a small scatter of prehistoric stone or bone tools or historic metal cans, town sites, temples, fishponds, road system complexes, shell middens, and buried evidence of occupation. Climate change threats on archeological resources can take many forms, including erosion, inundation, and chemical alteration. Erosion can be exacerbated by changes in water supply, such as increases in rainfall overall or the intensity of individual rainfall events; by drought; and by additional

Effects of Hurricane Sandy on masonry in Crisfield, Maryland, 2012 (Source: Lisa Craig)

stresses affecting sediments, such as loss of soil structure due to melting permafrost (NPS 2016). Threats to coastal and near-coastal cultural resources will also come from activities undertaken to resist rising waters. Sea walls and other barriers may provide protection to critical coastlines at favorable cost benefit tradeoffs, but their construction will potentially impact large numbers of cultural resources (Anderson et al. 2017).

Ethnographic resources are expressions of human culture and the basis for continuity of both tangible and intangible components of cultural systems, including traditional arts, native languages, religious beliefs, and subsistence activities. Ethnographic resources include tangible places such as sites, structures, and landscapes, as well as natural resources needed for cultural expression, such as salmon, sweet grass, or species of predatory birds. Climate change impacts on ethnographic resources damage tangible resources and/or disrupt or otherwise disconnect people from their arts, language, beliefs, and activities and associations with the places in which they have performed them. Impacts include permafrost melt, which can accelerate coastal erosion that in turn may force relocation of communities, separating people from

subsistence resources. Changes in sea ice due to increased temperatures and changing winds may limit access to traditional hunting areas and are expected to shift migratory patterns of significant marine prey. Warming temperatures and change in precipitation also may affect the distribution and phenology (how periodic events in biological life cycles are influenced by seasonal and interannual variations in climate, as well as habitat factors) of key plant and animal species (NPS 2016).

Table 3-3 provides a brief summary of climate change impacts on the environment and infrastructure. This is summarized from the National Park Service *Cultural Resources Climate Change Strategy* (NPS 2016). Details tables of impacts to cultural resources by type of resource are provided in Section 4.4.

Table 3-3. Brief Summary of Climate Change Impacts on the Environment and Infrastructure

Climate Change Hazards	Climate Change Concerns	Impact on the Environment and Infrastructure
Drought	– Fire – Drought – Extreme weather events	– Increased exposure from vegetation loss and erosion – Destabilization of wetlands which reduce storm or flood risk – Loss of landscape features – Damage to structures – Terrestrial species range may shift, and new species may become special status species, effecting traditional hunting and gathering patterns – Changes in historic/ culturally significant vegetation patterns
Flooding (riverine, coastal)	– Saturated soils – Inundation and flooding – Increased storm surge height – Increased coastal erosion – Higher water table – Saltwater intrusion	– Increased exposure from vegetation loss and erosion – Destabilization of wetland or waterlogged sites – Erosion of supporting ground around structures – Increased pressure to relocate or elevate structures and/ or surrounding structures. – Loss of landscape features – Damage to structures – Increased risk of post-flood subsidence – Impacts from post-flood mitigation – Rust and increased materials maintenance

Climate Change Hazards	Climate Change Concerns	Impact on the Environment and Infrastructure
Heat	– Permafrost melt – Increased freeze-thaw cycle – Higher relative humidity – Stronger wind patterns – Species shift – Energy demand	– Accelerated rusting in submerged and coastal archeological resources – More rapid decay of organic materials – Faster deterioration of exposed artifacts and sites – Increased rate of chemical decay of collections – Increased crystallization of efflorescent salts due to increased evaporation rates, leading to increased rates of structural cracking, and deterioration – Damage to foundations – Reduced access to marine hunting grounds due to shifting sea ice – Terrestrial species range may shift, and new species may become special status species, effecting traditional hunting and gathering patterns – May introduce destructive and nuisance pests – Changes in historic/ culturally significant vegetation patterns
Land Degradation	– Soil loss – Permafrost thaw – Coastal erosion – Energy demand – High wind – Increased evaporation rates	– Increase in fire season length – Soil loss and erosion around buildings, structures, and archeological sites – Increase energy consumption – Accelerated rusting in submerged and coastal archeological resources – More rapid decay of organic materials – Faster deterioration of exposed artifacts and sites – Increased rate of chemical decay of collections – Increased crystallization of efflorescent salts due to increased evaporation rates, leading to increased rates of structural cracking, and deterioration – Damage to foundations – Terrestrial species range may shift, and new species may become special status species, effecting traditional hunting and gathering patterns – May introduce destructive and nuisance pests – Changes in historic/ culturally significant vegetation patterns

3.4 Cultural Resources Vulnerabilities and Implications for the Military Mission

DoD's Cultural Resources Program is designed to support the military's mission while maintaining the long-term sustainability of its cultural resources (DoD 4715.16). DoD manages and maintains cultural resources under its control through sound and responsible stewardship, and the preservation of historic, archaeological, architectural, and cultural values. Climate change hazards can impede DoD CRMs' ability to efficiently administer the Cultural Resources Program and provide support to the military mission.

Climate change hazards can impact the military mission in two ways. The first is through increased regulatory compliance requirements. Climate change may result in additional regulatory compliance, that could increase costs, and/or cause project delays, and/or restrict training. For example, depending on the cultural or natural resources that are affected, compliance with NHPA, the Threatened and Endangered Species Act, the Clean Water Act, EO 11988, "Floodplain Management" or EO 11990, "Protection of Wetlands" or other regulations may become necessary or more complex. In other cases, damages caused by climate hazards could result in new projects to prevent future harm. These projects may require National Environmental Policy Act (NEPA) compliance, as well as compliance with other regulations. Many of these regulations require consultation or stakeholder involvement with other agencies, tribes, public and/or other special interest entities.

The second way climate change hazards can impact military readiness is by direct damage to facilities and operational assets. As stated previously, DoD has thousands of facilities that are eligible for listing or are listed on the NRHP. Climate change can speed up the deterioration of buildings and facilities that are not only historic, but essential to maintaining military operations. Projected sea level rises could result in loss of infrastructure and could require relocation of infrastructure and facilities rendering some historic properties uninhabitable and no longer of use. Increases in wildfire frequency and severity pose another very serious risk to military facilities and other infrastructure that could be historic. Construction of structures to reduce some climate risks, like construction of a seawall, could destroy archaeological resources. The next chapter provides additional information on potential climate change hazards and their impact on DoD cultural resources, as well as some strategies for addressing these hazards.

A helicopter drops flame retardant onto a forest fire, date unknown (Source: U.S. Department of Defense)

4. ADAPTATION PRINCIPLES AND PRACTICES FOR CULTURAL RESOURCES

The DoD must manage their cultural resource programs in accordance with federal laws and regulations, and DoD and Service-specific policies and requirements. These regulations and policies require that cultural resources are protected or effects to these resources are minimized or mitigated. This chapter provides guidance, tools, and other resources to assess climate change risk. It also links potential climate change hazards to impacts on DoD cultural resources. The last section of this chapter provides consideration for appropriate strategies for addressing the risks and impacts and assessing the feasibility of climate adaptation strategies. These tools and resources will help CRMs think creatively in identifying measures capable of reducing key climate vulnerabilities and enhancing installation resilience. CRMs can evaluate potential strategies and actions can then be evaluated and prioritized based on feasibility, cost-effectiveness, and capacity to achieve desired goals and objectives. If the installation has a mission-focused, climate adaptation assessment or approach already developed, this would be a good reference to consult when initiating planning.

4.1 Existing DoD Guidance on Climate Adaptation

The Army, Navy, and Air Force have developed guidance on identifying climate threats and have incorporated resiliency strategies into installation planning. These same strategies may be applicable to managing climate hazards to cultural resources. These guidance documents are summarized below.

Army Climate Resilience Handbook, 2020

Army Directive (AD) 2017-07, *Installation Energy and Water Security Policy* (AD 2017), requires that Army planners identify climate threats on installations and incorporate installation resilience to changing climate risks during installation planning. AD 2020-03, *Installation Energy and Water Resilience Policy* (AD 2020), which supersedes AD 2017-07, states that threats both man-made and natural can jeopardize mission capabilities. Army installations must secure reliable access to energy and water by identifying and mitigating vulnerabilities that can disrupt these systems and mission readiness. Resilience must be built into the energy and water infrastructure across installations.

Additional direction for incorporating climate impacts into installation planning includes 10 USC § 2864 Master plans for major military installations (December 2021), which directs planning for energy and climate resilience efforts by identifying climate-related hazards and threats and determining installation vulnerability to them. It also amends the UFC 1-200-01 *DoD Building Code* (DoD 2019) and UFC 1-200-02 *High Performance and Sustainable Building Requirements* (DoD 2020) to require the use of authoritative sources of information and tools including resilience planning handbooks.

Updated guidance directs installations to incorporate climate impact risks into INRMPs. DoD Manual 4715.03 *Integrated Natural Resources Management Plan Implementation Manual* (August 2018) requires climate assessments to be incorporated into INRMPs, and the DoD planning document *Climate Adaptation for DoD Natural Resource Managers* (Stein et al. 2019) outlines a method for conducting climate assessments for INRMPs.

The *Army Climate Resilience Handbook* (ACRH) guides Army planners through a four-step risk-informed planning process. Working through the ACRH, the Army planner will

develop a Climate Vulnerability Assessment that:

1. Identifies the installation's climate resilience goals and objectives
2. Identifies how exposed the installation is to current nuisance and extreme weather events and to projected future climate impacts
3. Identifies how sensitive infrastructure, assets, mission, and readiness are to these impacts and how difficult adapting to these threats may be
4. Identifies a list of potential measures that can be used to improve an installation's preparedness and resilience

Under requirements in Section 335 of the 2018 National Defense Authorization Act (NDAA) and at the direction of the U.S Army Office of the Assistant Secretary of the Army for Installations, Energy, and Environment (ASA IE&E), the U.S. Army Corps of Engineers (USACE) conducted a climate vulnerability assessment of 113 Army installations against six climate impacts—coastal flooding, riverine flooding, desertification, wildfire, thawing permafrost, drought—along with volcanic and seismic impacts. This study built on previous assessments of climate vulnerability using methods developed by the USACE Climate Preparedness and Resilience Program for its Civil Works program.

The study resulted in a web-based tool for assessing climate impact exposure risk, displaying impacts across a portfolio of installations and ranking installation exposure risk. The Army made the tool available as an interim planning tool for use by installations for climate resilience planning in April 2020 (ASA IE&E 7 April 2020) while awaiting completion of the Army Climate Assessment Tool (ACAT). The ACAT reflects an updated Army understanding of climate exposure, expands the number of installations for which climate exposure data are available, and increases the number of projected climate impacts assessed.

The ACRH provides the methodology and process to systematically assess climate exposure impact risk and incorporate this knowledge and data into existing installation planning processes such as master plans. The ACRH is designed to be supported by the ACAT, which provides updated information on U.S. climate trends and related impacts by region; supplies climate impact exposure data for seven impact areas; and provides data on historical weather extremes. The process laid out in the ACRH is aligned with that developed for the Navy in its *Climate Change Planning Handbook: Installation Adaptation and Resilience* (Naval Facilities Engineering Systems Command [NAVFAC] 2017).

These Army approaches are consistent with the 2014 *DoD Climate Change Adaptation Roadmap* (DoD 2014), which laid out a framework with three overarching goals:

- Identify and assess the effects of climate change on DoD.
- Integrate climate change considerations across DoD and manage associated risks.
- Collaborate with internal and external stakeholders on climate change challenges.

The intent of the ACRH is to provide the analytical framework and methodology to help Army installation planners understand how to consider climate change in their installation planning processes, including Real Property Master Plans (RPMPs), Installation Energy and Water Plans (IEWPs), and INRMPs.

NAVFAC Climate Change Planning Handbook Installation Adaptation and Resilience, 2017

The handbook lists possible climate change impacts on Navy Plans and Operations, Testing and Training, Built and Natural Infrastructure, and Supply Chain and Acquisition. The occurrence and severity of these impacts will likely increase as the climate continues to change. In accordance with UFC 2-100-01, *Installation Master Planning*, and other DoD guidance, Navy Master Development Planners are directed "to consider" climate change in the development of Master Plans and projects. This handbook provides the analytical framework, as well as the tools and other guidance, to help planners understand how to consider climate change in their plans and projects for installation infrastructure. This document leads planners through the process of identifying and assessing possible adaptation action alternatives, or methods for adapting to the impacts of climate change. These adaptation measures are intended to improve their installation's resiliency, or capability to anticipate, prepare for, respond to, and recover from significant hazards.

This handbook is designed to be a desktop reference that can serve as a companion tool throughout the planning process, especially the analysis phase of the Navy Installation Development Plan (IDP) process. The intended output is a portfolio of possible adaptation action alternatives that can be incorporated into alternative courses of action, along with other considerations, in the IDP and other decision support processes.

Air Force Civil Engineer Severe Weather/ Climate Hazard Screening and Risk Assessment Playbook, 2020

The UFC 2-100-01, *Installation Master Planning*, and other DoD and Air Force guidance mandate that Department of Air Force installation professionals consider severe weather and climate risk in IDPs and facility projects. Congress also continues to focus on this topic with language in the FY18 NDAA Sec 335 Report directing DoD to identify installations at risk and improve planning for resilience.

The purpose of this playbook, and accompanying screening worksheet, is to provide a consistent and systematic framework to screen and assess severe weather, climate hazards, and their associated current/future risks at an Air Force installation. The playbook establishes a minimum list of severe weather and climate phenomenon to be screened and provides methods to determine whether an installation is exposed or susceptible to these severe weather and climate hazards and assess their relative risk. The playbook explores how to integrate the screening and risk assessment outputs into existing processes, such as planning products, building projects, emergency management plans, mission sustainment risk reports (MSRRs), etc.

4.2 DoD Climate Risk Assessment Tools and Resources

Tools and guidance documents are developed to better understand and manage climate risks. These tools enable personnel at all levels of the department - from installation planners to leadership - to understand each installation's exposure to climate risks using historical data and future climate projections. These tools help managers determine the major climate risks and adequate climate adaptation steps that can be taken. These tools can be used to understand potential risks that may impact cultural resources.

DoD Climate Assessment Tool

The Office of the Assistant Secretary of Defense funded the USACE to extend its climate exposure assessment-screening tool to include sections for Army, Navy

and Air Force use in order to increase the understanding the exposure of DoD installations to climate impacts. The resulting DCAT was created in compliance with the 2018 National Defense Authorization Act Section 335 (Public Law 115-91), which requires DoD to conduct an analysis of threats posed by a changing climate on national security and outline the vulnerabilities of military installations. The DCAT provides a screening-level exposure assessment of DoD installations for eight different climate-related hazards (including installation exposure to coastal and riverine flooding, drought, desertification, wildfire, and permafrost thaw). The DCAT provides installation maps and shape files such as a 1% annual exceedance probability (AEP) event (also known as the 100-year storm), 1% AEP + 2 or 3 feet of freeboard, sea level rise (SLR) + surge, as well as graphical depictions of differences from current conditions to "reasonably foreseeable expected changes." Conducting a DCAT analysis can require expertise and/or experience to ensure that the data retrieved is accurate and usable.

USACE Tools

Providing support to civilian and military infrastructure projects, USACE continues to develop assessment and adaptation tools useful in adapting to risks associated with potential changing weather patterns. USACE is developing a suite of web accessible tools to support repeatable analytical results for climate preparedness and resilience planning and engineering design. The sea level change calculator and the sea level tracker are available. The USACE has also developed two tools supporting impacts analysis and design for climate-impacted hydrology. More tools will be added as they become available (USACE, Climate Preparedness and Resilience).

USACE Engineering with Nature

The USACE is pursuing nature-based solutions through the Engineering With Nature (EWN) Initiative. Nature-based solutions have been implemented to support civil works functions and infrastructure. EWN is the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaborative processes. One of the opportunities that can be pursued through the use of EWN is the application of Natural and Nature-Based Features (NNBF). NNBF are landscape features that are used to provide engineering functions relevant to flood risk management. Examples of NNBF include beaches and dunes; vegetated environments such as maritime forests, salt marshes, freshwater wetlands and fluvial flood plains, and seagrass beds; coral and oyster reefs, barrier islands, among others. These features may occur naturally in landscapes or be engineered, constructed and/or restored to mimic natural conditions. EWN also has publications featuring magazine articles, fact sheets, brochures, and studies (USACE Engineering With Nature).

DoD is actively working to integrate nature-based solutions in its resilience plans and projects and is uniquely positioned to deploy those solutions in partnership with the USACE and others as a key element of their strategies to protect the military mission, military installations and ranges, and surrounding communities. *Engineering With Nature Supporting Mission Resilience and Infrastructure Value at Department of Defense Installations* highlights seven examples of this practice on DoD installations, supporting conversation about the potential to "engineer with nature" across the DoD to develop broadly based resilience (Bridges, et al 2021).

The EWN website offers many resources and tools for delivering sustainable economic,

social, and environmental benefits associated with infrastructure (USACE Engineering with Nature).

DoD Installation Exposure to Climate Change at Home and Abroad

As stated in Chapter 2, EO 14008, requires the DoD to submit a draft action plan to the National Climate Task Force and the Federal Chief Sustainability Officer that describes steps the agency can take with regard to its facilities and operations to bolster adaptation and increase resilience to the impacts of climate change. A key requirement of this task is a description of each agency's climate vulnerabilities, particularly in the area of installation, building and facility energy, and water efficiency. This report supports DoD's response to this EO through the analysis of installation exposure to climate change hazards at home and abroad. Information in this report, combined with other DoD data and analytical results, will also be used to support that Climate Risk Analysis (CRA) required by EO 14008.

This report includes high-level information on resilience measures installations can deploy to reduce their vulnerability to changes in both chronic and extreme climate hazards. It recommends implementing a "multiple lines of defense" approach that can include a mix of management, temporary, structural, nature-based, and nonstructural measures in order to deliver performance and resilience over the intended project lifecycle. The DCAT, described above, provides a consistent screening-level assessment of exposure to projected current and future climate hazards across 1,391 selected DoD installations. This data was used in the development of this report.

Defense Logistics Agency (DLA) Sustainability Program Awareness Training Module

The Defense Logistics Agency (DLA) Installation Management has drafted the DLA Sustainability Program Awareness training module for DLA's workforce to keep abreast of the climate change efforts the agency has initiated. This training effectively communicates DLA's strategic sustainability objectives in alignment with DoD's broader sustainability objectives. As part of the Sustainability program, climate change adaptation is covered in a portion of the training, which elaborates on basic concepts, studies, policies, and resources. The training module will be accessible through DLA's learning management system and, once launched, will be mandatory for all employees.

Climate Adaptation for DoD Natural Resource Managers: A Guide to Incorporating Climate Considerations into Integrated Natural Resources Management Plans, 2019

This guide is designed to help military natural resource managers prepare for and reduce climate-related risks, and to ensure that DoD installations can continue to meet the evolving needs of the U.S. military. INRMPs serve as guiding documents for how natural infrastructure on DoD installations is maintained and managed in support of ecosystem and mission sustainability. Accordingly, this guide focuses on how to incorporate climate considerations into these foundational plans. Recognizing the diversity of needs and challenges facing installations—across military Services and across disparate geographies and ecosystems—this guide emphasizes options and best practices that can be adopted, as appropriate, by installations to meet their specific needs.

The guide consists of two major sections. Part I includes an overview of climate

risks to military installations and mission requirements; an introduction to adaptation; a briefing on climate science; a review of options for incorporating climate concerns into INRMPs; and a summary of climate and adaptation considerations for individual INRMP program elements. Part II offers a step-by-step method for carrying out the INRMP adaptation planning process. A series of appendices provide sources of adaptation-related information and expertise and a set of detailed worksheets that support installation-level application of the six-step INRMP adaptation planning process.

4.3 Non-DoD Climate Change Resources and Tools

This section summarizes key non-DoD guidance and available tools from other agencies and entities. These resources can provide valuable strategies for adapting to climate change that can be applied to protecting cultural resources, as well as infrastructure and natural resources. Additional resources are also included in the bibliography in Appendix A. Other agencies and entities are updating and enhancing guidance and tools regularly as the science matures and new information becomes available.

NPS Cultural Resources Climate Change Strategy (2016)

The NPS has taken an active role in addressing the issues climate change presents to parks and long-term resource stewardship. In 2009, the NPS established the Climate Change Response Program. Since then, the NPS has developed a group of documents that further support coordinated climate change response; to date these include: *Climate Change Response Strategy (*2010), *Climate Change Action Plan 2012-2014* (2012), *Green Parks Plan* (2012), *Using Scenarios to Explore Climate Change: A Handbook for Practitioners* (2013), and Director's policy memoranda (PM) addressing management policies (PM12-02), cultural resources (PM 14-02), and facilities (PM15-01). Climate change is being incorporated into park planning documents and regional climate change action plans, and a range of park-level assessments and projects are connecting climate science, policy, and practice across the NPS. This 2016 strategy builds on the foundation of PM14-02 and is intended primarily as a companion document to the *Climate Change Response Strategy* (2010). Throughout the 2016 strategy, approaches and methods from other NPS documents are incorporated. The purpose of this 2016 strategy is to set out the broad scope of cultural resources in relation to climate change and identify major directions of action in cultural resources and climate change for the NPS.

National Oceanic and Atmospheric Administration (NOAA)

NOAA's website, climate.gov, is a source of scientific climate data and information. The health, security, and economic well-being of Americans are closely linked to climate and weather. The website provides information to help the public make decisions on how to manage climate-related risks. For example, there is a Maps & Data section that provides reusable climate maps and datasets that document various climate conditions. This section intends to serve officials and professionals who need climate data to inform their decisions or to compile a climate adaptation report. In addition, the U.S. Climate Resilience Toolkit, (discussed below) was developed to serve policy and decision makers (NOAA Climate.gov).

Federal Emergency Management Agency (FEMA) National Risk Index

The National Risk Index is a dataset and online tool to help illustrate the United States communities most at risk for 18 natural hazards. It was designed and built by FEMA in

close collaboration with various stakeholders and partners in academia; local, state and federal government; and private industry. The Risk Index leverages available source data for natural hazard and community risk factors to develop a baseline risk measurement for each United States county and Census tract. The National Risk Index has interactive mapping and data-based interface that allow users to visually explore individual datasets to better understand what is driving a community's natural hazard risk. Users may also create reports to capture risk details on a community or conduct community-based risk comparisons, as well as export data for analysis using other software. Intended users of the National Risk Index include planners and emergency managers at the local, regional, state, and federal levels, as well as other decision makers and interested members of the general public. With improved understanding of natural hazard risk, communities can take action to reduce the risk specific to that community (FEMA National Risk Index).

The U.S. Climate Resiliency Toolkit

The U.S. Climate Resilience Toolkit website provides steps to resiliency, which is a framework for documenting climate hazards, assessing vulnerabilities and quantify risks, and developing workable solutions to reduce climate-related risks. This website also provides case studies of building resilience for businesses and their communities, as well as more than 200 digital tools to assist in building resilience, from engaging a community to developing a climate action plan, training courses, and state climate summaries from NOAA's National Centers for Environmental Information (NOAA Climate. Gov Tool Kit).

NOAA Off ce for Coastal Management Digital Coast

The Digital Coast was developed to meet the unique needs of the coastal management community. The website provides coastal data, as well as the tools, training, and information needed to use these data. Content comes from many sources, all of which are vetted by NOAA. Data sets range from economic data to satellite imagery. The site contains visualization tools, predictive tools, and tools that make data easier to find and use. Information is also organized by focus area or topic, including adaptation strategies, coastal land cover, coastal storms, ecosystem services, natural infrastructure, risk communication, vulnerability, and water quality (NOAA/Digital Coast).

U.S. Environmental Protection Agency (EPA), Climate Change Indicators in the United States, 2016

The EPA published this report to communicate information about the science and impacts of climate change, assess trends in environmental quality, and inform decision-making. The report presents 37 indicators to help readers understand changes observed from long-term data records related to the causes and effects of climate change, the significance of these changes, and their possible consequences for people, the environment, and society. Each of EPA's 37 indicators covers a specific climate-related topic, such as U.S. Greenhouse Gas Emissions. *Climate Change Indicators in the United States*, 2016, is written with the primary goal of informing a readers' understanding of climate change. It is also designed to be useful for the public, scientists, analysts, decision-makers, educators, and others who can use climate change indicators as a tool for:

- Effectively communicating relevant climate science information in a sound, transparent, and easy-to-understand way.
- Assessing trends in environmental quality, factors that influence

the environment, and effects on ecosystems and society.

- Informing science-based decision-making (EPA Climate Indicators).

Coastal Resilience Center (CRC) of Excellence

The mission of the Coastal Resilience Center of Excellence is to conduct research and education to enhance the resilience of infrastructure, economies, and the natural environment to the impacts of coastal hazards such as floods and hurricanes. It also includes future coastal hazard trends and the effects of these trends. The CRC website contains information on coastal infrastructure resiliency, building resilient communities, and coastal risk modeling (US Department of Homeland Security Publications and Products).

U.S. Geological Survey (USGS) The Climate Research and Development (Climate R&D) Program

The Climate R&D Program advances the understanding of the earth's physical, chemical, and biological components, the causes and consequences of climate and land use change, and the vulnerability and resilience of the earth to such changes. The Climate R&D website provides recent publications, reports and articles relevant to the Climate R&D Program. The website also contains climate history, land cover and land surface data developed for various types of research and management applications, including assessing the impacts of climate change, evaluating ecosystem status and health, understanding spatial patterns of biodiversity, and informing land use planning (USGS Climate Research and Development Program).

USGCRP National Climate Assessment

The Global Change Research Act of 1990 mandates that the USGCRP deliver a report to Congress and the President no less than every four years that "1) integrates, evaluates, and interprets the findings of the Program…; 2) analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and 3) analyzes current trends in global change, both human-induced and natural, and projects major trends for the subsequent 25 to 100 years."

The Fourth National Climate Assessment (NCA4) 2018 fulfills that mandate in two volumes. Volume II builds on the foundational science described in Volume I, the *Climate Science Special Report*. Volume II focuses on the human welfare, societal, and environmental elements of climate change and variability for 10 regions and 18 national topics, with particular attention paid to observed and projected risks, impacts, consideration of risk reduction, and implications under different mitigation pathways. Volume II of NCA4 provides examples of actions underway in communities across the U.S. to reduce the risks associated with climate change, increase resilience, and improve livelihoods. The assessment was written to help inform decision-makers, utility and natural resource managers, public health officials, emergency planners, and other stakeholders by providing a thorough examination of the effects of climate change on the U.S. (USGCRP 2018).

Environmental and Energy Study Institute (EESI)

EESI, founded in 1984, is a non-profit organization dedicated to promoting science-based solutions for climate change, energy, and environmental challenges. EESI provides local technical assistance to utility-based energy efficiency programs, which helps drive federal policy while achieving progress on-

the-ground. EESI now assists local nonprofits, state and local governments, and rural electric cooperatives and municipal utilities in eight states as they get on-bill financing programs up and running. EESI publishes web articles several times a week, covering current events or spotlighting initiatives of particular note (EESI About Us).

4.4 Linking Climate Change Variables to Cultural Resource Impacts

The previous sections provide the guidance and tools that can be used to understand the causes and effects of climate change and assess climate change risk and possible consequences to DoD installations. The following tables present the types of climate-related hazards and potential impacts on DoD cultural resources, including historic districts and landscapes, and ethnographic resources (Table 4-1), archaeological sites (Table 4-2); and buildings and structures (Table 4-3). Understanding the risk and potential consequences to cultural resources will allow managers to determine appropriate strategies for addressing the impacts. The following tables are created from the Cultural Resources Impacts Tables in the National Park Service *Cultural Resources Climate Change Strategy* (NPS 2016). The NPS tables have been reorganized to match the top five DoD climate hazards in Chapters 2 and 3 of this guidance document (i.e., heat, flooding, etc.).

Table 4-1. Climate Change Impacts on Historic Landscapes, Historic Districts, and Ethnographic Resources

Climate Hazard/ Impacts	Impacts on Cultural Landscapes, Historic Districts, and Ethnographic Resources
Drought/Increased Wildfire	– Loss or damage of associated structures – Change in vegetation density and composition – Bedrock and border spalls – Increased susceptibility to erosion and flooding – Loss of soil fertility due to high heat – Damage to structure and/ or associated historic landscape/ district from fire retardants – Discoloration, exfoliation, spalling, and smudging of culturally significant rock images, geoglyphs
Drought/Less Precipitation	– Decline/disappearance of some vegetation species; other species favored – Soil infertility due to decreased microbial activity – Limited water supply inhibits established maintenance practices – Increased soil erosion – Stress on culturally significant species impacts subsistence practices – Indirect effects to ceremonial cycles and religious practices involving weather control
Flooding/Increased Frequency and/ or Severity of Flooding Events	– Wash out or damage to roads, trails, and landscape/district features – Decline/disappearance of important vegetation species, other species favored – Loss of cultural places due to inundation/saturation – Loss of both plant and animal species for subsistence, medicine, ceremony, etc.

Climate Hazard/ Impacts	Impacts on Cultural Landscapes, Historic Districts, and Ethnographic Resources
Flooding/Increased Inundation	– Variable damage/loss of organic and inorganic materials and landscape/district features – Decline/ disappearance of some vegetation species, other species favored – Soil erosion – Soil infertility due to waterlogged, anaerobic conditions – Loss of or limited access to traditional places and culturally important sites (e.g., burial grounds, subsistence areas) – Loss of plant and animal species for subsistence, medicine, ceremony, etc.
Flooding/Higher Water Table	– Decline disappearance of important vegetation species, other species favored – Soil infertility due to waterlogged, anaerobic conditions – Loss of or limited access to culturally important sites (e.g., burial grounds)
Flooding/Saltwater Intrusion	– Soil infertility – Reduction in or loss of habitat for culturally significant plants and animals – Loss of drinking water supplies
Heat/Increased Global Temperature	– Decline/disappearance of some native vegetation species, other species favored – Loss of biodiversity due to competition as well as introduction, shifts in species ranges, and changes in temperature – Expansion of invasive species into higher latitudes/altitudes as climate warms, thermal barriers will be reduced; new Arctic shipping passages will reduce the time of travel between Asia, Europe, U.S. and will increase survival of invasives in shipping – Heat stress on culturally significant vegetation – Increased stress (e.g., desiccation, warping, cracking) on constructed landscape/ district features
Heat/Increase Freeze and Thaw Cycles	– Decline/disappearance of some vegetation species due to recurrent freezing – More rapid deterioration of constructed materials of landscape/district features (e.g., corrosion, decay, desiccation) – Increased absorption of salts from road and sidewalk treatments which can lead to efflorescence, cracking, and spalling, etc.
Heat/Permafrost Melt	– Decline/disappearance of some vegetation species – More rapid decay, desiccation of constructed materials of landscape/district features – Destruction of land and buildings due to increased coastal erosion
Heat/Higher Relative Humidity	– Decline/disappearance of critical vegetation species; increase/spread of some vegetation species; increased desiccation, warping, and cracking of constructed landscape/district features
Heat/Increased Wind	– Damage of loss of culturally significant plants – Change in historic/culturally significant vegetation patterns – Increase need for protective structures that shelter landscapes – Reduced access to marine hunting grounds due to strong/unusual wind patterns and shifting sea ice – Reduced access to animals in open spaces due to wind chills that drop temperatures
Land Degradation/ Invasive Species and Pests	– Potential loss of significant plant species due to introduction of new pests – Changes in viewsheds (e.g., historic landscapes/district, or sacred sites)

Climate Hazard/ Impacts	Impacts on Cultural Landscapes, Historic Districts, and Ethnographic Resources
Land Degradation/ Increased Frequency and/or Severity of Storm Surges	– Immediate alteration/ destruction of historic landscape/district or feature – Decline/ disappearance of some vegetation species, other species favored – Soil infertility from soil erosion, loss of topsoil – Increased risk of inundation of districts during unpredictable and extreme weather – Changes to surrounding landforms, which may affect future drainage
Land Degradation/ Increased Coastal Erosion	– Decline/ disappearance of some vegetation species, other species favored – Soil infertility from loss of topsoil – Loss or compromise of associated structures
Land Degradation/ Increased Wind	– Change in historic/culturally significant vegetation patterns. – Increase in need for protective structures
Storm Frequency or Intensity/More Precipitation and/or Heavier Precipitation	– Increased tree fall due to waterlogging – Limited ability to plant in waterlogged soil – Loss of historical integrity with improved drainage systems – Decline/disappearance of some vegetation species – Decreased soil fertility from erosion, waterlogging, and leaching – Loss of landscape features – Increased susceptibility to destructive fungi – Erosion of earthworks – Increasing difficulty in predicting storms – Indirect effects to ceremonial cycles and religious practices involving weather control
Storm frequency or Intensity/ Extreme Weather Events	– Immediate alteration/ destruction of historic landscape, particularly trees – Decline/disappearance of some vegetation species, other species favored, particularly in disturbed areas – Reduction in or loss of access due to washing out or damage to roads, trails, and landscape/district features – Limited access to cultural sites due to increased closures of areas – Need for new emergency response plans due to changes in hurricane strengths and tracks, and surrounding land use practices

Table 4-2. Climate Change Impacts on Archeological Resources and Sites

Climate Hazard/ Impacts	Impacts on Archeological Resources and Sites
Drought/Increased Wildfire	– Damage or destruction of associated structures – Heat alteration of artifacts – Heat fracturing of stone artifacts – Paint oxidation, color change – Physical damage from firefighting efforts (fire lines) – Decreased accuracy of carbon-14 dating due to carbon contamination. – Damage from fire-killed tree fall – Increased susceptibility to erosion and flooding
Drought/Less Precipitation	– Loss of stratigraphic integrity due to crack/ heave damage in drier soils – Destabilization of wetland or waterlogged sites – Exposure of submerged sites due to lower water levels in lakes – Sites more vulnerable to fire and wind – Increased exposure from vegetation loss and erosion
Flooding/Increased Frequency and/ or Severity of Flooding Events	– Direct physical damage to site from floating materials during floods – Destruction/loss of artifacts during flooding – Site erosion from overflow and new flood channels – Increased risk of post-flood subsidence – Impacts from post-flood mitigation (clean up, construction)
Flooding/Increased Inundation	– Total submersion of coastal sites – Downstream movement of items due to undercut shoreline sediments. – Changes in pH of buried artifacts and/or environments – Reduced site integrity due to ground heave and subsidence – Increased erosion of sites due to encroaching water levels, wave action exposure, and increased exposure to wet/dry cycles
Flooding/Higher Water Table	– Damage to artifacts, stratigraphy, soil features from saturation of site from below
Flooding/Saltwater Intrusion	– Deterioration of some artifacts due to change in surrounding soil and water chemistry – Compromise of the site due to changes in soil and water chemistry
Heat/Increased Global Temperature	– Microcracking of site contents from thermal stress – Faster deterioration of newly exposed artifacts and sites – More rapid decay of organic materials – Accelerated rusting in submerged and coastal resources from warmer ocean temperatures – Increased risk of damage due to decline/loss of protective vegetation or soil – Damage from increased biological activity at shallow underwater sites
Heat/Increase Freeze and Thaw Cycles	– More rapid decay of organic materials – Disruption of soil structure, especially in permafrost – Destruction of archeological deposits due erosion – Increased rates of deterioration in artifacts from thermal stress

Climate Hazard/ Impacts	Impacts on Archeological Resources and Sites
Heat/Permafrost Melt	– Loss of artifacts and contexts from increased erosion – More rapid decay of organic materials – Disruption of stratigraphy from changed soil structure and movement
Heat/Higher Relative Humidity	– More rapid decay of organic materials – Increased corrosion of vulnerable/less stable metal – Increased mold, especially in enclosed sites (e.g., vaults, tumuli, and caves)
Heat/Increased Wind	– Increased moisture penetration into porous materials – Burial through redistribution of soil – Abrasion of petroglyph and pictographs – Erosion and deflation of archeological deposits
Land Degradation/ Invasive Species and Pests	– Physical damage, loss of integrity and spatial coherence from altered habitat structure – Data loss, subsidence, feature collapse, structural damage from invasive consuming organics – Damage from new and increased number of burrowing animals
Land Degradation/ Increased Frequency and/or Severity of Storm Surges	– Destruction - total site loss – Erosion from wave action – Disturbance or removal during response and clean-up
Land Degradation/ Increased Coastal Erosion	– Full or partial loss of coastal sites and artifacts – Exposure of new and known archeological sites – Altered erosion patterns from reduction/changes in sea level or sea ice
Land Degradation/ Increased Wind	– Increased moisture penetration into porous materials – Burial through redistribution of soil – Abrasion of petroglyph and pictographs – Erosion and deflation of archeological deposits
Storm Frequency or Intensity/More Precipitation and/or Heavier Precipitation	– Site erosion from overflow and new flood channels – Soil destabilization/ shifting (ground heave, landslide, subsidence) – Damage to unexcavated artifact and site integrity from direct force of water
Storm frequency or Intensity/ Extreme Weather Events	– Erosion of coastal sites due to higher, stronger storm surges – Disturbance/exposure/burial due to stronger wave action – Deflation or abrasion due to stronger winds – Disturbance or removal during emergency response and clean-up – Destabilization/damage to underwater sites through movement of sediment and/or protective vegetation

Table 4-3. Climate Change Impacts on Buildings and Structures

Climate Hazard/ Impacts	Impacts on Buildings and Structures
Drought/Increased Wildfire	– Damage or loss of whole structures, or combustible components – Cracking, physical damage of masonry components from extreme thermal stress – Discoloration caused by smoke and/or heat – Damage from fire-killed tree fall – Damage to structure and/or associated historic landscape from fire retardants – Buildings may shift or settle due to associated erosion – Pressure to change character defining features such as wood shake roofing to fire resistant alternatives – Smoke damage
Drought/Less Precipitation	– Increase in dry salt deposits near masonry and porous stone which hydrate and infiltrate during infrequent rain events causing spalls and fractures – Reduced humidity stress on buildings (possible benefit) – Cracking and splitting of wooden/ organic features due to complete drying – Limited water supply for cooling, landscaping, other equipment
Flooding/Increased Frequency and/ or Severity of Flooding Events	– Structural collapse from moving force of floodwaters – Sewage backup and overflow leading to saturation and related flooding, contamination, and damage – Walls "implode" from hydrostatic force of standing water – Damage to utilities, generators, and electrical systems – Increased risk of rot, fungal/insect attack, mold, and mildew – Swelling/distortion of wooden building materials and architecture features due to inundation – Spalling, weathering of wood, brick, and stone materials due to salt infiltration during drying – Increased pressure to relocate or elevate structures, and/or surrounding structures
Flooding/Increased Inundation	– Submersion of coastal sites – Increase in nuisance flooding leading to problems of access and higher likelihood of flood damage – Damage to or overwhelming of drainage systems, leading to associated building damage – Deterioration/corrosion of infrastructure not designed for inundation or saltwater exposure – Increased cracking due to associated ground heave and subsidence – Crystallization of salts introduced to buildings by seawater – Disassociation of historic districts, settings due to increased pressure to relocate or elevate structures or surrounding structures – Loss of access leading to loss of use – Potential leaks inside buildings or structures
Flooding/Higher Water Table	– Rising dampness often marked by efflorescence/salt deposits – Rot of subsurface components from higher water table – Flooding damage in basements and other below grade features – Structural damage due to buoyant forces

Climate Hazard/ Impacts	Impacts on Buildings and Structures
Flooding/Saltwater Intrusion	– Increased risk of corrosion/rusting – Introduction of additional salts into the ground and into building materials
Heat/Increased Global Temperature	– Increased demand for complex air conditioning systems that can add stress to the building envelope and often requires significant alterations to a structure (including insulation, routing of extensive ducts and pipes, etc.)
Heat/Increase Freeze and Thaw Cycles	– Surface cracking, flaking, and sugaring of building stone and spalling of brick due to increase in wet frost – Damage to foundations due to increased frost heave action – Increased absorption of salts from road and sidewalk treatments which can lead to efflorescence, cracking, and spalling, etc. – Greater structural damage due to fluctuating environment, causing collapse or cracks in building that allow more access for pests
Heat/Permafrost Melt	– Destabilization of buildings and settlement into the ground – More rapid decay of organic building materials – Destruction of land and buildings due to increased coastal erosion
Heat/Higher Relative Humidity	– For brick and porous stone, increased moisture absorption, leading to increased risk of frost damage, mold growth, and stress from salt crystallization – Sulfur dioxide deposits on wet/ damp surfaces, corroding stone, metal, and glass – Swelling and cracking of wooden building materials and architectural features – Increased growth of destructive organisms (e.g., mold, algae) for wood, stone, and masonry – Increased potential for rot in wood and other organic material
Heat/Increased Wind	– Direct wind damage – Scouring/abrasion of exterior surfaces – Increase cracking, spalling, splintering, weathering of buildings due to accelerated drying – Damage from wind borne debris
Land Degradation/ Invasive Species and Pests	– New threats to wood structures and wooden architectural features as termites and other pests expand territory due to warmer, longer summers – Spread of destructive vegetative species (e.g., kudzu vine) farther north into new areas
Land Degradation/ Increased Frequency and/or Severity of Storm Surges	– Structural damage or collapse from moving force of storm surge – Damage to utilities, generators, and electrical systems – Cracks in building and associated destabilization of buildings and pipes due to ground heave and subsidence/shrink-swell soils – Erosion of supporting ground around structure – Increased pressure to relocate or elevate structures, and/or surrounding structures – Changes to surrounding landforms or vegetation, which may affect future drainage
Land Degradation/ Increased Coastal Erosion	– Loss or compromise of structure – Increased pressure to relocate or elevate structures, and/or surrounding structures – Increased rusting, corrosion, and salt deposits due to increased salt in the environment as the coastline encroaches

Climate Hazard/ Impacts	Impacts on Buildings and Structures
Land Degradation/ Increased Wind	– Direct wind damage – Scouring/abrasion of exterior surfaces – Increased cracking, spalling, splintering, weathering of buildings due to accelerated drying – Damage from wind borne debris
Storm Frequency or Intensity/More Precipitation and/or Heavier Precipitation	– Swelling/distortion of wooden building materials and architecture features due to wetness and damp – Increased risk of rot and fungal/insect attack – Historic building drainage systems unable to cope with downpours – Erosion of supporting ground around structure – Sewage backup and overflow – Increased rates of deterioration due to increase frost events in cold regions that were formerly dry – Accelerated decay of masonry units and mortars due to increased extremes of wetting and drying – Cracks in building infrastructure and associated destabilization of buildings and pipes due to ground heave and subsidence/ shrink swell soils – Severe damage and loss of historic structures made of adobe – Spalling, weathering of wood, brick, and stone materials due to salt infiltration during drying – Increased pressure to relocate or elevate structures, and/or surrounding structures – Potential interior leaks
Storm frequency or Intensity/ Extreme Weather Events	– Added stress from sudden thermal expansion/shock – Direct damage from wind-blown rain – Damage from wind-borne debris – Cracked pipes and swelling due to large temperature swings – Direct damage from wind and wind-blown rain – Damage from wind-borne debris

4.5 Strategies for Managing Cultural Resources to Reduce Climate Change Vulnerabilities

It is a worthwhile exercise to develop and consider strategies and actions for addressing climate change hazards and risks to establish priorities and possibly integrate with other program areas and resources management.

Strategies and actions for managing cultural resources that are at risk of damage or destruction from climate change can take three forms:

- prevent hazards from happening; or
- adapt to reduce the vulnerability of the property and its environs; or
- mitigate for the loss (when prevention or adaptation is not feasible).

Preventing the hazard from happening could involve active fire fuels management, pest management, or building maintenance. Restoring a floodplain or wetland ecosystem may also reduce a risk. These types of strategies and actions would require coordination with other program area managers to ensure consistency with meeting mission requirements and feasibility to implement, and may be implemented by other departments. In some cases, a historic property may be at high risk of loss and protection of the property would be unsuccessful or too costly. In this case, it may be best to do nothing or to save data about the resource (mitigation for loss). Table 4-4 provides additional information on strategies and actions.

Other factors to consider when assessing a possible strategy or action are: 1) the nature of the hazard (see Tables 4-1, 4-2, and 4-3 for hazards to specific resource types); 2) the probability of occurrence (high, medium, low, remote); 3) what the severity of potential consequences might be to the cultural resource (catastrophic or sever, mild, gradual); and 4) the vulnerability of the resource. Factors that contribute to resource vulnerability are the exposure of the resource to one or more climate hazards, the sensitivity of the resource to the hazards, and the degree of adaptive capacity to reduce this exposure and sensitivity. Part II of this guide provides methodology for thinking through adaptation planning process and considering strategies. Appendix C has worksheets and detailed instructions for documenting the process and outcomes for integrating into the ICRMP.

In all strategies and approaches, the values for which the property was recommended eligible to the NRHP should be the foundation on which strategies and actions are based. This will help to reduce the possibility of strategy or action having unintended negative consequences for the property. For example, an in-situ archaeological site is eligible because it has the potential to yield important data on the life of a prehistoric people; therefore, it is important for the site to stay intact and remain at its current location.

Strategies and actions should also avoid adverse effects to the historic property. Examples of adverse effects (36 CFR 800.5) include:

- Physical destruction of or damage to all or part of the property.
- Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous material remediation, and provision of handicapped access, which is not consistent with the Secretary's Standards for the Treatment of Historic Properties (36 CFR part 68) and applicable guidelines.
- Removal of the property from its historic location.
- Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance.
- Introduction of visual, atmospheric, or audible elements that diminish the integrity of the property's significant historic features.
- Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance to an Indian tribe or Native Hawaiian organization; and
- Transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

Table 4-4. Adaptation Strategies and Actions

(Source: This table has been adapted from Melnick et al. 2017)

Strategy/Action	Description
Mitigate for the loss/No Active Intervention or no change to current plans	Not changing current plans may be appropriate in situations of low vulnerability (no new action warranted) or when, due to one or more of a range of constraints, including lack of technological or economic feasibility, no action can be taken. This strategy may include assessment of the need for monitoring of resource condition, with a plan to revisit the situation at a future point in time or the current ICRMP may already include actions for this resource that will not be altered.
Mitigate for the loss/Document and Release	This strategy is a set of actions to record a resource and then subsequently allow the geographic location of the resource to undergo full effects of environmental or other forces. Documentation may include data recovery (full excavation) of an archeological site or inventory and recording of a building or structure or historic landscape (such as a Historic American Building Survey, Historic American Engineering Record, Historic American Landscape Survey), or a historic landscape inventory, possibly in combination with laser scanning documentation techniques. Other examples of documentation techniques that may be used include collection of pollen, seeds, or plant cuttings, and oral histories and video.
Mitigate for the loss/Interpret the Change	Interpreting the change is an action or set of actions that preserves and then serves to engage people in the future with the effects of climate change on a resource. This option may be used on its own or in combination with any of the other options. A dramatic example would be preservation of a coastal resource such that its location and form remain either intact or otherwise visible from the coast once it is offshore or partially submerged (e.g., construction of a cover or large buoy at the former location of a lighthouse or archeological site). Other examples include interpretation signage of changing ecosystems and a photo series of changes in garden phenology or vegetation across a historic landscape. While interpretation may be developed across any of the adaptation options on this list, for this option, interpretation addresses not only preservation and history of the resource, but also climate change itself, and seeks to tell the story of the place and climate change and how they are interacting.
Adapt to reduce the vulnerability of the property and its environs/Offset Stress	Removing or deflecting a stress is one or more actions taken to reduce or remove the environmental or other force(s) acting on the resource or component of the resource. The goal of this option is to enhance survival of a resource while minimizing changes to the physical materials and setting of the resource. Constraints on this option are likely to include impacts of actions on surrounding resources, such as natural habitat or infrastructure. Examples include temporary measures such as sandbags or levee plugs; an offsite retaining structure or living shoreline to reduce shore erosion; upstream re-vegetation to reduce flood hazards; and changes in adjacent forest management to reduce wildfire risk.

Strategy/Action	Description
Adapt to reduce the vulnerability of the property and its environs/Improve Resilience	Improving resilience consists of one or more actions that change the nature of a resource and/or the immediate setting of a resource, and that are designed to make a resource more resistant or resilient to environmental or other forces. The goal of this option is survival of the resource despite possible impacts of actions on the integrity of the resource, although this option does not necessarily mean the resource will be impaired. Examples include treatment of structural materials to better withstand increased moisture, wind, or an invasive species; elevation of a building to raise it above projected flood level; addition of a cap over an archeological site; changes in landscape plantings or soil treatments; and alternate storage arrangement of reference materials and documents.
Adapt to reduce the vulnerability of the property and its environs/Manage Change	Managing change is an action or set of actions that incorporate change into the form of the resource and/or into its management plan. The goal of this option is to maintain character-defining features of a resource, even if original specific materials or individual species are no longer part of the resource. For example, changing the tree species on historic landscapes by removing the original species that has died and replacing it with a species that is healthy in that environment and will provide similar shade and foliage conditions.
Prevent hazards from happening/Relocate or facilitate movement of resource	Relocating/facilitating movement includes two types of actions: (1) moving a resource, and (2) allowing movement to happen. The strategy of moving a resource is an action or set of actions that move all or a portion of a resource that cannot move on its own to a less vulnerable location. The iconic example of this option is the moving of the Cape Hatteras Lighthouse inland from the coast. The strategy of allowing movement to happen is an action or a set of actions that enable movement of living portions of resources to less vulnerable or more stable locations, or halting actions that would otherwise impede movement of living portions of resources to less vulnerable or more stable locations. Examples include allowing ecosystems such as a marsh or barrier island with cultural significance or which contains culturally significant species to migrate landward or allowing species with cultural significance to shift ranges. Such shifts may move all or components of a resource outside of the documented resource boundaries. Movement is not feasible for a whole historic landscape but may be appropriate for character-defining features of a landscape once the whole landscape cannot be saved.

Some examples from DoD installations that have implemented adaptation measures to address climate-related hazards include the following (Additional measures and details are included in Appendix B):

- Marine Corps Installations East Camp LeJeune – Camp Lejeune has made changes on historic and non-historic buildings that include the replacement of asphalt shingles to standing seam metal roofs; shoreline stabilization in some erosion-prone areas; and application of water-proof coatings on masonry walls as climate adaptation measures.
- Offutt AFB – The Air Force is rebuilding after the flood of 2019 to include future flood prevention measures. Changing

the heights of the rebuilt structures and raising the locations of electrical boxes have been a focus of these measures.

- Fort Bliss Directorate of Public Works Divisions – The Army collaborated to identify historically-compatible roofing material for numerous high-profile buildings within two historic districts on the installation. Over the past three years, the Army has installed a new roofing system that withstands increased wind speeds up to 130 miles per hour on a total of 29 buildings contributing to these historic districts. These new roofs allow the buildings to better handle the increasingly severe windy seasons during the spring months each year.
- Fort Bliss Historic Architecture Program – To reduce energy needs, the Fort Bliss Historic Architecture Program recommends the use of light-emitting diode (LED) lighting to provide energy efficiency without compromising the character of the historical building/district. This is achieved by utilizing modern fixtures which complement the architectural style of the resource, or by retrofitting the existing fixtures to accommodate the new LED lamps.

As stated in Section 4.2, the USACE supports the Engineering with Nature initiative to incorporate natural processes and structures to reduce risks. Projects that restore and/or emulate natural systems in order to increase human, ecosystem, and infrastructure resilience to climate impacts are referred to as nature-based solutions. These types of projects can reduce damage from natural hazards as well as, or better than, traditional engineered projects, often at less cost. Living shorelines, restored wetlands, reforestation projects, and green (vegetative) roofs are just a few examples of nature-based solutions.

They provide multiple environmental, economic, and social benefits, and can be used to restore natural systems as well as protect cultural resources and infrastructure. Natural-based solutions to climate change are projects including:

- **Living shoreline** — Living shoreline is a broad term that encompasses a range of shoreline stabilization techniques along estuarine coasts, bays, sheltered coastlines, and tributaries. The footprint of a living shoreline is made up mostly of native material. It incorporates vegetation or other living, natural "soft" elements alone or in combination with some type of harder shoreline structure (e.g., oyster reefs or rock sills) for added stability. Living shorelines maintain continuity of the natural land–water interface and reduce erosion while providing habitat value and enhancing coastal resilience. Living shoreline techniques work best along sheltered coasts (i.e., coasts not exposed to open ocean wave energy) to preserve and improve habitats and their ecosystem services at the land–water interface (NOAA 2015). Living shorelines can be used to protect archaeological sites and stabilize historic coastal infrastructure.
- **Natural infrastructure** — These projects restore or use existing natural systems and landscapes (such as forests, floodplains, and wetlands) to increase resilience to climate impacts. Natural infrastructure projects often support habitat restoration, which in turn, can protect prehistoric and historic sites from erosion, landslides, and flooding.

Living shoreline in Beaufort, NC, 2012 (Source: NOAA)

MacDill oyster reef stabilization, 2008 (Source: USACE Engineering with Nature)

Permeable paver parking lot on greenway, Luray, VA, 2017 (Source: downtownluray.com)

Living shoreline using oyster shells, Ocracoke, NC, 2016 (Source: Ocracoke Observer)

Bioretention planter, Sacramento, CA, 2016 (Source: Sacramento State University)

- **Habitat restoration** — Natural habitats preserved or restored to protect biodiversity and improve habitat health can reduce climate impacts. For example, in a burn scare area, upslope revegetation and reforestation may prevent soil erosion and landslides. Restoring wetlands may help reduce flooding. These stable habitats will protect archaeological sites and historic infrastructure, buildings, and districts from exposure caused by erosion, damage from flood, and increase resiliency to fire.
- **Green infrastructure** — These projects combine gray infrastructure (e.g., a seawall or building) with nature-based solutions to create hybrid systems that improve resilience to climate impacts. Typically, green infrastructure is a built or engineered solution such as a vegetated- or eco-roof or bioswale. Other examples are the use of permeable pavers to provide durability for driveways and sidewalks while allowing rainwater to filter into the ground below or engineered drainage systems. Managing rainwater can prevent inundation of historic building foundations and basement flooding. Green roofs can reduce heat extremes in historic buildings and structures.
- **Urban focus** — Nature-based solutions, such as increasing tree canopies, can be incorporated into historic urban environments to improve resilience to climate impacts such as extreme heat and flooding.
- **Flood prevention** — Nature-based solutions can help reduce the risk of flooding cost-effectively by absorbing and reducing runoff and reducing storm surge along the coast.
- **Water quality** — Nature-based solutions that reduce runoff and increase filtration minimize pollution and improve water quality. In addition, clean water improves the effectiveness of nature-based solutions along riverine and coastal systems, which allows the solutions to better support climate adaptation and reduce risks.

Some examples of DoD installations that have implemented nature-based measures to address climate-related changes include the following (Additional measures and details are included in Appendix B):

- Marine Corps Base Hawaii (MCBH) Kaneohe Bay — MCBH is in the process of permitting a barrier fence along the ocean-facing side of the North Beach Dunes, which contains the Mokapu Burial Area, to address coastal erosion and to protect the dunes. The installation is also mitigating coastal erosion within the boundary of a cultural resources site along the Fort Hase beach shoreline by installing a bio-engineered revetment above the high-water mark. This revetment will protect and stabilize both the shoreline and the site deposits.
- Marine Corps Recruit Depot, Parris Island — The Depot has planned a Charlesfort-Santa Elena National Historic Landmark shoreline stabilization study. The Depot will use the results to develop a draft design to restore shoreline stability.
- Marine Corps Base Camp Pendleton (MCBCP) — The MCBCP has evaluated individual archaeological sites to determine if they require stabilization projects. Some archaeological sites near rivers subject to erosion received stabilization projects.

- Arnold AFB — The Air Force maintains archeological sites in forested cover or no-till crops year-round to prevent erosion. The Air Force monitors site conditions to determine any negative impacts.
- Joint Base Langley-Fort Eustis — The installation's cultural resources program has developed and implemented an archaeological site monitoring program that measures and documents the rate of erosion on sites. The installation has developed and implemented temporary stabilization techniques to delay erosion on archaeological sites that are awaiting NRHP evaluations or stabilization. The installation has programmed funds to develop a "hybrid living" shoreline to stabilize a site known to contain Native American burials.
- Homestead Air Reserve Base (HARB) — HARB personnel are actively involved in the ongoing Biscayne Bay Southeastern Everglades Restoration efforts which seek to restore freshwater wetlands near the installation. Wetland restoration would provide a natural coastal buffer which would protect the installation from storm surge during extreme weather events.

U.S. Army and U.S. Coast Guard train for emergency evacuation at Fort Eustis, 2015 (Source: U.S. Air Force, Photo credit: Staff Sgt. Natasha Stannard/Released)

PART II
ICRMP INTEGRATION PROCESS

5. INCORPORATING CLIMATE CONSIDERATIONS AND STRATEGIES INTO ICRMPS

The previous chapters provide regulations, existing guidance and tools on climate adaptation, understanding climate variables and risks to cultural resources, and strategies for managing cultural resources to reduce climate change vulnerabilities. These previous chapters provide broad overviews of climate risks to DoD installations and cultural resources, and why climate adaptation should be integrated in cultural resources planning. This second part of the guidance provides instruction on working through the planning process and integrating the results into the ICRMP.

Incorporating climate considerations into ICRMPs can be done by one of two pathways: integration of climate considerations throughout the ICRMP; or inclusion of climate considerations as an appendix to the ICRMP. This chapter describes under what circumstances the full integration or appendix-only approaches may be applicable. It also provides instruction for completing the planning process and developing appropriate adaptation strategies. Appendix C includes the worksheets to support the planning process.

5.1 Pathways for Incorporating Climate Considerations into ICRMPs

Installation CRMs can integrate climate-related issues into ICRMPs using one of two pathways: (1) integration of climate considerations throughout the ICRMP; and (2) inclusion of climate-related information as an appendix to the ICRMP. The benefits for using each pathway are explained below and may depend on the revision or update cycle of the ICRMP.

Incorporating climate considerations into the body of the ICRMP has a number of benefits. These include improving the likelihood of climate risks being assessed across the full range of program elements and installation priorities, as well as engagement of a larger team in thinking about climate-related issues and solutions. In addition, when more than one department are facing the same climate vulnerabilities, adaptation-specific actions, or needed modifications to existing projects, are more likely to be seamlessly integrated into implementation plans, project scheduling, and ongoing monitoring. In order to achieve successful integration across other program elements, collaboration with other departments and decision makers during the strategy development phase of planning, as well as, understanding the broader mission-resilience goals and objectives would be necessary. Integrating climate considerations throughout the full ICRMP is more likely to contribute to a more cohesive and climate-informed cultural resource management program. On the downside, integrating climate considerations throughout the ICRMP may be more time-consuming and costly, at least initially. A major ICRMP revision may also result in the need for additional coordination.

Addressing climate in an appendix can offer another way of incorporating climate adaptation in an ICRMP. An advantage to

this approach is that all climate-related information and assessments are in one location in the document, making it easier to quickly review and understand the implications of climate change on the installation. Adding an appendix would require less integration throughout the ICRMP. It could also be done between major review and update cycles, so that some strategies may be able to be integrated into on-going cultural resources management sooner.

Climate and its effects on cultural resources and mission sustainability are subject to continual change. By having this information in an appendix, the CRM can easily make minor adjustments, updates, or add notes regarding status of program. It also provides a historic record of the reasoning and justifications for decisions made at that time. This information would be valuable for a new cultural resources manager to understand the logic, priorities, or trends of that time. As an appendix, the climate information is compartmentalized in one section. However, opportunities for understanding and addressing climate concerns across the full range of resource program elements may be missed. The scope or prioritization of existing projects and actions may change and as appropriate, the CRM may need to adjust or re-prioritize projects based on the risks and costs/benefits of each project in the context of potential future climatic conditions.

Climate change has implications for nearly all that DoD does. The *Climate Adaptation Plan* (Section 2.1), states that no Component can "opt out." However, a CRM may also consider the appendix option after determining that climate change effects to installation cultural resources are not a credible threat, as a way to show consideration without the need for an ICRMP revision. For example, an installation may have a few archeological sites, and these sites are located in an area not currently threatened by an increased fire risk or erosion. The strategy may be simply to monitor for change.

Climate adaptation is an iterative process and addressing impacts of climate change is not expected to be completed in a single ICRMP update or revision or appendix. An installation that starts with an appendix-only approach may fully incorporate this data throughout the various ICRMP sections when the ICRMP undergoes a major or 5-year revision. Appendices are a good place for detailed or technical information on climate projections, vulnerability assessments, and other climate-related analyses, as well as documenting comments and concerns.

Whether incorporating climate considerations throughout the ICRMP or including them as an appendix only, the document should:

- Serve as a resource for documenting current and future climate at the installation, including an assessment of uncertainties associated with climate projections.
- Consider the implications of climate-related changes to ICRMP goals, objectives, and actions (current and planned).
- Identify potential impacts and risks (direct and indirect) that climatic changes pose to the installation's cultural resources and to mission requirements and sustainability.
- Prioritize the risks, strategies and actions based on implications to military mission and funding.
- Develop effective strategies for addressing, at a minimum, the high priority strategies and actions.
- Link cultural resource adaptation concerns and responses with other installation planning processes and documents, particularly natural

resources and maintenance programs. This may provide a source for project funding.

5.2 DoD Guidance for ICRMPs

DoDI 4715.16, *Cultural Resources Management*, 4. Policy states "It is DoD policy to:

a. Manage and maintain cultural resources under DoD control in a sustainable manner through a comprehensive program that considers the preservation of historic, archaeological, architectural, and cultural values; is mission supporting; and results in sound and responsible stewardship.

b. Be an international and national leader in the stewardship of cultural resources by promoting and interpreting the cultural resources it manages to inspire DoD personnel and to encourage and maintain U.S. public support for its military.

c. Consult in good faith with internal and external stakeholders and promote partnerships to manage and maintain cultural resources by developing and fostering positive partnerships with Federal, tribal, State, and local government agencies; professional and advocacy organizations; and the general public."

The basic components and structure of an ICRMP are outlined in the DoDI 4715.16 Enclosure 6, and Service-specific instruction including:

- Army Regulation 200-1: *Cultural Resources Management*
- Office of the Chief of Naval Operations Instruction 5090.1B
- Air Force Instruction 32-7065, *Cultural Resources Management*
- Marine Corps Order P5090.2A *Environmental Compliance and Protection Manual*, Chapter 8, "Historic and Archeological Resources Protection"

The Services have individual templates for organization and content of the ICRMP. Because of the differences in the templates and the resulting variability in structure of the ICRMP among the Services, climate considerations can be integrated throughout the plans in different ways. However, DoDI 4715.16 establishes the requirement for DoD Services to prepare ICRMPs (Enclosure 2) and the general and specific requirements (Enclosure 6). CRMs can integrate climate adaptation strategies with the requirements of an ICRMP in the following areas:

- Establish priorities and related funding requirements for cultural resources management that ensure support of the mission, compliance with legal requirements, and ongoing stewardship responsibilities;
- Provide management procedures for the ongoing identification, maintenance, and enhancement of cultural resources;
- Promote the use of cultural resources in ways that are beneficial to the military mission, the resources, and other public interests;
- Integrate with other installation plans, including but not limited to the installation master plan, the facilities maintenance plan, training and range area management plans, natural resources management plans, mobilization and deployment plans, and information management systems;

- Address cultural resources and areas of critical or special concern from both technical and policy standpoints; and
- Develop preservation and mitigation strategies for threatened cultural resources.

5.3 Integrating Climate Considerations into the ICRMP

The following sections offer suggestions for what climate-related information is appropriate to include in an ICRMP and where the CRM can incorporate this information. For each of the four major ICRMP "sections" described below, a brief overview of what climate considerations that may relate to each section is provided. A list of climate-related information, analyses, or concerns that could be included is also provided. The four major ICRMP sections are:

- ICRMP Section 1: Introduction/General Information/Overview
- ICRMP Section 2 - Installation Profile/ Physical/Natural Setting
- ICRMP Section 3 - Installation Areas of Concern/Actions Impacting Cultural Resources
- ICRMP Section 4 – ICRMP Goals and Develop Climate Risk Strategies

The following sections present a process for considering and integrating climate concerns into ICRMPs. This six-step planning process is summarized below in Table 5-1. Each ICRMP section described below has supporting worksheets to use to develop that portion of the ICRMP. These worksheets, with detailed instructions, are included in Appendix C.

Table 5-1. Overview of ICRMP Planning Process

Step	Action	ICRMP Section
Step 1. Set Context for Adaptation Planning	– Identify and assemble planning team/engage partners. – Conduct internal and external scoping. – Compile background information, identify: • additional climate change-related laws and regulations • additional CRM responsibilities • other installation plans and planning process with climate change	Section 1 - Introduction/ General Information/ Overview
Step 2. Assess Climate Vulnerabilities and Risks	– Determine current climatic baseline condition – Determine future climate change projections (i.e., increased temperature or precipitation) – Assess potential changes to the natural environment (i.e., increased drought or wildfire) – Assess resulting risks to military mission	Section 2 - Installation Profile/ Physical/Natural Setting

Step	Action	ICRMP Section
Step 3. Identify Potential Effects to Cultural Resources	– List the installation cultural resources – Identify potential climate risks to installation cultural resources – Identify how vulnerable the resource is to the risk – Determining if the cultural resource is critical to sustaining the installation's military mission, and to what degree is this a risk to the mission	Section 3 - Installation Areas of Concern/Actions Impacting Cultural Resources
Step 4. Evaluate Implications for ICRMP Goals and Objectives	– Evaluate achievability of existing goals – Update/Add climate-related goals and objectives – Identify whether goals are short-term or long-term	Section 4 – ICRMP Goals and Develop Climate Risk Strategies
Step 5. Develop Strategies and Actions to Reduce Climate Risks	– Identify existing adaptation strategies and actions in other plans with implications for cultural resources – Identify additional potential adaptation strategies and actions – Evaluate the effectiveness/ feasibility of possible strategies – Select priority risk reduction measures	Section 4 – ICRMP Goals and Develop Climate Risk Strategies
Step 6. Implement Adaptation Actions and Projects	– Identify project requirements and dependencies – Incorporate actions/projects into ICRMP implementation table	Section 4 – ICRMP Goals and Develop Climate Risk Strategies
Post ICRMP development. ICRMP Implementation and Update Phases	– Define expected results of adaptation strategies – Monitor project effectiveness and ecological responses – Adjust strategies and plans as needed	N/A

5.3.1 ICRMP Section 1 – Introduction/ General Information/Overview

The Introduction/General Information/ Overview (or comparable) section of the ICRMP is intended to set the overall context for the plan. It usually includes the purpose of the plan, organization of the ICRMP, overview of laws and regulations, cultural resources management, and roles and responsibilities. It may also include a section on relationships to other installation plans and partners.

This first ICRMP section provides an opportunity to set the stage for incorporating climate considerations in the cultural resource management strategy. In addition to presenting legal and regulatory drivers for addressing climate-related risks, relevant materials to include in an overview section can include a description of what constitutes climate adaptation in general, an introduction to key installation climate concerns, and information about the spatial and temporal scope and scale of adaptation planning specific to the cultural resources management program at the installation.

Purpose of the Plan. Add statements about preservation and /or management in a dynamic environment.

Example Purpose Statement:

> New threats to cultural resources are emerging from climate-driven changes in the environment, which could compromise the capacity of military facilities and lands that support the military mission. This updated ICRMP includes adaptation strategies for managing these risks.

Goals and Objectives. Add to the list of objective statements about addressing climate risks to cultural resources.

Example Objective Statements:

- Assess emerging risks and vulnerabilities to cultural resources from climate-driven changes in the environment.
- Incorporate climate risk strategies into best management practices.

Organization of the ICRMP. Add statements about where specific information can be found. This might include any of the sections described below in this chapter. For example, Overview of Laws and Regulations, Relationship to Other Installation Plans, Internal and External Partners, etc.

Overview of Laws and Regulations — In addition to federal and state cultural resources laws, include overarching climate change EOs and other climate guidance requirements. (These can be found in Section 2.1 of this guidance document; as well as appropriate Service-specific guidance in Section 4.1 of this document.)

Relationships to Other Installation Plans — These plans would include master plans, sustainability plans, INRMPs, range management plans, and/or building maintenance procedures. These other plans will identify program goals and strategies for their specific program areas. Some of these goals and strategies may be applicable to cultural resources. For example, restoring the function of a wetland may reduce erosion of an archaeological site. However, some goals or strategies may conflict with cultural resources management goals. For example, installation of a seawall may impact submerged cultural resources, or replacing the siding on a historic building could impact its eligibility for listing in the NRHP. It is likely that the CRM is already working with other program leads to ensure common goals and that program-specific strategies do not conflict or inadvertently inflict harm to other

resources or program areas. This would just be an added topic.

Cultural Resources Management Responsibilities — CRMs would become aware of climate hazards and risks to cultural resources and assist with developing strategies to manage this risk. The CRM would do this in consultation with installations planners, engineers, maintenance personnel, range managers, and natural resources managers. As stated in Section 4.2 of this guidance document, DLA is developing a Sustainability Program Awareness training module. The CRM may want to investigate these types of training modules and create awareness of these training opportunities.

Partners — Identify key internal and external partners for assessing climate impacts and carrying out adaptation planning. Both internal and external partnerships provide an important mechanism for acquiring expertise, building capacity for climate adaptation, and implementing climate adaptation strategies in the ICRMP. Implementation of climate adaptation initiatives can benefit greatly from the subject matter expertise of other federal and state agencies and other non-governmental organizations.

Collaborative partnerships can also greatly facilitate the implementation of climate adaptation projects. Coordination and collaboration with other internal departments and programs can result in strategies that benefit more than just one program area, and result in greater efficiencies. The expertise of internal partners in their subject matter will be crucial for identifying these collaborative opportunities to adapt to climate change. For example, facilities engineers may have innovative ideas about reducing erosion under the threat of increasing storm intensity.

Leveraging these types of projects may provide an engineered solution for preservation or restoration projects. The following define who additional internal and external partners that may participate in climate adaptation planning process:

- Internal partners would include personnel from public works, facility maintenance, range control, environmental programs (natural resources), and emergency responders. Educate internal partners on awareness of plans, what to look for as far as resource degradation, and who to contact. Also provide training on what to do and not do during emergencies and what to do post-emergency. Maintenance staff may have input on current climate effects to historic structures, buildings, and infrastructure. Plans for natural resources or facilities management could have a positive or negative impact on cultural resources. For example, historic structures need use, the most sustainable building is one already built, maintaining use helps ensure maintenance of structures. On the other hand, installing a seawall or prescribed burns could adversely impact archaeological resources.
- External partners include the SHPO, neighbors, communities, and tribes and Native organizations. Develop strategies and inform the partners on approaches and strategies. If the installation is engaged in on-going, periodic consultation meetings or other forms of regular communication, the CRM can use these forums to inform partners of climate change concerns and risk-reduction strategies. If a strategy or action falls under the definition of an “undertaking” as

defined in 36 CFR 800.16, consultation is required with the SHPO, Advisory Council on Historic Preservation (ACHP), and tribes. Other opportunities for consultation with external stakeholders would arise during revisions and updates to the ICRMP, or development of a master plan, sustainability plan, INRMP, or range management plan. NEPA and Section 106 of the NHPA have consultation requirements. Some installations may also have annual or ongoing meetings with external partners. These meetings also offer opportunities to discuss climate concerns, strategies, and lessons learned that may also benefit the community.

The following is a summary of data/write ups to include in this section.

- Legal and regulatory drivers and policy guidance for climate change and climate adaptation, including DoDI 4715.03 and other department-wide and military service–specific guidance.
- Identification of key internal and external partners, and identification of individual stakeholder roles in consultation, assessing climate impacts, or carrying out strategies.
- Review of any climate-related assessments carried out for other installation planning processes or incorporated into other installation planning documents.

5.3.2 ICRMP Section 2 — Installation Profile/Physical/Natural Setting

The Installation Profile/Physical/Natural Setting section (or comparable) contains a variety of background information, including general descriptions of the installation and its environment. This section provides an overview of the installation's military mission, local and regional land uses, and tenants. It also provides a summary of the installation's general physical environment, including the built environment, and general biotic environment, including flora, fauna, threatened and endangered species, and special habitats (e.g., wetlands).

The Physical/Natural Setting is a logical place in the ICRMP to describe baseline climatic conditions (regionally and locally), to identify cultural resources currently experiencing threats and exposures, and to present projections of future conditions and top risks. As described in Chapter 4 of this guide (Sections 4.2 and 4.3), there are a variety of sources and approaches for projecting future climatic conditions, but best practices emphasize the use of a range of scenarios (rather than specific predictions) that acknowledge and account for uncertainties in modeling future climate variables.

Some of these projections will involve physical climate variables (e.g., temperature, precipitation) whereas others may involve derivative climatic factors (drought, sea-level rise), and still others climate-related conditions, such as changes in the frequency or severity of wildfire, flooding, or soil erosion. Because there can be a considerable amount of technical data and analysis associated with these projections, an overview and summary of current and future climatic conditions and trends could be included in this section of the ICRMP, with supporting details included in an appendix.

The following is a summary of data/write ups to include in this section:

- Baseline climatic conditions for the installation.
- Key climate concerns affecting the installation's cultural resources and associated mission requirements and sustainability.

- Important climatic and climate-related variables relevant to the installation's cultural resources.
- Sources of information related to regional and local climate change, including relevant publications and reports (e.g., regional, state, national climate change projections).
- Projections and scenarios of future change in climate (e.g., temperature, precipitation) and climate-related factors (e.g., sea-level rise, flooding, and wildfire).

5.3.3 ICRMP Section 3 — Installation Areas of Concern/Actions Impacting Cultural Resources

In this step, the CRM identifies target cultural resources; describes internal and/or external threats on the installation's cultural resources; assesses the impacts of those changes on cultural resources and the resulting climate vulnerabilities of those resources; and finally, determines how those resource vulnerabilities may pose risks to the installation's ability to sustain specific military mission requirements.

The CRM can use the climate-related variables identified in the previous sections to describe internal and/or external threats on installation cultural resources as well as activities impacting cultural resources. This section would include impacts on cultural resources and management issues associated with climate vulnerabilities. The focus of this section should include not only *current* but also *future* conditions. The information should include climate vulnerabilities, which resource types are at risk, why the resource type is vulnerable, and why it is of concern, particularly as it relates to the mission of the installation.

The CRM can present these concerns and impacts in a table and divided by resource type and climate concern (See Tables 4-1 through 4-3).

The following is a summary of data/write up to include in this section:

- Identification of cultural resources on the installation.
- Identification of potential climate risks to installation cultural resources, and how vulnerable the resource is to the risk.
- Determining if the cultural resource is critical to sustaining the installation's military mission, and to what degree is this a risk to the mission.

5.3.4 ICRMP Section 4 — ICRMP Goals and Develop Climate Risk Strategies

In the previous sections, the CRM identified cultural resources vulnerable to climate hazards, as well as the specific climate risk posed to the resources, and if the potential climate risks to the cultural resources would result in risk or impact to the mission of the installation. This section of the ICRMP identifies goals for the vulnerable cultural resources and possible strategies and actions that could reduce climate vulnerabilities and risks.

Goals of the Cultural Resources Management Program

Existing ICRMP goals and objectives may be broad enough to encompass climate adaptation goals, so that additional specific climate change goals may not be necessary. For example, the goal to have 100 percent of the installation surveyed for cultural resources would allow the CRM to better understand the types of resources that may be impacted by climate change. Or a goal to "Preserve significant historic properties whenever possible and mitigate appropriately in the long-term public interest when adverse

effects cannot be avoided" would still be valid, although require the CRM to review adverse effects in the new light of climate vulnerabilities.

Consideration of climate change may result in additional goals intended to address specific resources. These climate adaptation goals and objectives may be short-term to order to address immediate concerns (e.g., stabilize vulnerable historic structures), or long-term to address slow changes in climate vulnerability (e.g., remove resources from the environment in which they are vulnerable). CRMs may also want to establish goals for specific cultural resources that are essential to fulfilling the military mission.

Once goals are determined, the CRM can develop a range of potential management strategies/actions to achieve the goals and address climate-related vulnerabilities to resources or risks to mission requirements. Strategies are the broadest level management effort (e.g., avoidance or minimization of impact, or mitigation measures for impacts), and actions are specific activities/projects in support of the strategy (e.g., develop maintenance plans, hardened a shoreline, relocate a resource, documentation). The CRM may develop strategies and actions to address a continual condition (i.e., rising sea level) or an intermittent climatic condition (i.e., drought years versus non-drought years.) Also, the CRM can incorporate trigger points for when a shift to another strategy or action would occur. For example, determine the point at which the rise in sea level or water table would result in having to abandon an area or infrastructure.

Develop Strategies

This phase includes the development and evaluation of management adaptation options for long-term trends and events. The CRM will need to consider other factors, such as budget, personnel, legislative mandates, and mission. The CRM should integrate a level of flexibility into management options and plans to address specific climate change impacts. Climate change adaptation options are a range of alternative management approaches designed to mitigate impacts on cultural resources. Chapter 4 of this guidance document provides management strategies and actions.

Management strategies and actions may overlap over with other programs. For example, an installation master plan may identify a new use for a historic building, which could provide opportunities for repairs and hardening; maintenance plans may need to be updated to reflect an increase in insect infestation; or a fire management plan may need to consider the location of fire breaks. For these reasons another department may be in the best position to lead or implement a specific management action.

After determining a list of possible actions that will reduce climate risks, identifying ICRMP goals, and making sure these action and goals support the broader military mission requirements, the CRM should consider strategies or actions that should be as priorities for incorporation into the ICRMP. Subsequent implementation strategies may need to be identified. Actions will have varying levels of success, involvement, and costs. CRMs must balance multiple trade-offs among preservation objectives and activities required to support military readiness, often leaving staff little time to focus on stewardship priorities. Projects that require extensive planning, regulatory permitting, and/or external subject matter expertise can be especially burdensome; therefore, the CRM should consider these factors while developing strategies.

Actions and projects that are supported by compliance with regulatory drivers, such as the NHPA, will normally be prioritized over proactive stewardship initiatives. For proactive initiatives to be funded, they

typically have to support the military mission and/or have a nexus with a regulatory driver (although grant opportunities may exist). To the extent feasible, the CRM should link risks and adaptation projects associated with climate change to strong mission and/or legal or regulatory drivers. Explicit articulation of this link will help the CRM ensure that climate adaptation is appropriately prioritized.

The government budget planning cycle and funding approval process usually requires that CRMs to program their budgets years in advance. The extent to which a new adaptation actions or projects fit within or are modifications of existing ICRMP actions/projects, can facilitate the approval and execution of climate adaptation initiatives on a more expedited time frame (e.g., existing monitoring programs may need to be only slightly adjusted to accommodate climate-informed monitoring).

The following is a summary of data/write-up recommended to be included in this section of the ICRMP during future updates:

- Reference to other planning or guidance documents for facilities and other installation assets that may contain climate risk assessments or resilience strategies for cultural resources.
- Any planned infrastructure projects (e.g., levees, seawalls, facilities) that could affect, positively or negatively, cultural resources.
- Incorporate priority adaptation actions into an ICRMP implementation/project table.
- Identify regulatory considerations for climate adaptation projects.

Evaluation Strategies/Actions/Projects

Once the CRM has developed a broad list of possible adaptation actions, the list can be pared down to those that are most likely to be successful at reducing climate risks, achieving ICRMP goals, being implemented, and supporting broader military mission requirements. The intent of the "consequence table" in the worksheet in Appendix C is to identify those strategies or actions that should be considered as priorities for incorporation into the ICRMP and subsequent implementation. The CRM can complete a separate worksheet or consequence table to evaluate strategies that address different risks/vulnerabilities. Similarly, the CRM can fill out a separate consequence table to evaluate the different actions that may support a given strategy. Detailed instructions are provided in Appendix C.

CRMs should then evaluate the options or alternatives identified. The CRM has choices for scoring the options and alternatives under this approach. For example, rank options on a relative scale (e.g., low, medium, high) for how the options meet the criteria. In these instances, it is important to be clear about whether higher scores are "better" or "adequate." It may be useful to describe if the strategy is feasible for implementation and why or why not. It could be because of the high price and little value, or conflicting land use. This approach to strategy selection is just one approach for evaluation and comparison of options; installations should feel free to use other approaches based on their existing capacities and planning procedures.

Implementation of Adaptation Strategies/Actions

The next step is to help identify who will conduct the implementation of the adaptation strategies and actions/projects; whether and how the relevant strategies and actions fit within existing DoD program implementation; what decisions are

especially relevant to get the strategies and actions ready to implement; and when various element of the strategies and actions should be implemented. The order is to go from strategy to project development to implementation.

5.4 Inclusion of Climate-Related Information in an ICRMP Appendix

Addressing climate change issues in an ICRMP appendix can be a straightforward and cost-effective means of initiating engagement on an issue. For the appendix-only pathway, it is recommended that the CRM go through as much of the "Full Integration" approach (described above) as possible, and structure the information in the same steps as outlined above. For installations that already have evaluated their management program through a climate lens, the existing planned actions on projected climate risks can be included in the appendix. Within the body of the ICRMP, the CRM can refer readers to the appendix for climate-related information (including climate projections and vulnerability assessments) and for any long-term projects/actions that extend beyond the project execution time horizon. The CRM can provide a link in the ICRMP to this information in the appendix to allow for minimal text edits in the body of the ICRMP. The worksheets in Appendix C of this guide can be completed and contain the majority of the information for this appendix.

For installations that may not have fully evaluated climate risks to their programs, the CRM should still structure the appendix to mirror the above steps, but without linking existing planned actions to projected climate risks. Instead, the appendix can identify what is known about potential vulnerabilities to the cultural resource management program, and present intended courses of action for future program evaluations and adaptation planning. In these cases, the main planned action may be to set up a planning team to evaluate their program and its vulnerability to climate change. In this situation, adding climate-related information as an appendix provides an opportunity to incorporate data as it develops. In either case, the worksheets in Appendix C can be useful for "thinking through" this process.

6. GUIDANCE CASE STUDY

A case study was conducted after preparation of the 50% draft of this guidance document. The intention for the case study was to apply the guidance in a real application and determine what improvements could be made to the information presented and the worksheets. Ms. Lisa Bosalet, Cultural Resources Manager, Naval Weapons Station Seal Beach, U.S. Navy agreed to participate in the case study and assisted with the refinements to the final guidance document and forms.

Ms. Bosalet provided current ICRMPs for Seal Beach, Detachment (Det) Norco, and Detachment Fallbrook for review. The information from these ICRMPs was used to populate the initial worksheets. When completed, Ms. Bosalet reviewed the 50% draft guidance document and worksheets for each of the installations. She then provided comments and ideas for revisions to the guidance document and worksheets. After the review, a site visit was conducted to Det Norco and Seal Beach to field check the data and worksheets. From this case study, the worksheets underwent a major revision. Section 6.2, below, summarizes the key results from the case study.

6.1 Installation Overviews

Seal Beach Naval Weapons Depot — Navy Weapons Station Seal Beach is located along the coast near Long Beach California. The mission of Navy Weapons Station Seal Beach is to support the Navy's ordnance mission and other fleet and fleet support activities. Navy Weapons Station Seal Beach encompasses approximately 5,256 acres of land with the Seal Beach National Wildlife Refuge occupying about 920 acres. Land-uses include ordnance storage and maintenance facilities; agricultural out-leases (used as buffer lands); Seal Beach National Wildlife Refuge; public-private venture housing; officers' quarters and bachelor enlisted quarters; administrative and support areas; navy golf course; Defense Fuel Support Point San Pedro; and the wharf.

Navy Weapons Station Seal Beach has archaeological sites that are eligible or recommended as eligible for the NRHP. The historic ammunition storage bunkers are covered under an existing program comment.

The primary climate change hazard is sea level rise resulting in inundation and flooding of the installation. This could affect the installation's military mission.

Detachment Norco — Det Norco is located in the City of Norco, Riverside County, California, approximately 40 miles southeast of downtown Los Angeles. The mission of Det Norco is to provide shore-based infrastructure support to the Navy's ordnance mission and other fleet and fleet support activities. Det Norco occupies 247 acres of land, including a 47-acre man-made lake known as Lake Norconian. The vast majority of all facilities at Det Norco are used by the Naval Surface Warfare Center - Corona Division.

Det Norco has 13 contributing elements of the Lake Norconian Club Historic District. The boundaries of the historic district extend beyond the Det Norco boundaries. The Lake Norconian Club Historic District is a resource that occupies approximately 92 acres on Navy-owned land at Det Norco, with the remainder of the District located just north of Det Norco within the correctional facility that is owned by the State of California. One prehistoric archaeological site was recorded in 1977; however, the site, CA-RIV-1230, has not been formally evaluated.

Climate change concerns for Det Norco are caused by rising temperatures resulting in

excessive heat, drought, and wildfire, with the primary concern being wildfire. Increased severity of storms could cause the lake to flood, which would limit access to critical portions of the site; however, this is less likely to occur and, currently, less of a concern.

Detachment Fallbrook — Det Fallbrook is located adjacent to the community of Fallbrook, an unincorporated area of northern San Diego County, California, approximately nine miles from the Pacific coast. The detachment is adjacent to Marine Corps Base Camp Pendleton.

Det Fallbrook functions as a component detachment of Naval Weapons Station Seal Beach. The mission of Det Fallbrook is to support the Pacific Fleet's combat readiness and sustainability by providing ordnance, and ordnance-related products and services essential for Navy and Marine Corps forces to succeed in any challenge or conflict. Det Fallbrook comprises 8,850 acres of land. Land use includes ordnance storage facilities and an administration area. Grazing, through an out-lease program, is allowed in the ordnance storage areas.

Det Fallbrook has 127 known archeological sites. Four archaeological sites have been determined or recommended NRHP-eligible. The sites are located throughout the installation, and most are not impacted by or do not impact the mission. Two sites are located in areas that are critical to the mission.

Climate change concerns for Det Fallbrook include drought and increase severity of storms resulting in erosion. Although the drought has resulted in increased fire threats (fire frequency in the area has increased in the past 5 to 10 years), the type of archaeological sites are generally not affected by fire. Fire does, however, increased increase erosion potential. The soils at the installation are very erodible. Critical roads and access could be damaged due to erosion and impact the military mission.

Additional details about the installations and the completed worksheets for this case study are included in Appendix D.

6.2 Case Study Results

The CRM commented that the process of reviewing the document and draft worksheet resulted in considering climate change and effects on resources that had not been considered previously, and that the exercise was quite interesting.

The ICRMP addresses the overarching Cultural Resources Management Program for the installation. The ICRMP may already include cultural resources monitoring activities, so that additional monitoring for climate change may not be necessary. This action may, therefore, simply be referenced in the ICRMP as assisting with climate change adaptation.

It was recommended that the worksheets integrate pull down menus as much as possible. MSWord has very limited programing capabilities, so a second set of worksheets was developed in Excel were developed for those wanting more pull-down menus and linkages. Due to this linkage, the worksheets are in slightly different format than the Word version, however, they follow the same step-by-step planning process.

The worksheets are designed to guide the CRM through a process to determine what the climate hazards are, if the cultural resources are at risk and how these resources might be affected, and if so, what is an appropriate course of action. If no changes to the current cultural resources management program are proposed, the worksheet can provide input into future ICRMP updates by memorializing the conditions at that time, considerations,

and justification of the decisions for comparison purposes.

The case study also led to a discussion regarding listing cultural resources individually or lumping them together. In some cases, lumping the resources together would probably not be ideal, since the resources may have different climate exposures (even at the same installation) and therefore different solutions. This may be the case for historic districts, when a district is composed of many varying types of resources from buildings exposed to flooding and landscape features exposed to drought.

However, listing all resources individually in the tables would be very time consuming if the installation has numerous resources. For example, Fallbrook has upwards of 120 archaeological sites. All of these resources may be susceptible to the same climate change hazard – erosion. Another consideration is that only two of these archeological sites are in places that if that location were affected, the mission would be impacted by loss of access to an important area. Considering the effects to mission early may help focus the CRM on the most critical resources and save time not taking each individual resource through the climate worksheet process. The ICRMP has other mechanisms in place to address day-to-day management of the resource.

Cultural resource projects need a driver in order to secure funding. It is unlikely that proposing additional projects for addressing climate change, solely for the purpose of mitigating future potential change, would get funded. So far, climate change is not an action that triggers Section 106, so, again, it would be hard to justify and secure funding for projects solely focused on reducing effects from climate change. Securing funding for mitigation and implementing adaptation may be another reason for targeting cultural resources that are critical for mission or in areas critical to supporting the mission.

There could be multiple types of documents on an installation that address climate change in one form or another. Tracking down and reviewing all potential documents could be very time consuming. If this is the case, the INRMP and maintenance plans are likely the most appropriate documents to look for integration opportunities. Integrating cultural resources management with other plans and climate change projects or programs may be one way to acquire funding for the adaptation strategies.

Geographic information systems may be a good source for information on climate vulnerabilities. For example, data may exist depicting water sheds may indicate areas of potential erosion. A layer showing the location of archaeological sites layered over these areas could show which archeological resources are most vulnerable to this climate hazard.

There are a lot of references in the guidance document and included in Appendix A of this document that can be used as resources for ideas and planning. In addition, there is more and more information on this topic becoming available regularly on-line from federal and state agencies and entities.

6.3 Wake Island Exercise

The information in the Wake Island ICRMP was used to prepare a second set of worksheets. This case study was developed to test the worksheets in Word and for another Service (case study was done for Navy installations). These worksheets have not been vetted by the Air Force. They are included in Appendix E. Slight changes were made to the worksheets after completing this exercise to improve flow and usability.

A UH-60 Blackhawk helicopter hoists a team of Soldiers during special training, date unknown (Source: U.S. Army)

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APPENDIX A
BIBLIOGRAPHY

This appendix includes a couple of sample pages of the bibliography. The full bibliography is included in the Appendix A folder an Excel file. Note: new resources are becoming available regularly.

Title	Author	Date	Description/Summary/Abstract	Geographic Scope (city, state, region, national)	Primary Theme	Location of Document/ Website
National Park Service Cultural *Resources Climate Change Strategy* (CCRC)	National Park Service	2016	The CRCC Strategy provides guidance for NPS managers to anticipate, plan for, and respond to the real and potential effects of a changing climate on the cultural resources. It provides guidance to recognize and respond to a wide range of environmental changes that threaten cultural resources throughout the Nation.	National	Cultural Resources	https://www.nps.gov/subjects/climatechange/upload/NPS-2016_Cultural-Resoures-Climate-Change-Strategy.pdf
Climate Change Impacts on Cultural Resources Table	National Park Service	2016	This table can be used as a guide for identified impacts and understanding the effects of climate change. The table succinctly describes how different manifestations of climate change will affect different types of cultural resources. The table is organized by major measurable trends of climate change, such as temperature and precipitation. Rows within the table include observable phenomena of these trends and how these trends will be experienced. These phenomena are the forces to which cultural resources are being or will be exposed.	National	Cultural Resources	https://www.nps.gov/subjects/climatechange/upload/NPS-Climate-Impacts-to-Cultural-Resources_7-2016.pdf
Report on Effects of a Changing Climate to the Department of Defense	Office of the Secretary of Defense for Acquisition and Sustainment	2019	This report provides an assessment of the significant vulnerabilities from climate-related events in order to identify high risks to mission effectiveness on installations and to operations. In developing this report, the approach was discussed with staff from the House and Senate Armed Services Committees on more than one occasion. This report is organized into three primary sections: I. Summary of Climate Effects and Resulting Vulnerabilities; II. DoD Efforts to Increase Installation Resiliency & Operational Viability; and III. Conclusions	National	Climate Change Impacts	https://media.defense.gov/2019/Jan/29/2002084200/-1/-1/1/CLIMATE-CHANGE-REPORT-2019.PDF

Title	Author	Date	Description/Summary/Abstract	Geographic Scope (city, state, region, national)	Primary Theme	Location of Document/ Website
Planning Handbook on Climate Change Installation Adaptation and Resilience	Naval Facilities Engineering Command	2017	Naval Facilities Engineering Command released a handbook for use by planners in assessing climate impacts and evaluating adaptation options to consider in the existing Installation Development Plan (Master Plan) process. The Handbook contains an extensive set of worksheets to be used in documenting the results of planners' assessment and evaluation, including economic analyses of adaptation alternatives.	National	Climate Change Adaption	https://www.fedcenter.gov/_kd/go.cfm?destination=ShowItem&Item_ID=31041
DoD UFC 1-200-02, *High-performance and Sustainable Building Requirements*	DoD	2017	DoD UFC 1-200-02, ***High Performance and Sustainable Building Requirements*** was updated to ensure appropriate incorporation of climate-related impacts. The UFC provides minimum requirements, and guidance for planning, designing, constructing, renovating, and maintaining high performance and sustainable buildings that will enhance DoD mission capability by reducing total ownership costs.	National	Building Requirements	https://www.wbdg.org/FFC/DOD/UFC/ufc_1_200_02_2016_c4.pdf
DoD Directive 4715.21, *Climate Change Adaptation and Resilience*	DoD	2018	DoD Directive 4715.21 ***Climate Change Adaptation and Resilience***, assigning responsibilities to many DoD components for incorporating climate considerations into planning for infrastructure and operations in order to assess and manage risks associated with the impacts of a changing climate.	National	Climate Change Adaptation	https://dod.defense.gov/Portals/1/Documents/pubs/471521p.pdf

Title	Author	Date	Description/Summary/Abstract	Geographic Scope (city, state, region, national)	Primary Theme	Location of Document/ Website
Climate Change and The Historic Environment	English Heritage	2012	This report by the United Kingdom advisory group is their current view on the implications of climate change and the historic environment. It is intended both for the heritage sector and also for those involved in the wider scientific and technical aspects of climate change; in the development of strategies and plans relating to climate change impacts; or in projects relating to risk assessment, adaptation, and mitigation.	Foreign - National	Cultural Resources	https://www.english-heritage.org.uk

APPENDIX B
INSTALLATION QUESTIONNAIRE SUMMARY

Installation Questionnaire

A brief questionnaire was prepared and submitted to specific DoD installations to gather information about current climate-related issues and types of cultural resources on DoD installations, and current climate change-related activities. The data collected from the questionnaire is used throughout the guidance document and a summarized below.

Number of Responses:

Army	Air Force	Marine Corps	Navy	Total
8	13	9	10	40

Has a climate risk assessment been completed for the installation?

Climate Risk Assessment for Installation	Army	Air Force	Marine Corps	Navy	Total
Yes	-	3	1	-	4
No	-	4	8	10	22

Types of climate threats currently being experienced at the installation:

Types of Climate Threats	Army	Air Force	Marine Corps	Navy	Total
Sea Level	1	11	5	10	27
Rising Temperature	1	8	4	6	19
Melting of ice and permafrost	--	3	--	--	3
Dust storms	2	--	--	--	2
Coastal Flooding	1	9	5	10	25
Riverine Flooding	--	4	3	1	8
Land Degradation	6	4	1	--	11
Heat	5	4	3	--	12
Drought	6	1	2	1	10
Energy Demand	4	3	2	1	10
Wildfires	3	2	2	2	9
Increase in the Number of Ice Jams	--	4	--	--	4
Increase in the Number of Wildfires	3	2	--	--	5
Increase in the Number of Tornadoes	--	2	1	--	3
Increase in the Number of Hurricanes	--	6	6	4	16
Increase in the Number of Ice Storms	--	--	1	--	1
Increase in the Number of Storms with Excessive Rainfall	--	7	2	3	12
Increase in the Severity of Tornadoes	--	2	--	--	2
Increase in the Severity of Storm Surge	--	7	2	4	13
Increase in the Severity of Hurricanes	--	6	2	3	11
Increase in the Severity of Ice Storms	--	--	--	--	--

Note: Beach erosion due to sea level rise is not listed but is and will be a factor on the west coast.

Types of cultural resources on DoD installations that are vulnerable to climate threats:

Types of Cultural Resources	Army	Air Force	Marine Corps	Navy	Total
Buildings	3	11	6	8	28
Structures	3	8	5	9	25
Infrastructure	2	8	5	7	22
Objects	2	2	3	5	12
Archaeological Sites	7	10	6	10	33
Ethnographic Sites	1	4	1	2	8
Sacred Sites/Traditional Cultural Properties	5	1	1	1	8
Historic Districts	3	3	5	7	18
Historic Landscapes	2	5	3	6	16
Burial Sites	3	5	6	7	21

Does the installation have a recent (new or updated within the past 5 years) ICRMP?

Does the Installation Have a Recent ICRMP?	Army	Air Force	Marine Corps	Navy	Total
Yes	5	11	6	6	28
No	3	--	3	4	10

Does the ICRMP address climate adaptation?

Does the ICRMP Address Climate Adaptation?	Army	Air Force	Marine Corps	Navy	Total
Yes	1	9	2	--	12
No	7	3	7	10	27

Is climate adaptation in other installation plans or programmatic agreement?

Is Climate Adaptation in Other Installation Plans or Programmatic Agreement?	Army	Air Force	Marine Corps	Navy	Total
Yes	--	7	2	7	16
No	8	4	7	3	22

The following lists the types of plans or agreement documents in which installations have integrated climate adaptation considerations:

- Installation Air Program – Considers Green House Gas (GHG) emissions.
- National Environmental Policy Act (NEPA) reviews – Considers climate change and its effects on installation resources.
- Sustainability Plan – Addresses the Sustainability Range initiative and climate change impacts and improving water management.
- Base Master Plan – References Climate Change Adaptability and Resiliency (CCAR).
- INRMP – Climate change and adaptation approaches, projects to track plant and wildlife changes.
- Installation Sustainability Strategy – Outlined and addressed long-term solutions for energy demand. The strategy measures and sets future goals for utility/energy consumption, GHG production, solid waste production, and sustainable design/construction best practices.
- Programmatic Agreement and Memorandum of Agreement to include sea level rise concerns, or other climate change-related risks.

The following are the responses to the question "What type of strategies and actions, if any, have already been implemented due to severe climate threats?"

- Marine Corps Base Hawaii (MCBH) Kaneohe Bay – MCBH is in the process of permitting a barrier fence along the ocean-facing side of the North Beach Dunes, which contains the Mokapu Burial Area, to address coastal erosion and to protect the dunes. The base is also mitigating coastal erosion within the boundary of a cultural resources site along the Fort Hase beach shoreline by installing a bio-engineered revetment above the high-water mark. This revetment will protect and stabilize both the shoreline and the site deposits.
- Marine Corps Base Quantico (MCBQ) – MCBQ is working to improve water efficiency through the utilization of recycled water for non-potable use. This is in accordance with the MCBQ *Sustainability Plan, Section 2.2 Improve Water Resources Management*. In addition, to meet the sustainable ranges initiative Goal 6, MCBQ has addressed damage from extreme weather events by relocation training activities, conducting immediate cleanup, and reclaiming areas, where possible.
- Marine Corps Recruit Depot, Parris Island – The Deport is near completion of a Climate Change Adaptability and Resiliency (CCAR) study that addresses a scenario based on conservative sea-level rise (SLR) models from present day to 2065. The Depot will integrate the results of this study into Base Master Planning and future environmental projects. Additionally, the Depot is a part of an Environmental Security Technology Certification Program (ETSCP) pilot for unmanned aircraft system (UAS) that enable evaluation of natural resources. The Depot has planned a Charlesfort-Santa Elena National Historic Landmark shoreline stabilization study for FY21. It will be based on previous studies, the assessment of current conditions, and vulnerable shoreline areas. The

Depot will use the results to develop a draft design to restore shoreline stability. The Depot has also planned an FY22 Archaeological Site Condition Assessment project for 10 National Register of Historic Places (NRHP)-eligible sites. This study will evaluate site damage and potential threats and outline future protection and maintenance efforts.

- Marine Corps Base San Diego (MCBSD) – The MCBSD has installed energy efficient products and photovoltaic (Solar) energy equipment to compensate for energy demands.
- Marine Corps Air Station Beaufort (MCASB)– The MCASB is incorporating storm surge modeling into a project for the new fuel pier. An erosion control project is also underway to repair and prevent further erosion in an area adjacent to a cultural resources site. Sever rain and hurricanes have compounded the severity of the erosion.
- Marine Corps Installations East Camp LeJeune – Camp Lejeune has made changes on historic and non-historic buildings that include the replacement of asphalt shingles to standing seam metal roofs; shoreline stabilization in some erosion-prone areas; and application of water-proof coatings on masonry walls as climate adaptation measures.
- Marine Corps Base Camp Pendleton (MCBCP) – Through the Archeological Conditions Assessment and Site Monitoring (CASMET) Program, the MCBCP has evaluated individual archaeological sites to determine if they require stabilization projects. Some archaeological sites near rivers subject to erosion received stabilization projects. There are approximately 100 more sites to be evaluated.
- Homestead Air Reserve Base (HARB) – HARB personnel are actively involved in the ongoing Biscayne Bay Southeastern Everglades Restoration (BBSEER) efforts which seek to, restore freshwater wetlands near the installation. Wetland restoration would provide a natural coastal buffer which would protect the installation from storm surge during extreme weather events. HARB submitted a Readiness and Environmental Protection Integration (REPI) proposal for the FY21 grant cycle and is seeking to partner with local conservation organizations to accomplish mutually beneficial freshwater wetland restoration goals.
- Offutt Air Force Base (AFB) – The Air Force is rebuilding after the flood of 2019 to include future flood prevention measures. Changing the heights of the rebuilt structures and raising the locations of electrical boxes have been a focus of these measures.
- Joint Base Elmendorf Richardson (JBER) – JBER has increased monitoring and vegetation management for trees killed by spruce beetles (clearing and removing affected trees). JBER also conducts regular controlled burns in training areas. JBER started shoreline monitoring and a measurement project in 2020. The Natural Resource Program has multiple projects that monitor changes in plants and wildlife (i.e., salmon, beluga, waterfowl, migratory birds, alpine plants, and water quality).
- Arnold AFB – Arnold AFB is experiencing increased rainfall that could result in increased erosion of archaeological sites at the base. However, the AF maintains the sites

in forested cover or no-till crops year-round to prevent erosion. The AF monitors site conditions to determine any negative impacts. Drought should not impact the archeological sites unless it is so sever that vegetation cannot survive.

- Fort Bliss Directorate of Public Works Divisions – The Army collaborated to identify historically-compatible roofing material for numerous high-profile buildings within two historic districts on the installation. Over the past three years, the Army has installed a new roofing system that withstand increased wind speeds up to 130 miles per hour on a total of 29 buildings contributing to these historic districts. These new roofs allow the buildings to better handle the increasingly severe windy seasons during the spring months each year.
- Fort Bliss Historic Architecture Program – In coordination with the Sustainability & Energy Division, the Army looks for opportunities to reduce water usage by xeriscaping landscapes that have high water demands (primarily turf). Fort Bliss Historic Architecture Program recommends the use of light-emitting diode (LED) lighting to provide energy efficiency without compromising the character of the historical building/district. This is achieved by utilizing modern fixtures which complement the architectural style of the resource, or by retrofitting the existing fixtures to accommodate the new LED lamps.
- Fort Irwin – This installation has already experienced extreme storms and weather events. There is the expectation of more extreme weather events that could include excessive (for a given time period) rainfall, high winds and dust, flooding of buildings in low-lying areas, and more extreme temperatures. Fort Irwin is currently pursuing climate control measures for their curation facilities that will take into account the potential for more extreme temperatures.
- Tooele Army Depot uses fire breaks as a measure to control wildfire.
- US Army Garrison (USAG) Presidio at Monterey – The USAG Presidio of Monterey encompasses nine (9) dis-contiguous "sub-installations" spanning 5 counties across California. Each "sub-installation" has a different level of potential climate threats; however, all can be impacted by wildfire, drought (especially regarding the local water purveyor and policies around this issue depending on the installation) and energy demand issues (specifically due to the electricity provider, Pacific Gas & Electric (PGE), a company that has been shutting off power across the state in order to avoid further catastrophic wildfires which have been linked to PGE faulty equipment). Actions taken with regard to water at their installations in Monterey County include implementing low impact development, installing low flow to 0-flow fixtures; installing purple pipe (even in historic buildings) and cisterns to reuse water. For wildfire, the Monterey installation is working with the local community to allow staging and safe passage through the installation if required (this installation bi-sects Monterey and there are only two ways around the installation). For land degradation, the Monterey installation has an erosion issue affecting a NRHP-listed site with Native American Graves Protection and Repatriation Act (NAGPRA) concerns. The Army is continuing to work with

the City (who leases/manages the property), federally recognized tribes, and other interested stakeholders to develop a solution to this issue.

- Joint Base Langley-Fort Eustis – The installation's cultural resources program has developed and implemented an archaeological site monitoring program that measures and documents the rate of erosion on sites. The installation had an archaeological site management study conducted of thirty-one archaeological sites that are impacted by erosion. That study developed a scoring system of erosion risk and outlined potential corrective actions. The installation has developed and implemented temporary stabilization techniques to delay erosion on archaeological sites that are awaiting NRHP evaluations or stabilization. The installation has programmed funds to develop a "hybrid living" shoreline to stabilize a site known to contain Native American burials. The archaeological site management study, data from the archaeological site monitoring program, and several academic conference papers and posters on the topic are available.
- Oliktok Long Range Radar, Alaska – The road paralleling the shore from the oilfield/ desalination plant infrastructure area to the radar site washes out regularly and has been rebuilt/ repaired a number of times. A new road will be built further inland. Since there is less shore ice to protect the land in the fall/summer/ spring, coastal erosion has become an issue. Archaeological and ethnographic sites which were located along the shore eroded out many years ago. The Inupiat cemetery may be at risk in the coming years. Buildings that contribute to the historic Distant Early Warning (DEW) system of radars may also be at risk in the coming years and these buildings are still used for radar so are critical to the mission.
- Eareckson Air Station, Alaska – This installation has archaeological sites, a cemetery, and World War II features along the shoreline, as well as facilities, which are subject to heavier wave action and severe storms. Most recently the pier and sewage plant have suffered damage. The pier requires major repairs more often. Coastal archaeological sites and a small Unangan (Aleut) cemetery are also at risk.
- Cape Lisburne Long Range Radar Station (LRRS), Alaska – The USAF is building a seawall to protect the runway along the shore at Cape Lisburne LRRS. The runway has been subject to flooding in recent years, and an ethnographic/archaeological site borders the runway.
- Barter Island Long Range Radar Station (LRRS), Alaska – The State of Alaska moved the airport inland from where it had previously been located on the shoreline. The Barter Island LRRS is close to the City of Kaktovik, an Alaska Native community. The old runway was previously the site of the early 20th century village of Kaktovik and an ancient Thule period site (about 400 years old). Historic sites include archaeological sites, the early 20th century Kaktovik village(s), and the Cold War-era DEW radar site. There is no longer enough shore ice to protect the shore in fall, winter, or spring.
- MacDill AFB – This AFB has an INRMP, Installation Complex Encroachment Management Action Plan (ICEMAP), Installation Energy Plan (IEP), and

Installation Emergency Management Plan (IEMP).

- Navy Air Station Oceana, Norfolk, Virginia – In 2019, a Virginia Beach Joint Land Use Study was completed to specifically address current and future challenges related to tidal flooding and sea level rise.
- Navy Base Coronado (NBC) – Based on feedback from the installation, DoD Strategic Environmental Research and Development Program (SERDP) project RC-2644 looked at the vulnerability of military installations in the Pacific Basin to coastal flooding under climate change and developed best management plans. There are also a few sea level rise projects proposed by the Navy Region Enhanced Readiness Team. The NBC and San Clemente Island (SCI) INRMP has a section on climate change. The SCI Biosecurity Plan covers sea-level rise at the installation. A memorandum of understanding (MOU) signed between Commander Navy Region Southwest (CNRSW), and the Port of San Diego (SD) agrees to share information regarding sea level rise as a Topic of Concern. Much of the planning for sea level rise happens at the regional level and includes the shoreline installations. Any sea-level rise-related planning encompasses cultural resources assets without specifically identifying the resources; however, the plans do not consider specific needs or possibilities for at-risk cultural resource assets.
- Navy Base Point Loma – The INRMP has a section on climate change. The Installation Development Plan (IDP) UFC/Consistency Guide has a section on Planning Opportunities and Constraints, which includes a section on Climate Change and Environmental Influence.
- Navy Region Hawaii (Joint Base Pearl Harbor-Hickam, Pacific Missile Range Facility [PMRF]) – Climate threats from coastal flooding, storm surge and wildfires at Joint Base Pearl Harbor-Hickam and PMRF have exposed buried cultural deposits and damaged coastal archaeological sites such as historic fishpond walls. Actions to control these threats include stabilizing the fishpond walls and placing geotextile fabric on top of the coastal dune. Drought conditions at Lualualei Naval Magazine have increased the number of wildfires. Actions included documenting exposed archaeological sites.
- Navy Indian Head – Climate change activities include shoreline stabilization and phase II archaeological studies, and site approvals for the location of new facilities.
- Navy Guam/Andersen AFB – The CRM initiated a 2-meter contour map of the installation topography and coastline in order to assess coastal erosion due to rising sea levels. The exercise concluded that archaeological sites on Andersen AFB are generally not affected by current sea levels due to the sites being largely set back sufficiently from the tidal zone. In general, sites and historic properties on Andersen AFB are not affected by the same environmental disturbances as those on other Naval Base sites on Guam, due to the location of the majority of Andersen's resources high on a limestone plateau. However, tidal changes may eventually affect coastal sites at some time in the future, and increased risk of severe typhoon could threaten any of Andersen AFB's resources. There has been a proposal

to merge the ICRMPs of AAFB and Naval Base, as both needs updating; however, the different potential effects of climate change to the topographies of the two different installations should be considered if this option is chosen.

Attachments

The following information was included in the questionnaire submission from two of the installations. MCBH provide the draft language and recommendations that it will be adding to its ICRMP updated. Cape Canaveral AFS (CCAFS) provided notes about their participation in the Dune Vulnerability Team and the resulting plans for documenting three National Historic Landmark launch complexes. This information is presented below as it was provided in the questionnaire and is not summarized or edited.

MCBH has added the following draft language and recommendations to its forthcoming updated ICRMP Draft 2:

According to DoDI 4715.21, the DoD must be able to adapt current and future operations to address the impacts of climate change in order to maintain an effective and efficient U.S. military. Mission planning and execution must include:

a. Identification and assessment of the effects of climate change on the DoD mission.

b. Consideration of those effects when developing plans and implementing procedures.

c. Anticipation and management of any risks that develop as a result of climate change to build resilience.

MCBH contains diverse types of historic properties, including archaeological sites, buildings, structures, districts, burial sites, and resources with traditional or religious importance to Native Hawaiians Organizations. These historic properties are resources of value to a variety of stakeholders and are at risk from changing climatic conditions. MCBH CRMs need to adapt and incorporate new management strategies into their stewardship planning. All of these threats have the potential to cause increased maintenance needs or shorten the life and usability of historic buildings and facilities. This would result in increased maintenance and replacement costs, diverting funds away from other mission-critical projects, and may impact training lands and facilities. MCBH CRMs would have increased compliance burdens, and irreplaceable historic resources and archaeological sites could be destroyed and lost. In 2020, a Senate Armed Service Committee Hearing identified the most vulnerable DoD installations to the effects of climate change, and MCBH was identified due to climate threats from hurricanes, sea level rise, and flooding. The potential effects of climate change on MCBH plans and operations include an altered, limited, or constrained environment for military operations due to increased inundation, erosion, and flooding damage, as well as changing historic building heating and cooling demand, affecting installation energy intensity and operating costs.

Effective adaptation planning will ensure the continued availability of historic properties at MCBH so that Marines can train and operate today and into the future. As appropriate, MCBH will seek refinements to existing processes and develop new climate-specific plans and guidance:

- The DoD's Cultural Resources Management Policy (DoDI 4715.16) should be updated to incorporate consideration of potential climate change impacts in the management of installation cultural resources.
- The USMC Guidance for Completion of an ICRMP Update should provide specific direction for how this ICRMP should incorporate climate change.
- Climate change considerations should be documented in the MCBH ICRMP using this guidance, and be coordinated with the appropriate regulatory agencies, Native Hawaiians Organizations, consulting parties and stakeholders.
- MCHB CRMs should engage in effective collaboration with internal and external stakeholders for planning climate change adaptation and emergency response.
- MCBH CRMs should utilize the updated installation master plan, which includes 1) an assessment of the risks from extreme weather and climate change effects that are specific to the installation; and 2) plans to address those risks as appropriate to identify risks to historic properties, for their vulnerability assessments.
- MCBH CRMs should follow the NPS Climate Change Response Strategy for adaptation to and mitigation of climate change effects on historic properties by 1) completing an inventory of historic properties at risk and conducting vulnerability assessments; 2) prioritizing and programming funds for implementing actions to minimize risk to historic properties from climate change and monitoring the results; and 3) integrating climate change mitigation measures into cultural resource management planning.

Cape Canaveral AFS (CCAFS) Notes:

1. In the early 2000s the 45 SW participated in the Dune Vulnerability Team which consisted of personnel from NPS, US Geological Service (USGS), University of Florida, National Aeronautics and Space Administration (NASA)/Kennedy Space Center (KSC) and the 45 SW. The purpose was to address coastal erosion from hurricanes which was threatening the shoreline along Volusia County and Brevard County. The study showed a significant loss of shoreline with the most vulnerable section paralleling ICBM Road which was our "missile row" containing 3 NHL launch complexes. A second study was conducted of the CCAFS coastline in 2015 by the USGS.
2. In 2015 at my request I conducted a teleconference with representatives from KSC, NPS, Florida SHPOs, the THPOs (none of the three attended), and the ACHP. We discussed climate change and its effect on the historic launch complexes and other historic structures on CCAFS. I stated it was the 45 SW's position we were not going to invest in stabilization of structures that will be destroyed by climate change within the next 25 years. It was not a prudent expenditure of funds. We agreed the best plan moving forward was intensive documentation and I am currently working on a Programmatic Agreement. At the same time, we are finishing evaluating all the structures on CCAFS. The intensive documentation consists of high-definition 3D laser scanning, historic building surveys, HABS/HAERs in some cases, completion of Florida Master Site File forms, and other methods. Most of the work has been done except evaluation of 100 remaining facilities and the laser scanning. Projects have been created

and programmed through FY 2030 for the intensive documentation and are listed below.

FY 2021

- Digital Laser Scanning, Spatial and Reality Capture Documentation of Cape Canaveral Lighthouse
- Digital Laser Scanning, Spatial and Reality Capture Documentation of Hangar C
- Digital Laser Scanning, Spatial and Reality Capture Documentation of Launch Complex (LC)-26
- Digital Laser Scanning, Spatial and Reality Capture Documentation of LCs 16, 18, and 20

FY 2022

- Digital Laser Scanning, Spatial and Reality Capture Documentation of LC 12, 15, and 30
- Digital Laser Scanning, Spatial and Reality Capture Documentation of the LC 26 Gantry
- Digital Laser Scanning, Spatial and Reality Capture Documentation of the LC 5/6 Spin Test Facility (8BR3052)
- Digital Laser Scanning, Spatial and Reality Capture Documentation of Hangar S

FY 2023

- Digital Laser Scanning, Spatial and Reality Capture Documentation of the Hangar Y Area (8BR3923)
- Digital Laser Scanning, Spatial and Reality Capture Documentation of the Missile Assembly Checkout Area (MACA) (8BR3533)
- Digital Laser Scanning, Spatial and Reality Capture Documentation of the Naval Ordnance Test Unit Support Area Historic District (BR3926)

FY 2024

- Digital Laser Scanning, Spatial and Reality Capture Documentation of the Integrate-Transfer-Launch (ITL) Area (8BR3923)

FY 2025

- Scan NRHP Eligible Facilities within the CCAFS Industrial Area-Year 1
- Scan Delta II Processing Areas

FY 2026

- Scan NRHP Eligible Facilities within the CCAFS Industrial Area-Year 2

FY 2027

- Scan CCAFS Fuel Storage Areas

FY 2028

- Digital Heritage Visualization and Interpretation Campaigns for CCAFS. Note: The regulatory agencies agreed they didn't want documents or files that sat on a shelf. They wanted included in any agreement that there would be a public engagement and public education component.

FY 2029

- Digital Laser Scanning, Spatial and Reality Capture Documentation of the Skid Strip

Completed Projects 2008-2020

- Digital Laser Scanning, Spatial and Reality Capture Documentation of LC-1/2/3/4
- Digital Laser Scanning, Spatial and Reality Capture Documentation of LC-21/22
- Digital Laser Scanning, Spatial and Reality Capture Documentation of LC-31/32
- Digital Laser Scanning, Spatial and Reality Capture Documentation of NHL LCs 14, 19 and 34
- Digital Laser Scanning, Spatial and Reality Capture Documentation of Facility 49800
- Digital Laser Scanning, Spatial and Reality Capture Documentation of Area 55
- Digital Laser Scanning, Spatial and Reality Capture Documentation of CCAFS historic cemeteries

1. In conjunction with historic properties documentation the archaeological resources are being documented and the proposal for intensive documentation of these resources are addressed in the attached proposal and has resulted in the creation of the Cape Canaveral Archaeological Mitigation Project.
2. With the increase and intensity of hurricanes, tropical storms, and nor'easters we have begun a program of conducting beach surveys after each storm event. We have seen an increase in the amount of historic missile debris as well as prehistoric artifacts and fossil material washing up on the beaches.
3. Since CCAFS is on the coast and there is the potential of a catastrophic storm event a four-year project designated Digital Laser Scanning, Photogrammetry, and Imaging of Archeological Collections and Artifacts, Cape Canaveral Air Force Station, Florida. This will scan and recreate a virtual curation facility of artifacts recovered on CCAFS.

APPENDIX C
ICRMP CLIMATE ADAPTATION WORKSHEETS

ICRMP Adaptation Planning Worksheets

The following worksheets support installation-level application of the ICRMP planning process and are modeled after the worksheets in the Climate Adaptation for DoD Natural Resource Managers (Stein et al. 2019). They provide a structured means for managers to gather, evaluate, and analyze adaptation-relevant information. The worksheets are designed to build on and draw from one another with earlier sections in the process informing subsequent worksheets. Because adaptation planning is an iterative process, the worksheets also provide an opportunity to "show your work" to document decisions and facilitate future assessments or refinements.

The worksheets are intended to serve as an aid for carrying out adaptation planning; they are not intended to be prescriptive. Although the worksheets are designed to be used sequentially, users should not feel compelled to fill out all of the worksheets or each cell in a given worksheet. Additionally, the level of detail that users entered into the worksheets may vary, depending on the availability of relevant information, and on whether the worksheets are being used to inform a preliminary screening of adaptation needs and options, or to support in-depth decision-making and allocation of resources. Users may adapt or modify these worksheets (for instance, adding additional rows or columns) to support the planning needs of particular installations most effectively.

Managers may also find it useful to initially focus on a limited number of resources, risks, or strategies and keep a "parking lot" of items to address in subsequent passes through the adaptation planning process. At any point in filling out the worksheets, do not linger—for instance, due to incomplete information or knowledge—instead, make an informed conjecture (documenting assumptions) to keep moving through the planning process. Should additional information become available, then revisit and refine the relevant worksheet and outcomes.

ICRMP Worksheets

The point of the worksheet exercise is to consider the resources, the mission and what is realistic climate change adaptation strategies that could realistically be implemented by the installation.

MSWord Worksheets – This Appendix provides worksheets in MSWord for each of the four major ICRMP "sections" described in Chapter 5. The supporting worksheets to use to develop the sections of the ICRMP, and include:

- ICRMP Section 1: Introduction/General Information/Overview
  - Worksheet 1 – Background Information
- ICRMP Section 2 – Installation Profile/ Physical/Natural Setting
  - Worksheet 2 – Climate Concerns and Projections
- ICRMP Section 3 – Installation Areas of Concern/Actions Impacting Cultural Resources
  - Worksheet 3 – Cultural Resources and Climate Risks
- ICRMP Section 4 – ICRMP Goals and Develop Climate Risk Strategies
  - Worksheet 4.1 – Identification of Possible Adaptation Strategies and Actions

- Worksheet 4.2 – Evaluation and Selection of Adaptation Strategies and Actions
- Worksheet 4.3 – Implementation of Adaptation Strategies and Actions

These worksheets were created in MSWord. Due to the software limitation, they have limited pull-down menu function. However, in MSWord, they are more easily integrated into the body of ICRMP, especially if including in an appendix. Users can cut and paste from one worksheet to the next if needed. The worksheet illustrated in this appendix can be used if MSWord is preferred over Excel. Both the MSWord and Excel versions of the worksheets are provided in a separate Appendix C folder.

Excel Worksheets - As stated above, a separate folder is provided that includes the worksheets in Excel and MSWord. The Excel file contains worksheet 2, 3a-c, and 4a-c worksheets with "pull down menu" capabilities. These worksheets are arranged differently (by cultural resource type) compared to the Word versions of the worksheets. Users can manually adjust the height of rows in Excel if needed. Although different than the Excel versions, these worksheets will provide the same data and information outcome to include in the ICRMP.

These worksheets have also been created in Excel to add "pull-down menu functionality." In Excel, the worksheets were re-organized by resource type and include:

- ICRMP Section 1: Introduction/General Information/Overview (MSWord only)
  - Worksheet 1 – Background Information. This worksheet is not included in the Excel versions. Use the Word version since it is text to be integrated in various sections of the ICRMP.
- ICRMP Section 2 – Installation Profile/ Physical/Natural Setting
  - Worksheet 2 – Climate Concerns and Projections – Is provided in the Excel file
- ICRMP Section 3 – Installation Areas of Concern/Actions Impacting Cultural Resources – This is organized by resource type
  - Worksheet 3a – Historic Resources and Climate Risks for Historic District, Cultural Landscape and Ethnographic resources
  - Worksheet 3b – Cultural Resources and Climate Risks for Archeological resources
  - Worksheet 3c – Cultural Resources and Climate Risks for Historic Buildings and Structures
- ICRMP Section 4 – ICRMP Goals and Develop Climate Risk Strategies – the three worksheets are merged into one and organized by resources type
  - Worksheet 4a – Strategies and Actions for Historic District, Historic Landscape and Ethnographic resources
  - Worksheet 4b – Strategies and Actions for Archaeological resources
  - Worksheet 4c – Strategies and Actions for Historic Buildings and Structures

Use the appropriate resource type spread sheets. An installation may not be managing all resource types.

The case studies in Appendix D and E and in the Excel file folder provide examples of completed worksheets.

MSWord Worksheets

ICRMP Section 1: Introduction/General Information/Overview

Section 1 sets the context for incorporating climate change considerations into the installation's ICRMP. The Section 1 worksheet is intended to help identify stakeholders and expertise, and available information resources.

Worksheet 1. Planning Scope and Background Information offers a framework for identifying key stakeholders and available information and expertise. Taking climate into consideration often necessitates planning at larger geographic scales and longer time frames than are typically represented in ICRMPs.

Instructions for Worksheet 1.

1. **The Introduction/General Information/Overview (**or comparable) section of the ICRMP is intended to set the overall context for the plan. It usually includes the purpose of the plan, organization of the ICRMP, overview of laws and regulations, cultural resources management, and roles and responsibilities. It may also include a section on relationships to other installation plans and stakeholders. The overview section lays the framework for why climate change is included in the ICRMP.
2. **Stakeholders/Partners:** ***Identify key stakeholders/participants to engage in the adaptation planning process.*** Relevant participants are expected to come from within and outside of the installation. To the extent feasible, identify individuals or specify organizations to engage. Involving knowledgeable climate scientists and other relevant experts early on can help installations navigate the process more effectively.
3. **Available Information/Expertise:** ***Compile existing background information and identify available expertise.*** Identify and compile any existing studies or resources for understanding regional or local climate projections and cultural resource responses. Existing information can include regional climate summaries, such as included in the National Climate Assessment, state-level assessments, and other adaptation plans. Many state and federal agencies and universities have climate science and adaptation experts available. Chapter 4.2 and Appendix A of the guidance manual offer starting points for available information.

Worksheet 1. Background Information

Section of ICRMP – Introduction/General Information/Overview:

Section number(s) in existing ICRMP (these could be all under one section heading or slightly different section headings):

In the following bullets, add the appropriate section number and draft statements to be added to those sections of the ICRMP. Pick from statements provided or write new ones:

- Purpose of the Plan section #_____.

Add statements about preservation and /or management in a dynamic environment.

_____

New threats to cultural resources are emerging from climate-driven changes in the environment, which could compromise the capacity of military facilities and lands that support the military mission. This updated ICRMP includes adaptation strategies for managing these risks. _____
_____
_____
_____

- Goals and Objectives is in section #_____.

Note: May need to work through additional worksheets prior to developing plan goals.

Assess emerging risks and vulnerabilities to cultural resources from climate-driven changes in the environment.

Incorporate climate risk strategies into best management practices and into the cultural resources management program. Share information with other departments on the effects of climate change on cultural resources and potential strategies to counter these effects.

_____

- Organization of the ICRMP section #_____.

Add statements about where specific information can be found. This might include any of the following:

Overview of Laws and Regulations section #_____.

Add overarching climate change Executive Orders, DoD directives, DoD guidance, and Service-specific guidance. Descriptions can be found in Sections 2.1 (DoD directives and Executive Orders); and Service-specific guidance in Section 4.1.

Select the appropriate requirements to be added to the ICRMP:

Executive Orders, DoD directives, DoD guidance

- ☐ Executive Order (EO) 13653, 1 November 2013, *Preparing the United States for the Impacts of Climate Change*
- ☐ EO 13693, 19 March 2015, *Planning for Federal Sustainability in the Next Decade*
- ☐ EO 14008, 27 January 2021, *Tackling the Climate Crisis at Home and Abroad*
- ☐ DoD Directive 4715.21, *Climate Change Adaptation and Resilience* (2018)
- ☐ *DoD Roadmap* (DoD 2014)
- ☐ Updated Unified Facilities Criteria (UFCs)
- ☐ Other _____
- ☐ Other _____
- ☐ Other _____

Service-Specific Guidance on Climate Adaptation

- ☐ Army Climate Resilience Handbook, 2020
- ☐ NAVFAC Climate Change Planning Handbook Installation Adaptation and Resilience, 2017
- ☐ Air Force Civil Engineer Severe Weather/Climate Hazard Screening and Risk Assessment Playbook, 202

Relationships to Other Installation Plans section #_____.

These plans would include master plans, sustainability plans, INRMPs, range management plans, and/or building maintenance procedures. The two most likely plans are the INRMP and facilities maintenance plans. These other plans will identify program goals and strategies. Some of these goals and strategies may be applicable to cultural resources. For example, restoring the function of a wetlands may reduce erosion of an archaeological site. However, some goals or strategies may conflict with cultural resources management goals. For example, installation of a seawall may impact submerged cultural resources, or replacing the siding on a historic building could impacts its eligibility for listing in the NRHP. It is important for the CRM to work with other program leads to ensure common goals and that program-specific strategies to not conflict or inadvertently inflict harm to other resources or program areas.

Review of any climate-related assessments carried out for other installation planning processes, and any strategies developed. Complete the following table with relevant plans. Delete those that are not appropriate. This process can be time consuming, so users may want to focus on the most relevant for an installation. If more archaeological sites, the INRMP may be a good start. If most historic buildings and structures, the maintenance plans may be more important. Also, the State Historic Preservation Office may have climate change guidance for cultural resources.

In some cases, these plans may already be included in the installation ICRMP and describe relationship to cultural resources management. Add a statement describing any climate strategies that might benefit cultural resources management.

Relationship to Other Plans		
Plan Title/ Originating Department	**How it relates to CR management** *Identify plan goals and strategies that are applicable to cultural resources management.*	**Does plan address climate change and Strategies?** List any strategies that would be appropriate for cultural resources.
Integrated Natural Resources Management Plan (ICRMP)		
Building Maintenance Plans		
Sustainability Plan.		
Range Management Plans		
Installation Master Plan		
State Climate Change cultural resources strategy		
Others		

- Cultural Resources Management Responsibilities section #_____.

Add additional Cultural Resources Manager's responsibilities those that apply. Add any additional responsibilities or edit those below as needed:

- Assess climate change risks and threats to cultural resources.
- Discuss climate vulnerabilities and risks with installations planners, engineers, maintenance personnel, range managers, natural resources managers, and tenants.
- Assist with developing strategies to manage climate change risks with installation planners and managers.

- Stakeholders section #_____.

The ICRMP should already identify stakeholders with cultural resources interests. This step would be to identify additional key internal and external stakeholders for assessing climate impacts and carrying out adaptation planning. This step can also be to add the subject of climate change and potential impacts into the existing dialog with current stakeholders. Both internal and external partnerships provide an important mechanism for acquiring expertise, building capacity for climate adaptation, and implementing climate adaptation strategies in the ICRMP. Implementation of climate adaptation initiatives can benefit greatly from the subject matter expertise of other federal and state agencies and other non-governmental organizations.

Collaborative partnerships with internal stakeholders can also greatly facilitate the implementation of climate adaptation projects. The expertise of internal stakeholders in their subject matter will be crucial for identifying opportunities to adapt to climate change. For example, facilities engineers may have innovative ideas about reducing erosion under the threat of increasing storm intensity. Leveraging these types of projects may provide an engineered solution for preservation or restoration projects.

- Internal stakeholders could include personnel from public works, facility maintenance, range control, environmental programs (natural resources), and emergency responders. Educate internal stakeholders on plans and strategies, what to look for as far as resource degradation, and who to contact. Also provide training on what to do and not do during emergencies and what to do post-emergency. Maintenance staff may have input on current climate effects to historic structures, buildings, and infrastructure.
- External stakeholders include the SHPO, neighbors, communities, and tribes and Native organizations. Develop strategies and inform the stakeholders on approaches and strategies. If the installation is engaged in on-going, periodic consultation meetings or other forms of regular communication, the CRM can use these forums to inform stakeholders of climate change concerns and risk-reduction strategies. If a strategy or action falls under the definition of an "undertaking" as defined in 36 CFR 800.16, consultation is required with the SHPO, ACHP, and tribes. Other opportunities for consultation with external stakeholders would arise during revisions and updates to the ICRMP, or development of a master plan, sustainability plan, INRMP, or range management plan. NEPA and Section 106 of the NHPA have consultation requirements. Some installation may also have annual or ongoing meetings with external stakeholders. These meetings also offer opportunities to discuss climate concerns, strategies, and lessons learned that may also benefit the community.
- Determined that particular cultural resources cannot be saved. Stakeholders can then weigh in on mitigation strategies that benefit the stakeholder group, or plan for the loss.

Stakeholders			
Stakeholder	**Climate Change Interest or Expertise**	**Internal or External**	**POC Information (Name, Email, Phone)**
Public health officials and local emergency planners	Emergency preparedness	External	
NOAA	Climate change forecasting tools	External	
USACE	Coastal hardening; sea level rise strategies	External	

Section 2. - Installation Profile/Physical/Natural Setting

The purpose of this ICRMP section is to identify key climate concerns for the installation and understand how relevant climatic factors are projected to change over time. Installation-specific climate change information may already be available through other plans, such as an Integrated Natural Resources Management plan or Sustainability Plan. This information would be including the section of the ICRMP that describes the installation and its physical and natural setting.

Section 2 is supported by this worksheet:

- Worksheet 2. Climate Risks, Effects and Trends

Worksheet 2. Climate Risks, Effects and Trends assists with documenting the higher-level elements of climate concerns and projections drawing from existing information and forecasting tools (see section 4.1 of the guidance). The amount of detail the installation is able to complete will likely vary. For all factors, be sure to document the source for the specific projections, whether literature, data sets, organizations, DoD offices or analyses, individual experts, in sufficient detail to allow for future validation and updates.

Instructions for Worksheet 2

1. **Key Climate Risks:** ***Identify climate-related change risks of particular concern for the installation.*** These will typically be articulated as the specific threats or impacts of concern (e.g., increased droughts, increased heat, land degradation, and/or increased flooding). Existing regional or local climate assessments may help in identifying climate-related risks that should be of concern to the installation in the context of cultural resource management. See Table 2-1 in guidance for climate change risks.
2. **Climatic Factors:** ***Identify the specific climatic effects associated with those risks.*** These effects should be as specific as possible to an installation and resources. They can include physical variables (e.g., air and water temperature, precipitation, sea level changes, flood levels and frequency, etc.). Depending on the variable it may be appropriate to consider both averages and extremes. NOTE: Some of these will overlap with the identified "climate concerns" (e.g., sea-level rise), whereas others may reflect underlying physical drivers of those impacts (e.g., both changes in precipitation patterns and rising temperatures may contribute to drought; rising average winter temperatures may be a driver of expansion of invasive species). The purpose of identifying the specific climatic effect is to help determine what climate-related variables may be relevant for future projections. To the degree possible, focus on those variables that are relevant to the cultural resources of interest (e.g., the height of storm surge may be more important than timing of storms). See Table 2-1 in guidance for climate effects.
3. **Describe climatic change trends:** ***Based on current available information, what are the trends and future projections for the climatic factors identified in column 2 of the worksheet.*** Section 4.2 of this guide includes resources for gathering this information. The DCAT, in particular, provides a screening-level exposure assessment of DoD installations for eight different climate-related hazards (including installation exposure to coastal and riverine flooding, drought, desertification, wildfire, and permafrost thaw).

Trend. Knowing the directionality or trend of a climate factor can be informative, even without detailed projections of rate or magnitude. If possible, indicate the trend or directionality (e.g., hotter/cooler, drier/wetter, more variable, shift in seasonality). To the degree possible, note how these climatic factors are projected to change in the future. Such projections usually will be derived from existing sources. Multiple scenarios of future conditions are often appropriate (e.g., low vs. high), as are projections for different timescales (e.g., 30–50 years vs. 70–100 years). However, if possible, use the same timescales for each climate risk in order to prioritize strategies.

4. **Indicate whether or not the installation has completed a climate change assessment.** If so, indicate where this information is available and use that information to describe future climatic conditions. It would be beneficial to copy the information from the previous assessment into the Natural Setting section of the ICRMP if not done already.

Worksheet 2. Climate Risks, Effects, and Trends

The following information should be included in Section #_____ of the ICRMP.

Provide description from previous or current climate assessment. This worksheet can be inserted as a table and also included to summarize the risks and trends.

Worksheet 2. Climate Risks, Effects, and Trends		
Has the installation completed a climate change assessment? Note: If yes, indicate where the results are available.	Example: INRMP	
Information Sources List sources of information used to fill in this table.	Website, Other installation plan, etc.	
Key Climate Change Risk *What is the key climate change–related risks or threats to the installation, and more specifically for the cultural resources? See table 2-1.*	**Climatic Change Effects** *What are the climatic effects related to those concerns that are relevant for the installation and the resources being managed? See table 2-1 (Best to copy from table to select all that apply.)*	**Trend/Projections** *What is the trend or directionality for this factor, if known? What are available projections for this variable?* *Notes: Knowing the directionality or trend of a climatic factor can be informative, even without detailed projections of rate or magnitude.* Use consistent timeframes for each climate risk if possible.

Section 3 - Installation Areas of Concern/Actions Impacting Cultural Resources

The purpose of Section 3 is to identify target cultural resources; describe internal and/or external threats on the installation's cultural resources; assess the impacts of the resulting climate vulnerabilities to those resources; and finally, determine how those resource vulnerabilities may pose risks to the installation's ability to sustain specific military mission requirements.

Instructions for Worksheet 3

1. **Installation Cultural Resource(s):** List the cultural resources to be assessed for climate vulnerability. Cultural resource may be archaeological sites, building, structures, historic districts or landscapes, or items. The resources identified here should reflect resources that are of particular management concern for exposure to climate change.

   Notes: Users may want to consider listing each resource in a separate row or grouping like resources. Archaeological sites that are grouped geographically and exposed to similar climate risks could be bundled on one line. Users can add additional lines as needed. Users may also need to add a single resource on multiple lines to identify all climate risks to that single resource. Word pull-down menu function is limited to one selection pr line.

2. **Key Climate Change Risk:** For each of the cultural resources listed, identify the key climate change–related risks or threats to this cultural resource. Chapter 4 of this guide present the types of climate-related risks to DoD cultural resources, including archaeological sites (Table 4-1); buildings and structures (Table 4-2); and historic landscapes, historic districts, and ethnographic resources (Table 4-3). Understanding the risk and potential consequences to cultural resources will allow managers to determine appropriate strategies for addressing the impacts.

3. **Climate-Related Impacts:** For each resource listed, identify the impacts that may occur due to the climate change risk. This information may be derived from Tables 4-1 through 4-3 in Chapter 4 of this guide, as well as through input from resource experts both within and outside of the installation, and existing vulnerability assessments or other scientific literature.

4. **Degree/Reason for Vulnerability:** Estimate the relative degree of vulnerability for individual cultural resources and describe why they are considered vulnerable. Being specific about the reasons a resource is vulnerable will be useful in identifying possible risk reduction approaches and developing management responses. To assess vulnerability, estimate how and to what degree the resource would be affected by and respond to expected climate-related changes (sensitivity), and estimate the degree to which the cultural resource is likely to be subjected to the change to which it is sensitive (exposure). What is the overlap between the threat and the exposure? For example, buried archaeological sites may be highly sensitive to flooding, but if it is found outside current and projected flood zones on the installation, it would not be considered vulnerable to that threat.

5. **Military Mission Risks from Cultural Resource Vulnerabilities** links the risks and vulnerability of cultural resources to the sustainability of military mission and its requirements. Based on the cultural resource

vulnerabilities identified in the worksheet below, consider what effect these vulnerabilities may have on the mission requirements. Although there may be direct climate impacts affecting the installation's ability to meet its mission (e.g., temperatures too hot for training, wind damage to structures), the focus here is how climate-vulnerable cultural resources may pose risks to the mission. This could be high, medium, low, or no risk. In worksheet #4, users may choose to only carry forward the high and medium rated items. This could be due to limited funding or manpower to carry out a strategy. Describe how the cultural resource is important to the installation's military mission. For example, historic coastal infrastructure could be used for vital training, or the military logistics activities.

Complete the worksheet and include in Appendix ____.

Worksheet 3A. Archeological Resources and Climate Risks				
Cultural Resources *What are the cultural resource features (e.g., archaeological sites, buildings, historic district) that are managed at the installation?*	**Key Climate Change Risk** *What is the key climate change–related risks or threats to archeological resource? See Table 4-1 in guide.*	**Climatic Change Impacts** *What are the climatic factors or variables related to those concerns, and which are relevant for the installation and the resources being managed? See Table 4-1 in guide. (Best to copy from table to select all that apply.)*	**Degree/Reason for Vulnerability** *Rate the relative vulnerability (e.g., Very High, High, Medium, Low) and describe the reason for that rating.* It also may be useful to highlight any uncertainties in the assessment.	**Risks to Installation Mission Requirements** *Is the preservation of this cultural resource important to sustaining military mission?* *How might this cultural resource vulnerability affect the ability of the installation to deliver its military mission (e.g., training, testing, access, house important function, etc.)?*
Notes: List each resource on a separate row below. *Archaeological sites that are grouped geographically and exposed to similar climate risks could be bundled on one line.* *Add additional lines as needed* *May need to add single resource in multiple times to identify all climate risks to a single resource. Word menu function limited to one selection.*	*Word has very limited function for drop down. Only one item can be selected from a drop-down menu.*	*Table 2 contains numerous potential impacts per risk to choose from.*		
	Choose an item		Choose an item	Choose an item
			Reason	How is it important to mission
	Choose an item		Choose an item	Choose an item
			Reason	How is it important to mission
	Choose an item		Choose an item	Choose an item
			Reason	How is it important to mission

Worksheet 3B. Historic Buildings and Structures and Climate Risks				
Cultural Resources *What are the cultural resource features (e.g., archaeological sites, buildings, historic district) that are managed at the installation?*	**Key Climate Change Risk** *What is the key climate change–related risks or threats to historic building and structures? See Table 4-2 in guide.*	**Climatic Change Impacts** *What are the climatic factors or variables related to those concerns, and which are relevant for the installation and the resources being managed? See Table 4-2 in guide. (Best to copy from table to select all that apply.)*	**Degree/Reason for Vulnerability** *Rate the relative vulnerability (e.g., Very High, High, Medium, Low) and describe the reason for that rating.* It also may be useful to highlight any uncertainties in the assessment.	**Risks to Installation Mission Requirements** *Is the preservation of this cultural resource important to sustaining military mission?* *How might this cultural resource vulnerability affect the ability of the installation to deliver its military mission (e.g., training, testing, access, house important function, etc.)?*
Notes: List each resource on a separate row below.	Add additional lines as needed.	*Table 2 contains numerous potential impacts per risk to choose from.*		
	Choose an item		Choose an item	Choose an item
			Reason	How is it important to mission
	Choose an item		Choose an item	Choose an item
			Reason	How is it important to mission
	Choose an item		Choose an item	Choose an item
			Reason	How is it important to mission

Worksheet 3C. Historic Landscape, Historic Districts, or Ethnographic Resources and Climate Risks				
Cultural Resources *What are the cultural resource features (e.g., archaeological sites, buildings, historic district) that are managed at the installation?*	**Key Climate Change Risk** *What is the key climate change–related risks or threats to these cultural resources? See Table 4-3 in guide.*	**Climatic Change Impacts** *What are the climatic factors or variables related to those concerns, and which are relevant for the installation and the resources being managed? See Table 4-3 in guide. (Best to copy from table to select all that apply.)*	**Degree/Reason for Vulnerability** *Rate the relative vulnerability (e.g., Very High, High, Medium, Low) and describe the reason for that rating.* It also may be useful to highlight any uncertainties in the assessment.	**Risks to Installation Mission Requirements** *Is the preservation of this cultural resource important to sustaining military mission?* *How might this cultural resource vulnerability affect the ability of the installation to deliver its military mission (e.g., training, testing, access, house important function, etc.)?*
Notes: List each resource on a separate row below. A historic district could be on one line with important buildings and features identified. May want to list individually, if have differing risks (a building in an area prone to flooding would need different strategies than one in a fire prone area.	Add additional lines as needed.	*Table 2 contains numerous potential impacts per risk to choose from.*		
	Choose an item		Choose an item	Choose an item
			Reason	How is it important to mission
	Choose an item		Choose an item	Choose an item
			Reason	How is it important to mission
	Choose an item		Choose an item	Choose an item
			Reason	How is it important to mission

Section 4: Evaluate Implications for ICRMP Goals and Develop Strategies and Actions to Reduce Climate Risks

The purpose of Section 4 is to help managers evaluate whether and how climate change might compromise the installation's ability to meet key ICRMP goals and objectives, based on the information gathered from assessing the vulnerabilities of target cultural resources and the associated risks to the military mission. This section will also help installations identify, evaluate, and select appropriate adaptation strategies and actions. As stated above, users may carry forward all of the cultural resources, or just those that are of high and medium risk to military mission.

Section 4 is supported by three worksheets:

- **Worksheet 4.1. Identification of Possible Adaptation Strategies and Actions**
- **Worksheet 4.2. Evaluation and Selection of Adaptation Strategies and Actions**
- **Worksheet 4.3. Implementation of Adaptation Strategies/Actions**

Worksheet 4.1 Identification of Possible Adaptation Strategies and Actions is designed to help managers articulate a range of potential management strategies/actions to address climate-related vulnerabilities to specific cultural resources. The concept here is to be as inclusive as possible and not be constrained by factors such as cost (that comes in Worksheet 4.2). Here, strategies are the broadest level management efforts (e.g., avoidance, minimization, mitigation measures, adopt a historic landscape approach), and actions are specific activities/projects in support of the strategy (e.g., develop maintenance plans, harden a shoreline, relocate a resource, documentation). Managers may identify current management actions, potential modifications to those actions, and/or new actions that may enable the installation to meet climate-informed goals for those resources and then articulate the specific assumptions and rationale for why proposed strategies and actions will reduce relevant risks and vulnerabilities.

As possible adaptation strategies and actions to reduce climate risks are being identified and evaluated, "no action" could also be considered. Depending on the magnitude of risk and level of uncertainty, passive (hands-off) or status quo management may be the most prudent approach.

1. **Risk:** ***Identify the specific climate-related risks to be addressed.*** Copy the specific climate change risk from worksheet 3, column 2 for strategies and actions are being designed.
2. **Adaptation Reduction Strategies/ Actions:** ***Identify potential strategies to reduce the climate risks identified in Worksheet 3.*** Strategies constitute general approaches for addressing a problem, and are supported by specific actions, which are identified in the first and second columns on Worksheet 4.1. Strategies are in Table 4-4 of the guide, although this list is not all inclusive. List all that are feasible.
3. **Project Details:** ***Describe what is to be done. Identify specific projects that would help to achieve the strategies/ action identified under Column 2 in the worksheet.*** Again, the projects identified in this column may include existing efforts, modifications of those efforts, and/or new projects that might be capable of reducing the relevant risks and enabling the installation to meet its climate-informed goals. There may be one or more projects available to support a given strategy. List all the

projects that are appropriate. See Table 4-4 for ideas, although this list is not all inclusive. List all that are feasible. If details are unknown, describe what needs to be accomplished (i.e., prevent erosion.)

4. **Rationale and Assumptions:** ***Describe why a given strategy or action could be effective in addressing the risk or vulnerability.*** Laying out how the strategy/action is designed to reduce a specific risk, along with the assumptions behind that hypothesis, are key for evaluating the likely effectiveness of the strategy in Worksheet 4.2. Additionally, being able to "connect the dots" by linking actions to climate impacts is an overarching principle for effective climate adaptation. Documenting the rational also provides a record of this thought process for future managers and decision makers.

Include this table in Appendix ___ to document thought process.

Worksheet 4.1. Identification of Possible Adaptation Strategies and Actions				
Cultural Resources *Copy cultural resources column (column 1) from worksheet 3 and paste in this column*	**Climate Change Risk** *Copy the specific column 2 from Worksheet 3)*	**Risk Reduction Strategies/ Actions** *What strategies/action could reduce these vulnerabilities and risks? Columns 1 and 2 Table 4-4*	**Project** *What projects could be carried out to realize a given strategy/action? Table 4-4. What is the intention of the project?*	**Rationale and Assumptions** *How is this strategy or set of actions likely to reduce these vulnerabilities or risks?*
	Notes: Describe the specific vulnerability (to cultural resources) or risk (to military mission) to be addressed by the strategy and their associated actions/projects.	*Notes: List possible strategies for reducing the vulnerability or risk. Strategies can be general in nature, since more detailed supporting actions/ projects are listed in the next column. Additional rows can be added if needed.*	*Notes: For each strategy/ action identified in the column to the left, list the project details that could help to achieve its intended risk reduction benefits. Be as specific as possible. These can be existing, modified, or new projects.*	*Notes: Describe why this strategy (and its associated actions/projects) may be capable of reducing the stated vulnerabilities and risks. Note any assumptions or uncertainties.*
	Choose an item	Strategy 1 Choose an item		
		Strategy 2 Choose an item		
		Strategy 3 Choose an item		
	Choose an item	Strategy 1 Choose an item		
		Strategy 2 Choose an item		
		Strategy 3 Choose an item		

Worksheet 4.2 Evaluation and Selection of Adaptation Strategies/Actions/Projects is intended to help installations reduce a broad list of possible actions down to those that are most likely to be successful at reducing climate risks, achieving ICRMP goals, and supporting broader military mission requirements. The intent of this "consequence table" is to identify those strategies or actions that should be considered as priorities for incorporation into the ICRMP and subsequent implementation. A separate worksheet or consequence table can be filled out to evaluate strategies that address each different risks/vulnerabilities. Similarly, users can fill out a separate consequence table to evaluate each different actions that may support a given strategy.

Instructions for Worksheet 4.2

1. ***Focus of worksheet.*** Users can note on the worksheet what the consequence table is being used to evaluate. Users can use the worksheet on a particular risk/vulnerability, comparing potential strategies for reducing that risk. Users can also use the worksheet to carry out a more in-depth exploration of a particular action/project, comparing potential actions or projects that might support implementation of that strategy. As noted above, users can create multiple versions of this worksheet can be filled out, focusing on different risks or strategies, depending on specific installation planning needs.
2. ***List a set of management strategies/ actions/projects for evaluation*** (derived from Worksheet 4.1). Users should insert these strategy/action/ project in the head the columns (i.e., "Strategy/Action/project 1") on the worksheet. Modify the worksheet to include as many columns as needed to accommodate all strategies or actions to be evaluated, including taking no action, if appropriate. These strategies/actions can reflect options where the intent is to select the best among them, or they may reflect a suite of strategies or actions where the intent is to include multiple actions that meet certain criteria.
3. ***Create criteria for evaluating the strategies/actions.*** Insert the criteria for evaluating the strategies/actions in the left-hand columns. Modify the worksheet to include as many rows as needed to accommodate all criteria to be used in the evaluation. Choosing among adaptation strategies will depend on a range of factors, including the installation's particular needs, interests, and resources. Defining explicit criteria for use in evaluation and comparison of alternatives helps clarify what really matters, not just with respect to desired ecological outcomes, but also in terms of other important values or benefits. In particular, it is important to make sure users address risk, tradeoffs, and uncertainties. Illustrative evaluation categories are included on Worksheet 4.2.
4. ***Evaluate and score the strategies/ actions based on agreed-upon criteria.*** Worksheet 4.2 is based on a structured decision-making "consequence table" approach and is designed to help managers evaluate options or alternatives identified in Worksheet 4.1. There are many ways in which to conduct scoring under this approach. For example, rank options on a relative scale (e.g., low, medium, high) for how the options meet the criteria. In these instances, it is important to be clear about whether higher scores are "better" or "worse." For transparency, it may also be useful to qualify one's choice with a reason for choosing the particular rank. This type of "consequence table" is just one

approach for evaluation and comparison of options; installations should feel free to use other approaches based on their existing capacities and planning procedures.

5. ***Determine which strategies/actions merit incorporation into the ICRMP.*** Based on evaluation against the agreed-upon criteria, managers are in a position to select the strategies/actions that best meet their needs and are feasible to implement. Selecting which strategies/actions to include in the ICRMP can be based on a number of techniques, which can range from quantitative techniques (i.e., highest total values) to selecting alternatives that optimize one or more particular criteria. There is no right or wrong way but use of a consequence table such as this allows managers to be transparent and explicit about their selection process. Identify the action to be carried forward.

An example of a completed worksheet 4.2 is included after the blank worksheet.

Include this table in Appendix ___ to document thought process.

Worksheet 4.2. Evaluation and Selection of Adaptation Strategies/Actions/Projects			
Focus of Worksheet: Resource and Specific Risk (create additional tables for each resource and risk)			
Strategy/Action/Project to Evaluate List strategy/action/project to be evaluated in columns at right. These should carry over from Worksheet 4.1. Add columns for additional strategies/actions as needed.	**Action/Project 1**	**Action/Project 2**	**Action/Project 3**
Notes: Choosing among adaptation strategies will depend on a range of factors, depending on the installation's particular needs, interests, and resources. Major categories below are illustrative.			
Criteria for Evaluation Identify and list below relevant criteria for evaluating/comparing proposed strategies-actions/projects. Add rows for additional criteria as needed.			
Effectiveness at meeting climate-informed cultural resource goals/ provide reasoning for choice	Choose an item	Choose an item	Choose an item
Effectiveness in meeting other installation objectives/provide reasoning for choice	Choose an item	Choose an item	Choose an item
Feasibility/provide reasoning for choice	Choose an item	Choose an item	Choose an item
Recommend for Inclusion in INCRMP?	Choose an item	Choose an item	Choose an item

Worksheet 4.2. Evaluation and Selection of Adaptation Strategies/Actions/Project - Example			
Focus of Worksheet: Example: Archaeological and burial site along eroding shoreline – create additional tables for each resource and risk			
Strategy/Action/Project to Evaluate List strategy/action/project to be evaluated in columns at right. These should carry over from Worksheet 4.1. Add columns for additional strategies/actions as needed.	*Action/Project 1*	*Action/Project 2*	*Action/Project 3*
Notes: Choosing among adaptation strategies will depend on a range of factors, depending on the installation's particular needs, interests, and resources. Major categories below are illustrative.	Example: Offset Stress - Hardened the shoreline with riprap (shells or local stone)	Improve resiliency - Construct a seawall	Relocate resource
Criteria for Evaluation *Identify and list below relevant criteria for evaluating/comparing proposed strategies-actions/projects. Add rows for additional criteria as needed.*			
Effectiveness at meeting climate-informed cultural resource goals	High	Medium	Low
	Protect buried graves from erosion	Would protect from future erosion, but may impact some site features during construction	Would impact site
Effectiveness in meeting other installation objectives	High	Medium	Low
	Protect beach training area from erosion	Protect beach training area from erosion	Would not provide any additional protections to natural resources or training area
Feasibility	High	Medium	Low
	Costs relatively low and installation could be a training exercise.	Costs higher	Low to moderate cost depending on mitigation
Recommend for Inclusion in INCRMP?	Best	Adequate	Worst

Worksheet 4.3 Implementation of Adaptation Strategies/Actions provides a general framework to help installations identify: who will carry out the implementation of the adaptation strategies and actions/projects; whether and how the relevant strategies and actions fit within existing DoD program implementation; what decisions are especially relevant to get the strategies and actions ready to implement; and when various element of the strategies and actions should be implemented. The order is to go from strategy to action to projects.

Instructions for Worksheet 4.3

1. **Recommended Strategies/Actions:** ***List the strategies, actions, or projects identified in Worksheet 4.1 for incorporation into the ICRMP.***
2. **Responsible Parties:** ***Identify who has responsibility or needs to be involved in carrying out this action or project.*** For example, can it be done in-house, or will it be done via contract?
3. **Relationship to Existing ICRMP Strategies:** ***Determine whether and how the action or project fits into existing efforts.*** Is the action within the installation's authority or will it fit within an approved project or program?
4. **Project Planning Needs:** ***Identify what needs to be done to get this project ready to implement.*** Note here what would be necessary to put in place prior to projection implementation, such as regulatory permits, funding mechanisms, engineering work, detailed project design, or scientific research to validate the approach or solve technical issues. Are there any unique adaptation barriers to implementing the action or project (e.g., legal, social)?
5. **Timing and Sequencing:** ***Identify when the project is needed or should be carried out.*** Identify when the project should be started. Are there any dependencies that would influence the timing or sequencing of implementation? In some cases, specific dates may be relevant (e.g., start "phase 1" in FY 19). In others, it may be necessary to identify specific management trigger points (e.g., actions to be implemented in response to a specific climate threshold, such as a certain increase in sea-level rise).

Incorporate into ICRMP Implementation Table. Once a project has been adequately defined, incorporate it into the ICRMP's implementation table or the ICRMP Program Planning objectives. Section # 7.1

Worksheet 4.3. Implementation of Adaptation Strategies/Actions					
Cultural Resources *From column 1 in worksheet 4.1*	**Recommended Strategies/Actions** *List selected strategies/ actions recommended for incorporation into the ICRMP (from Worksheet 4.2).*	**Responsible Parties** *Who would have responsibility for or be involved in implementing the strategy/action?*	**Relationship to Existing ICRMP Strategies** *Does this fit within a current ICRMP effort, or is it a new activity/ project?*	**Project Planning Needs** *What preparations or requirements would be necessary before carrying out the recommended strategies/ actions?*	**Timing and Sequencing** *When should the action/project be implemented (immediately or at some future time)?*
		Notes: Identify whether this project could be done in-house, via contract, or through partnering.		*Notes: List permitting, funding, design, methods development, scientific research, etc. Are there any unique implementation challenges (e.g., legal, social, technical)?*	*Notes: Identify when the project should be started. Consider dependencies that may require project sequencing, or any ecological thresholds that may trigger needed action.*

An Airman walks past the 325th Logistics Readiness Squadron materiel management flight warehouse at Tyndall Air Force Base, Florida, which was damaged by Hurricane Michael, March 13, 2019 (Source: Senior Airman Javier Alvarez/U.S. Air Force)

APPENDIX D
ICRMP CASE STUDY

Case Study Notes
2022

Ms. Lisa Bosalet Cultural Resources Manager, Naval Weapons Station Seal Beach, U.S. Navy agreed to participate in a case study. This case study was conducted after preparation of the 50% draft of this guidance document to apply the guidance in a real application and determine what improvements could be made to the information presented and the worksheets.

Ms. Bosalet provided current ICRMPs for Seal Beach, Detachment (Det) Norco, and Detachment Fallbrook. The information from these ICRMPs were used to populate the initial worksheets. When completed, Ms. Bosalet reviewed the draft guidance report and completed worksheets for each of the installations. She then provided comments and ideas for revising the guidance and worksheets. After the review, a site visit was conducted to Seal Beach and Det Norco to field check the worksheet data. From this case study, the worksheets have undergone a major revision. Below are the key results from the case study.

Case Study Results

The CRM commented that the process of reviewing the document and draft worksheet resulted in the CRM considering climate change and effects on resources that had not been considered before. The CRM found the exercise to be quite interesting.

The ICRMP addresses the overarching Cultural Resources Management Program for the installation. The ICRMP may already include monitoring activities, so the CRM would not need to add monitoring again for climate change adaptation measure. So, this type of project may simply be referenced as assisting with climate change adaptation.

It was recommended that the worksheets integrate pull down menus as much as possible. This has been done; however, it required changing to a different software, since MSWord has very limited programing capabilities. Therefore, a second set of worksheets was developed in Excel were developed for those wanting more pull-down menus and linkages. Due to this linkage, the worksheets are in slightly different format than the MSWord version, however, they follow the same step-by-step planning process.

The worksheets are designed to guide the CRM through a process to determine what the climate risks are, if the cultural resources are at risk and how they might be affected (they may not be at this time), and if so, what is an appropriate course of action. If no changes to the current cultural resources management program are proposed, the worksheet can serve to memorialize the current situation, considerations, and justification of the decisions for future comparison purposes.

Cultural resources can be listed in the worksheets individually or lumping them together by type. In some case, lumping the resources together would probably not ideal, since the various resources may have different climate exposures (even at the same installation) and therefore different adaptation solutions. However, listing all resources individually in the tables would be very time consuming if the installation has numerous resources. For example, Fallbrook has upwards of 120 archaeological sites. All of these resources may be susceptible to the same climate change risk and therefore result in the same strategies. In cases where an installation is managing numerous cultural resources, the CRM may want to focus on the resources that are most critical to the mission, or if impacted would impact the mission. The ICRMP has other mechanism in

place to address day-to-day management of the resource.

Cultural resource projects typically need a regulatory driver in order to secure funding. It is unlikely that proposing additional projects for addressing climate change, solely for the purpose of mitigating future potential change, would get funded. So far, climate change is not an action that triggers Section 106, so, again, it would be hard to justify and secure funding for projects solely focused on reducing effects from climate change. This is another reason for targeting cultural resources that are critical for mission; it may be one way to secure funding.

There could be multiple types of documents at an installation that address climate change. Tracking down and reviewing all potential documents would be very time consuming. However, integrating cultural resources management with other climate change projects or programs may provide a way to get funding. The INRMP and maintenance plans are likely the most important document to review for integration opportunities.

GIS may be a good source for information for climate change planning. Resource information and location can be layered with climate vulnerable area to determine resources at risk and type of climate risk.

There are a lot of references in the guidance document included in Appendix A that can be used as resources for ideas and planning. More and more information on this topic is becoming available regularly on-line from numerous agencies and entities.

Case Study Installation Overviews

The information below is summarized from the current installation ICRMPs and discussion with Ms. Bosalet.

Seal Beach Naval Weapons Depot – Navy Weapons Station Seal Beach is located along the coast near Long Beach California. The mission of Navy Weapons Station Seal Beach is to support the Navy's ordnance mission and other fleet and fleet support activities. Navy Weapons Station Seal Beach encompasses approximately 5,256 acres of land with the Seal Beach National Wildlife Refuge occupying about 920 acres. Land-uses include ordnance storage and maintenance facilities; agricultural out-leases (used as buffer lands); Seal Beach National Wildlife Refuge; public-private venture housing; officers' quarters and bachelor enlisted quarters; administrative and support areas; navy golf course; Defense Fuel Support Point San Pedro; and the wharf.

Seal Beach – Wildlife Refuge, 2022 (Source: J. Aaron)

Seal Beach – shell midden, 2022 (Source: J. Aaron)

Navy Weapons Station Seal Beach has six archaeological sites that are eligible or recommended as eligible for the NRHP. The prehistoric sites comprise shell middens, lithic scatters, and shell and lithic scatters. One site, CA-ORA 1502 is an artifact scatter with human remains.

Primary climate change concerns for the installation are sea level rise resulting in inundation and flooding. The archeological site containing human remains is in the wall of the flood control channel adjacent to the perimeter road. If the perimeter road washes out, patrols of the perimeter would be hindered jeopardizing the mission, as well as the archeological site. The other sites are generally not at risk from inundation.

Detachment Norco – DetDet Norco is located in the City of Norco, Riverside County, California, approximately 40 miles southeast of downtown Los Angeles. The mission of Det Norco is to provide shore-based infrastructure support to the Navy's ordnance mission and other fleet and fleet support activities. Det Norco occupies 247 acres of land, including a 47-acre man-made lake known as Lake Norconian. The vast majority of all facilities at Det Norco are used by the Naval Surface Warfare Center - Corona Division. The types of facilities at Det Norco include the Research, Testing, and Evaluation (RT&E) laboratory buildings, which account for most of the facilities at the detachment. Other facilities at the detachment provide command administrative and support services, facilities storage, and recreation functions. Land use around Det Norco is a mix of residential, commercial, and institutional properties. Major land ownerships adjacent to the detachment include property owned by the State of California and occupied by a correctional facility, the Cook Inlet Company, the Riverside Community College District of Norco College, and residential houses.

Det Norco has 13 contributing elements of the Lake Norconian Club Historic District. The boundaries of the historic district extend well beyond the Det Norco boundaries. The Lake Norconian Club Historic District is a resource that occupies approximately 92 acres on Navy-owned land at Det Norco, with the remainder of the historic district located just north of Det Norco within the correctional facility that is owned by the State of California. Thirteen contributing elements that fall within the boundaries of Det Norco include the casino/pavilion (Building 201), boathouse (Building 203), laundry/garage building (Building 204), maids' quarters (Building 209), gas station island, two gazebos, a footbridge, and a historic landscape which includes Lake Norconian. The four remaining contributing elements are situated on state property and include the Lake Norconian Club Hotel, tearoom/terrace, powerplant, and smokestack. Of these buildings, buildings 204 and 203 serve important mission functions. The Navy plans

Det Norco – Building 201, casino/pavilion across Lake Norconian, 2022 (Source: J. Aaron)

to rehabilitate buildings 201 and 209 as funds become available.

One prehistoric archaeological site was recorded in 1977; however, the site, CA-RIV-1230, has not been formally evaluated. The site's location may be inaccurate, or the site may have been destroyed.

Climate concerns for Det Norco are caused by rising temperatures resulting in excessive heat, drought, and fire, with the primary concern being fire. Although increased severity of storms could cause the lake to flood, which would limit access to critical portions of the site, this is less of a concern at this time.

Detachment Fallbrook – Det Fallbrook is located adjacent to the community of Fallbrook, an unincorporated area of northern San Diego County, California, approximately nine miles from the Pacific coast. The detachment is bounded by Marine Corps Base Camp Pendleton to the north, west, and much of the south with the Santa Margarita River forming one of the common borders between the two properties. The eastern and a portion of the southern border are adjacent to the residential and commercial areas of the community of Fallbrook, Fallbrook Air Park, and semi-rural agricultural lands.

Det Fallbrook functions as a component detachment of Naval Weapons Station Seal Beach. The mission of Det Fallbrook is to support the Pacific Fleet's combat readiness and sustainability by providing ordnance, and ordnance-related products and services essential for Navy and Marine Corps forces to prevail in any challenge or conflict. Det Fallbrook acts together with Naval Weapons Station Seal Beach as one of the major ordnance storage, maintenance, production, and distribution facilities for the western United States. Det Fallbrook encompasses approximately 8,850 acres of land. Land-use includes ordnance storage facilities and an administration area. The grazing out-lease program is an overlay onto the ordnance storage areas.

The 326 buildings and structures that have been evaluated, were determined not eligible for the NRHP. Det Fallbrook has 127 known archeological sites. Four archaeological sites have been determined or recommended NRHP-eligible, eight sites are recommended as not eligible for the NRHP, and 115 sites have not been evaluated. The sites are located throughout the installation, and most are not impacted by or do not impact the mission. Two sites, CA-SDI-15133 and CA-SDI-158, are located in areas that are critical to the mission. One site, CA-SDI-15133, is the largest site and crosses a main transportation artery. The other site, CA-SDI-15133, is near the missile maintenance and storage facilities.

A bedrock milling feature, date unknown (Source: https://www.bing.com/images/search=bedrock+milling+feature)

Climate concerns for Det Fallbrook include drought and increase severity of storms resulting in erosion. Although the drought has resulted in increased fire threats (fire frequency in the area has increased in the past 5 to 10 years), due to the type of archaeological sites (milling sites), the sites are generally not affected by fire; however, increased fire can increase erosion. The soils at the installation are very erodible. Critical roads and access could be damaged due to erosion. Grazing is the primary way the detachment reduces wildfire fuels which can be extensive over the property.

Fire around Naval Weapons Station Fallbrook, 2014 (Source: U.S. Marine Corps, Photo Credit: Cpl. Orrin Farmer)

Det Norco – Building 203, boat house and dock, 2022 (Source: J. Aaron)

Det Norco – landscape elements, 2022 (Source: J. Aaron)

Seal Beach ICRMP Adaptation Planning Worksheets

The following worksheets support installation-level application of the ICRMP planning process and are modeled after the worksheets in the Climate Adaptation for DoD Natural Resource Managers (Stein et al. 2019). They provide a structured means for managers to gather, evaluate, and analyze adaptation-relevant information, and the worksheets are designed to build on and draw from one another with earlier sections in the process informing subsequent worksheets. Because adaptation planning is an iterative process, the worksheets also provide an opportunity to "show your work" to document decisions and facilitate future assessments or refinements.

The worksheets are intended to serve as an aid for carrying out adaptation planning; they are not intended to be prescriptive. Although the worksheets are designed to be used sequentially, users should not feel compelled to fill out all of the worksheets or each cell in a given worksheet. Additionally, the level of detail entered into the worksheets may vary, depending on the availability of relevant information, and on whether the worksheets are being used to inform a preliminary screening of adaptation needs and options, or to support in-depth decision-making and allocation of resources. These worksheets may be adapted or modified (for instance, adding additional rows or columns) to support the planning needs of particular installations most effectively.

Managers may also find it useful to initially focus on a limited number of resources, risks, or strategies and keep a "parking lot" of items to address in subsequent passes through the adaptation planning process. At any point in filling out the worksheets do not linger—for instance, due to incomplete information or knowledge—make an informed conjecture (documenting any assumptions) to keep moving through the planning process. Should additional information become available, then revisit and refine the relevant worksheet and outcomes.

ICRMP Section 1: Introduction/General Information/Overview

Worksheet 1. Background Information

Section of ICRMP – Introduction/General Information/Overview:

Section number(s) in existing ICRMP (these could be all under one section heading or slightly different section headings):

In the following bullets, add the appropriate section number and draft statements to be added to those sections. Pick from statements provided or write new ones:

- Purpose of the Plan section #___1.1____.

Add statements about preservation and /or management in a dynamic environment.

_____

New threats to cultural resources are emerging from climate-driven changes in the environment, which could compromise the capacity of military facilities and lands that support the military mission. This updated ICRMP includes adaptation strategies for managing these risks. _____

_____

- Goals and Objectives is in section #___1.2___.

Note: May need to work through additional worksheets prior to developing plan goals.

Assess emerging risks and vulnerabilities to cultural resources from climate-driven changes in the environment.

Incorporate climate risk strategies into best management practices. _____

_____

_____

- Organization of the ICRMP section #___2.0___.

Add statements about where specific information can be found. This might include any of the following:

Overview of Laws and Regulations section #___2.1___.

Add overarching climate change Executive Orders, DoD directives, DoD guidance, and Service-specific guidance. Descriptions can be found in Sections 2.1 (DoD directives and Executive Orders); and Service-specific guidance in Section 4.1.

Select the appropriate requirements to be added to the ICRMP:

Executive Orders, DoD directives, DoD guidance

- [x] Executive Order (EO) 13653, 1 November 2013, *Preparing the United States for the Impacts of Climate Change*
- [x] EO 13693, 19 March 2015, *Planning for Federal Sustainability in the Next Decade*
- [x] EO 14008, 27 January 2021, *Tackling the Climate Crisis at Home and Abroad*
- [x] DoD Directive 4715.21, *Climate Change Adaptation and Resilience* (2018)
- [x] *DoD Roadmap* (DoD 2014)
- [ ] Updated Unified Facilities Criteria (UFCs)
- [ ] Other _____
- [ ] Other _____
- [ ] Other _____

Service-Specific Guidance on Climate Adaptation

- [ ] Army Climate Resilience Handbook, 2020
- [x] NAVFAC Climate Change Planning Handbook Installation Adaptation and Resilience, 2017
- [ ] Air Force Civil Engineer Severe Weather/Climate Hazard Screening and Risk Assessment Playbook, 202

Relationships to Other Installation Plans section #___4.2___.

These plans would include master plans, sustainability plans, INRMPs, range management plans, and/or building maintenance procedures. The two most likely plans are the INRMP and facilities maintenance plans. These other plans will identify program goals and strategies. Some of these goals and strategies may be applicable to cultural resources. For example, restoring the function of a wetlands may reduce erosion of an archaeological site. However, some goals or strategies may conflict with cultural resources management goals. For example, installation of a seawall may impact submerged cultural resources, or replacing the siding on a historic building could impacts its eligibility for listing in the NRHP. It is important for the CRM to work with other program leads to ensure common goals and that program-specific strategies to not conflict or inadvertently inflict harm to other resources or program areas.

Review of any climate-related assessments carried out for other installation planning processes, and any strategies developed. Complete the following table with relevant plans. Delete those that are not appropriate. This process can be time consuming, so users may want to focus on the most relevant for one's installation. If more archaeological sites, the INRMP may be a good start. If most historic buildings and structures, the maintenance plans may be more important. These other plans may provide mechanisms for funding. Also, the State Historic Preservation Office may have climate change guidance for cultural resources.

In some cases, these plans may already be included in the installation ICRMP and describe relationship to cultural resources management. Add a statement describing any climate strategies that might benefit cultural resources management.

Relationship to Other Plans		
Plan Title/ Originating Department	**How it relates to CR management** *Identify plan goals and strategies that are applicable to cultural resources management.*	**Does plan address climate change and Strategies?** *List any strategies that would be appropriate for cultural resources.*
Integrated Natural Resources Management Plan 4.2.3 of ICRMP	– Provides data on sea level rise predictions and installation inundation – Provides objective and tasks for habitat protection which would help keep ground stabilized and provide resiliency to fire, which would protect cultural resources. Some of the tasks may cause ground disturbance and would need archaeological clearance.	Overall habitat adaptation and health. Nothing specific to climate
Facilities Site Approval Process 4.2.2 of ICRMP	The Facilities Site Approval Process requires the review of any project that either changes the use of a facility or changes or has the potential to change the land use or physical layout of an area. The starting point for selecting a site for a project is the Land Use or Installation Development Plan. The installation planning process also includes a preliminary environmental review.	

Cultural Resources Management Responsibilities section # 3.3 .

Add additional Cultural Resources Manager's responsibilities those that apply. Add any additional responsibilities or edit those below as needed:

- Assess climate change risks and threats to cultural resources.
- Discuss climate vulnerabilities and risks with installations planners, engineers, maintenance personnel, range managers, natural resources managers, and tenants.
- Assist with developing strategies to manage climate change risks with installation planners and managers.

Stakeholders – Other consulting parties Section # 3.4.5 .

The ICRMP should already identify stakeholders with cultural resources interests. This step would be to identify additional key internal and external stakeholders for assessing climate impacts and carrying out adaptation planning. This step can also be to add the subject of climate change and potential impacts into the existing dialog with current stakeholders. Both internal and external partnerships provide an important mechanism for acquiring expertise, building capacity for climate adaptation, and implementing climate adaptation strategies in the ICRMP. Implementation of climate adaptation initiatives can benefit greatly from the subject matter expertise of other federal and state agencies and other non-governmental organizations.

Collaborative partnerships with internal stakeholders can also greatly facilitate the implementation of climate adaptation projects. The expertise of internal stakeholders in their subject matter will be crucial for identifying opportunities to adapt to climate change. For example, facilities engineers may have innovative ideas about reducing erosion under the threat of increasing storm intensity. Leveraging these types of projects may provide an engineered solution for preservation or restoration projects.

- Internal stakeholders would include personnel from public works, facility maintenance, range control, environmental programs (natural resources), and emergency responders. Educate internal stakeholders on awareness of plans, what to look for as far as resource degradation, and who to contact. Also provide training on what to do and not do during emergencies and what to do post-emergency. Maintenance staff may have input on current climate effects to historic structures, buildings, and infrastructure.
- External stakeholders include the SHPO, neighbors, communities, and tribes and Native organizations. Develop strategies and inform the stakeholders on approaches and strategies. The CRM can use on-going consultation to inform stakeholder of climate change concerns, strategies, and mitigation. If a strategy or action falls under the definition of an "undertaking" as defined in 36 CFR 800.16, consultation is required with the SHPO, ACHP, and tribes. Other opportunities for consultation with external stakeholders would arise during revisions and updates to the ICRMP, or development of a master plan, sustainability plan, INRMP, or range management plan. NEPA and Section 106 of the NHPA have consultation requirements. Some installation may also have annual or ongoing meetings with external stakeholders. These meetings also offer opportunities to discuss climate concerns, strategies, and lessons learned that may also benefit the community.

- It would be very important to consult with internal and external stakeholders if it is determined that particular cultural resources cannot be saved. Stakeholders can then weigh in on mitigation strategies that benefit the stakeholder group, or plan for the loss.

Stakeholders			
Stakeholder	**Climate Change Interest or Expertise**	**Internal or External**	**POC Information (Name, Email, Phone)**
Public health officials and local emergency planners	Emergency preparedness	External	Emergency Services Coordinator Seal Beach Police Department at (562) 799-4100 ext. 1145.
NOAA	Climate change forecasting tools	External	https://www.climate.gov/ 1401 Constitution Avenue NW Washington, DC 20230
USACE	Coastal hardening; sea level rise strategies	External	https://www.spl.usace.army.mil/ USACE, Los Angeles District 915 Wilshire Blvd. Los Angeles, CA 90017

Section 2. - Installation Profile/Physical/Natural Setting

The purpose of this ICRMP section is to identify key climate concerns for the installation and understand how relevant climatic factors are projected to change over time. Installation-specific climate change information may already be available through other plans, such as an Integrated Natural Resources Management plan or Sustainability Plan. This information would be including the section of the ICRMP that describes the installation and its physical and natural setting.

Worksheet 2. Climate Risks, Effects and Trends

The following information should be included in Section # 5.1 of the ICRMP.

Provide description from previous climate assessment. The worksheet can be inserted as a table and also included to summarize the risks and trends.

5.1.1 Climate Change

Global warming has the potential to raise the sea level from 9cm to 88cm by 2100. The coastal wetlands of NAVWPNSTA Seal Beach and most of the Station are at risk from inundation in a mild to worse case sea level rise scenario. Because the surrounding areas are so heavily developed, low-lying zones of NAVWPNSTA Seal Beach between dikes and the sea would likely flood. Combining a detailed elevation map for the Station with the maximum predicted sea level rise of 88 centimeters (INRMP 2014). Other trends include increase in temperature and drought conditions (Orange County 2017). Table 5-X below summarizes the climate risks and trends for NAVWPNSTA Seal Beach.

Worksheet 2 was completed in Excel and is included at the end of this case study section 4.

Section 3 - Installation Areas of Concern/Actions Impacting Cultural Resources

The purpose of Section 3 is to identify target cultural resources; describe internal and/or external threats on the installation's cultural resources; assess the impacts of those changes on cultural resources and the resulting climate vulnerabilities of those resources; and finally, determine how those resource vulnerabilities may pose risks to the installation's ability to sustain specific military mission requirements.

Worksheet for archeological resources (3b) is completed in Excel and is included at the end of this case study section 4.

Include in Appendix L.

Note: The 135 storage structures covered by the Ammunition Storage Facilities Program Comment. No additional mitigation is required.

Section 4: Evaluate Implications for ICRMP Goals and Develop Strategies and Actions to Reduce Climate Risks

The purpose of Section 4 is to help managers evaluate whether and how climate change might compromise the installation's ability to meet key ICRMP goals and objectives, based on

the information gathered from assessing the vulnerabilities of target cultural resources and the associated risks to the military mission. This section will also help installations identify, evaluate, and select appropriate adaptation strategies and actions. As stated above, users may carry forward all of the cultural resources, or just those that are of high and medium risk to military mission.

The Worksheet 4b is completed in Excel.

Include the worksheet in Appendix ___L___ to document thought process.

Worksheet 2. Climate Risks, Effects and Trends - Seal Beach			
Has the installation completed a climate change assessment? Note: If yes, indicate where the results are available. **(example: INRMP, maintenance plan, etc.)**		INRMP	
Information Sources List sources of information used to fill in this table (example: websites, other installation plans, etc.).		INRMP Climate Change and Health Profile Report Orange County, Feb 2017 https://www.drought.gov/states/california/county/orange https://www.timeanddate.com/weather/@5379524/climate	
Key Climate Change Risk What are the key climate change–related risks or threats to the installation, and more specifically for the cultural resources? See table 2-1		**Climatic Change Effects** What are the climatic effects related to those concerns, and which are relevant for the installation and the resources being managed? See table 2-1 (Best to copy from table to select all that apply.)	**Trend/Projections** What is the trend or directionality for this factor, if known (i.e., higher/lower, colder/hotter, etc.)? What are available projections for this variable (i.e., 10 - 20 years, 50 years, etc.)? Notes: Knowing the directionality or trend of a climatic factor can be informative, even without detailed projections of rate or magnitude. Use consistent timeframes for each climate risk if possible.
...	Flooding	Damage to physical infrastructure (roads, targets, ranges) and protected ecosystem resources Saltwater intrusion	Raise the sea level to 88cm (34.6 in) by 2100
...	Increasing storm frequency and intensity	Increased flooding Water quality issues Soil and vegetation loss Transportation infrastructure damage	A new NASA study shows that warming of the tropical oceans due to climate change could lead to a substantial increase in the frequency of extreme rainstorms by the end of the century. However, trends in the occurrences of storms, ranging from severe thunderstorms to winter storms to hurricanes, are subject to much greater uncertainties than trends in temperature and variables that are directly related to temperature.
...	<<press button at left>>	<<press button at left>>	<< enter trend info>>

The Case Study worksheets are included in a separate Appendix D folder.

Worksheet 3a. Climate Change Impacts on Historic Landscape, Historic Districts, or Ethnographic Resources

Cultural Resources What are the cultural resource resources within this resource type that are managed at the installation? May want to list individually, or grouped if similar types, or if treatment would be similar. May consider listing separately those that are mission critical from those that are not (see column F)	**Key Climate Change Risk** What are the key climate change–related risks or threats to these cultural resources? See Table 4-1 in guide.		**Climatic Change Impacts** What are the climatic factors or variables related to those concerns, and which are relevant for the installation and the resources being managed? See Table 4-1 in guide. (select all that apply.)	**Degree/Reason for Vulnerability** Rate the current relative vulnerability (e.g., Very High, High, Medium, Low) and describe the reason for that rating. It also may be useful to highlight any uncertainties in the assessment. The vulnerability could change in the future.	**Risks to Installation Mission Requirements** Is the preservation of this cultural resource important to sustaining military mission? What aspect of mission (e.g., training, testing, access, house or support important function, etc.)? How might this cultural resource vulnerability affect the ability of the installation to deliver its military mission? For example, if the district houses important mission function, loss of a building could impact mission activities or damage important
Ammunition Structures covered under existing PA, not carried forward	...	Flooding/Increased Inundation		<select> <<enter reason here>>	<select> <<enter details here>>

Strategies- Choosing among adaptation strategies will depend on a range of factors, depending on the installation's particular needs, funding, stakeholders, compliance, and resources. Resources with higher risks to mission and/or impacts are more imminent will likely receive funding priority. Major categories are illustrative. (See table 4-4)	**Strategies-** More than one strategy can be selected. Different strategies may be listed for short- or long-term consideration or available funding, etc. A strategy may already be in place in an existing resources or facilities management program that will also address the climate condition. **(Note, this is a ranking of strategy nothing to complete in this column)**	**Project/Goal -** What project could be carried out to realize the strategy/action? Table 4-4 and section 4.6 offers some ideas. The project maybe an existing, modified or a new project. Be as specific as possible. If cannot be specific, describe goal of project.
<select>	Strategy 1	<<enter project here>>
<select>	Strategy 2	<<enter project here>>
<select>	Strategy 3	<<enter project here>>

Effectiveness at meeting climate-informed cultural resource goals/ provide reasoning for choice. Examples: Would enhance survival of the archaeological sites while minimizing changes to the physical setting of the resources. Would not protect resource in situ, but would protect information and artifacts. Would improve chance of surviving a wildland fire.	**Effectiveness in meeting other installation objectives/ provide reasoning for choice. Examples:** Protect other logistics and support operations from flooding. Also reduces natural resources damage from wildfire. Also reduces flooding and erosion.	**Feasibility/ provide reasoning for choice. Examples:** Moderate to high costs depending on design, however, also meet other installation objectives and protect mission. Low to moderate costs, would require consultation with tribes, particularly if human remains are present, curation costs may apply.	**RECOMMEND FOR INCLUSION IN ICRMP?** If multiple strategies are included, select the best recommendation for the current situation. The best "today" may change in the future as conditions change.
<select>	<select>	<select>	<select>
<enter reasoning here>	<enter reasoning here>	<enter reasoning here>	
<select>	<select>	<select>	
<enter reasoning here>	<enter reasoning here>	<enter reasoning here>	
<select>	<select>	<select>	
<enter reasoning here>	<enter reasoning here>	<enter reasoning here>	

The Case Study worksheets are included in a separate Appendix D folder.

Worksheet 3b. Climate Change Impacts on Archeological Resources and Sites

Cultural Resources What are the cultural resource resources within this resource type that are managed at the installation? May want to list individually, or grouped if similar types, or if treatment would be similar. May consider listing separately those that are mission critical from those that are not (see column F)	**Key Climate Change Risk** What are the key climate change–related risks or threats to these cultural resources? See Table 4-2 in guide.		**Climatic Change Impacts** What are the climatic factors or variables related to those concerns, and which are relevant for the installation and the resources being managed? See Table 4-2 in guide. (select all that apply.)	**Degree/Reason for Vulnerability** Rate the current relative vulnerability (e.g., Very High, High, Medium, Low) and describe the reason for that rating. It also may be useful to highlight any uncertainties in the assessment. The vulnerability could change in the future.	**Risks to Installation Mission Requirements** Is the preservation of this cultural resource important to sustaining military mission? What aspect of mission (e.g., training, testing, access, house or support important function, etc.)? How might this cultural resource vulnerability affect the ability of the installation to deliver its military mission? For example, if the district houses important mission function, loss of a building could impact mission activities or damage important	**Strategies-** Choosing among adaptation strategies will depend on a range of factors, depending on the installation's particular needs, funding, stakeholders, compliance, and resources. Resources with higher risks to mission and/or impacts are more imminent will likely receive funding priority. Major categories are illustrative. (See table 4-4)
CA-ORA 1502 is an artifact scatter with human remains	...	Flooding/Increased Inundation	Changes in pH of buried artifacts and/or environments Reduced site integrity due to ground heave and subsidence Increased erosion of sites due to encroaching water levels, wave action exposure, and increased exposure to wet/dry cycles	High This site has been exposed due to previous weather events	Access lies adjacent to pereimter road used for security	Adapt to reduce the vulnerability of the property and its environs / Improve R Mitigate for the loss / Document and Release <select>
CA-ORA-298 - Prehistoric: shell midden ("Hog Island")	...	Flooding/Increased Inundation	Changes in pH of buried artifacts and/or environments Reduced site integrity due to ground heave and subsidence	Low site unlikely to be impacted	Other not important to mission	Mitigate for the loss / No Active Intervention or no change to current plans <select> <select>
CA-ORA-1118 - Prehistoric: shell midden/scatter	...	Flooding/Increased Inundation	Changes in pH of buried artifacts and/or environments Reduced site integrity due to ground heave and subsidence	Low site unlikely to be impacted	Other not important to mission	Mitigate for the loss / No Active Intervention or no change to current plans <select> <select>
CA-ORA-1503 - Prehistoric: shell and lithic scatter	...	Flooding/Increased Inundation	Changes in pH of buried artifacts and/or environments Reduced site integrity due to ground heave and subsidence	Low site unlikely to be impacted	Other not important to mission	Mitigate for the loss / No Active Intervention or no change to current plans <select> <select>
CA-ORA-1504 - Prehistoric: shell scatter	...	Flooding/Increased Inundation	Changes in pH of buried artifacts and/or environments Reduced site integrity due to ground heave and subsidence	Low site unlikely to be impacted	Other not important to mission	Mitigate for the loss / No Active Intervention or no change to current plans <select> <select>
CA-ORA-1714 - Prehistoric: shell and lithic scatter	...	Flooding/Increased Inundation	Changes in pH of buried artifacts and/or environments Reduced site integrity due to ground heave and subsidence	Low site unlikely to be impacted	Other not important to mission	Mitigate for the loss / No Active Intervention or no change to current plans <select> <select>

The Case Study worksheets are included in a separate Appendix D folder.

Strategies- More than one strategy can be selected. Different strategies may be listed for short- or long-term consideration or available funding, etc. A strategy may already be in place in an existing resources or facilities management program that will also address the climate condition. **(Note, this is a ranking of strategy nothing to complete in this column)**	**Project/Goal -** What project could be carried out to realize the strategy/action? Table 4-4 and section 4.6 offers some ideas. The project maybe an existing, modified or a new project. Be as specific as possible. If cannot be specific, describe goal of project.	**Effectiveness at meeting climate-informed cultural resource goals/ provide reasoning for choice.** Examples: Would enhance survival of the archaeological sites while minimizing changes to the physical setting of the resources. Would not protect resource in situ, but would protect information and artifacts. Would improve chance of surviving a wildland fire.	**Effectiveness in meeting other installation objectives/ provide reasoning for choice. Examples:** Protect other logistics and support operations from flooding. Also reduces natural resources damage from wildfire. Also reduces flooding and erosion.	**Feasibility/ provide reasoning for choice. Examples:** Moderate to high costs depending on design, however, also meet other installation objectives and protect mission. Low to moderate costs, would require consultation with tribes, particularly if human remains are present, curation costs may apply.	**RECOMMEND FOR INCLUSION IN ICRMP?** If multiple strategies are included, select the best recommendation for the current situation. The best "today" may change in the future as conditions change.
Strategy 1	Harden site to prevent erosion	High would enhance survivability of site	High protect road, important for security	Medium Would be initiated and managed through Facilities Management Division	Strategy 1
Strategy 2	Mitigate the site for the eventual loss of components	Low would protect information, but not physical site	Low meet compliance requirements, only	Low would require consultation with tribes, likely only be initiated when damage	
Strategy 3	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	
Strategy 1	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select>
Strategy 2	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	
Strategy 3	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	
Strategy 1	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select>
Strategy 2	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	
Strategy 3	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	
Strategy 1	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select>
Strategy 2	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	
Strategy 3	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	
Strategy 1	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select>
Strategy 2	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	
Strategy 3	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	
Strategy 1	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select>
Strategy 2	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	
Strategy 3	<<enter project here>>	<select> <enter reasoning here>	<select> <enter reasoning here>	<select> <enter reasoning here>	

The Case Study worksheets are included in a separate Appendix D folder.

Worksheet 4b. Implementation of Adaptation Strategies/Actions for Archeological Sites					
Cultural Resources From column 1 in worksheet 3b (linked)	**Recommended Strategies/Actions List selected strategies/actions recommended for incorporation into the ICRMP (from Worksheet 3b, column N). (linked)**	**Responsible Parties** Who would have responsibility for or be involved in implementing the strategy/action?	**Relationship to Existing ICRMP Strategies** Does this fit within a current ICRMP effort, or is it a new activity/project?	**Project Planning Needs** What preparations or requirements would be necessary before carrying out the recommended strategies/ actions?	**Timing and Sequencing** When should the action/project be implemented (immediately or at some future time)?
		Notes: Identify whether this project could be done in-house, via contract, or through partnering.		*Notes:* List permitting, funding, design, methods development, scientific research, etc. Are there any unique implementation challenges (e.g., legal, social, technical)?	*Notes:* Identify when the project should be started. Consider dependencies that may require project sequencing, or any ecological thresholds that may trigger needed action.
CA-ORA 1502 is an artifact scatter with human remains	Strategy 1	Facilities Management Division, also involve CRM and public works	This is a new project. It would be under Facilities Management with input from CRM and tribes	It would be under Facilities Management Division. It would require funding and compliance. Input from and coordination with CRM and tribes	Planning should begin with the next few years t identify a funding mechanism.
CA-ORA-298 - Prehistoric: shell midden ("Hog Island")	<select>	<<enter responsible parties>>	<<enter relationship info>>	<<enter planning needs>>	<<enter timing info>>
CA-ORA-1118 - Prehistoric: shell midden/scatter	<select>	<<enter responsible parties>>	<<enter relationship info>>	<<enter planning needs>>	<<enter timing info>>
CA-ORA-1503 - Prehistoric: shell and lithic scatter	<select>	<<enter responsible parties>>	<<enter relationship info>>	<<enter planning needs>>	<<enter timing info>>
CA-ORA-1504 - Prehistoric: shell scatter	<select>	<<enter responsible parties>>	<<enter relationship info>>	<<enter planning needs>>	<<enter timing info>>
CA-ORA-1714 - Prehistoric: shell and lithic scatter	<select>	<<enter responsible parties>>	<<enter relationship info>>	<<enter planning needs>>	<<enter timing info>>

The Case Study worksheets are included in a separate Appendix D folder.

Det. Norco – ICRMP Climate Adaptation Worksheets

Worksheet 1. Background Information

Section of ICRMP – Introduction/General Information/Overview:

Section number(s) in existing ICRMP (these could be all under one section heading or slightly different section headings):

Information to include:

- Purpose of the Plan section #___1.1____.

Add statements about preservation and /or management in a dynamic environment.

Add: New threats to cultural resources are emerging from climate-driven changes in the environment, which could compromise the capacity of military facilities and lands that support the military mission. This updated ICRMP includes adaptation strategies for managing these risks. _____

- Goals and Objectives is in section #___1.2____.

Add: Assess emerging risks and vulnerabilities to cultural resources from climate-driven changes in the environment. Incorporate climate risk strategies into best management practices and installation planning and operations. _____

- Organization of the ICRMP section #___2.0____.

Add statements about where specific information can be found. This might include any of the following:

Overview of Laws and Regulations section #___2.1____.

Add overarching climate change EOs and requirements can be found in Section 2.1 of this guide; as well as appropriate Service-specific guidance in Section 4.1.

Select the appropriate requirements to be added to the ICRMP:

Executive Orders, DoD directives, DoD guidance

- [x] Executive Order (EO) 13653, 1 November 2013, *Preparing the United States for the Impacts of Climate Change*
- [x] EO 13693, 19 March 2015, *Planning for Federal Sustainability in the Next Decade*
- [x] EO 14008, 27 January 2021, *Tackling the Climate Crisis at Home and Abroad*
- [x] DoD Directive 4715.21, *Climate Change Adaptation and Resilience* (2018)
- [x] DoD Roadmap (DoD 2014)
- [x] Updated Unified Facilities Criteria (UFCs)

☐ Other _____

☐ Other _____

☐ Other _____

Service-Specific Guidance on Climate Adaptation

☐ Army Climate Resilience Handbook, 2020

☒ NAVFAC Climate Change Planning Handbook Installation Adaptation and Resilience, 2017

☐ Air Force Civil Engineer Severe Weather/Climate Hazard Screening and Risk Assessment Playbook, 202

Relationships to Other Installation Plans section #___4.2___.

These plans would include master plans, sustainability plans, INRMPs, range management plans, and/or building maintenance procedures. These other plans will identify program goals and strategies. Some of these goals and strategies may be applicable to cultural resources. For example, restoring the function of a wetlands may reduce erosion of an archaeological site. However, some goals or strategies may conflict with cultural resources management goals. For example, installation of a seawall may impact submerged cultural resources, or replacing the siding on a historic building could impacts its eligibility for listing in the NRHP. It is important for the CRM to work with other program leads to ensure common goals and that program-specific strategies to not conflict or inadvertently inflict harm to other resources or program areas.

Review of any climate-related assessments carried out for other installation planning processes, and any strategies developed.

These plans are already included in the Seal Beach ICRMP and describe relationship to cultural resources management. Add a statement in section 4.2 describing any climate strategies that might benefit cultural resources management.

Relationship to Other Plans		
Plan Title/ Originating Department	**How it relates to CR management** *Identify plan goals and strategies that are applicable to cultural resources management.*	**Does plan address climate change and Strategies?** *List any strategies that would be appropriate for cultural resources.*
Lake and Landscape Management Plan 4.2.4 of ICRMP	The Lake and Landscape Management Plan (2016) is a component of the INRMP and ICRMP and includes a detailed discussion of the Navy's historic district contributing elements to the lake and landscape which are within the Lake Norconian Club Historic District. This plan was developed to evaluate and recommend the most effective management approach to meet natural resources, cultural resources, and administrative needs for Lake Norconian, the ponds, and landscape features contributing to the Historic District, while supporting Navy mission.	Plan is to ensure a balanced management of natural and cultural resources stewardship responsibilities. This plan does not have specific climate change strategies. Future revisions to this plan or the ICRMP could include more resilient plant species appropriate for the historic district
Historic Building Maintenance Plan	The Historic District Maintenance Plan (2013) is a component of the ICRMP and includes a detailed discussion of the Navy's historic district contributing elements to the Lake Norconian Club Historic District. This plan was developed to assist the Navy with its ongoing management and maintenance of historic buildings and facilities. Various components of the PWD have responsibility for the action items in this plan.	Does not have climate-specific strategies but does discuss current condition of buildings maintenance and rehabilitation plans. Future revisions to this plan or the ICRMP could consider fire resiliency.

Cultural Resources Management Responsibilities – Section # 3.3

Section 3.3.2.6 - Cultural Resources Managers would be responsible for creating additional awareness for climate vulnerabilities and assist with developing strategies to manage this risk. This would be done in consultation with installations planners, engineers, maintenance personnel, range managers, and natural resources managers.

Add to other responsibilities:

- Assess climate change risks and threats to cultural resources.
- Discuss climate vulnerabilities and risks with installations planners, engineers, maintenance personnel, range managers, natural resources managers, and tenants.
- Assist with developing strategies to manage climate change risks with installation planners and managers.

Stakeholders – Other consulting parties Section #3.4.5 - Identify key internal and external stakeholders for assessing climate impacts and carrying out adaptation planning. To the extent feasible, identify specific individuals or organizations. Involving climate scientists and other relevant experts early on may help installations navigate the process more effectively.

Consider adding:

Stakeholders		
Stakeholder	**Climate Change Interest or Expertise**	**Internal or External**
Public health officials and local emergency planners	Emergency preparedness	External
Local fire departments(s)	Emergency preparedness	External
NOAA	Climate change forecasting tools	External

Section 2. - Installation Profile/Physical/Natural Setting

The purpose of this ICRMP section is to identify key climate concerns for the installation and understand how relevant climatic factors are projected to change over time. Installation-specific climate change information may already be available through other plans, such as an Integrated Natural Resources Management plan or Sustainability Plan. This information would be including the section of the ICRMP that describes the installation and its physical and natural setting.

Worksheet 2. Climate Risks, Effects and Trends

The following information should be included in Section #___5.1___ of the ICRMP.

This worksheet completed in Excel.

5.1.1 Climate Change

Global warming has the potential to raise the sea level from 9cm to 88cm by 2100. The coastal wetlands of NAVWPNSTA Seal Beach and most of the Station are at risk from inundation in a mild to worse case sea level rise scenario. Because the surrounding areas are so heavily developed, low-lying zones of NAVWPNSTA Seal Beach between dikes and the sea would likely flood. Combining a detailed elevation map for the Station with the maximum predicted sea level rise of 88 centimeters (INRMP 2014). Other trends include increase in temperature and drought conditions (Orange County 2017). Table 5-X below summarizes the climate risks and trends for NAVWPNSTA Seal Beach.

Worksheet 2 was completed in Excel and is included at the end of this case study section 4.

Section 3 - Installation Areas of Concern/Actions Impacting Cultural Resources

The purpose of Section 3 is to identify target cultural resources; describe internal and/or external threats on the installation's cultural resources; assess the impacts of those changes on cultural resources and the resulting climate vulnerabilities of those resources; and finally,

determine how those resource vulnerabilities may pose risks to the installation's ability to sustain specific military mission requirements.

Worksheet 3a was completed in Excel and is included at the end of this case study section 4.

Complete the worksheet and include in Appendix L.

Note: The Lake Norconian Club Historic District is addressed as a single resource for the purposes of climate change adaptation. The district includes the casino/pavilion (Building 201), boathouse (Building 203), laundry/garage building (Building 204), maids' quarters (Building 209), Gas Station Island, two gazebos, a footbridge, and a historic landscape which includes Lake Norconian. Buildings 201 and 203 have unique maintenance concerns due to location on or over the lake. Climate change is not expected to change these conditions for the foreseeable future. The decision to lump or split this buildings and features should be revisited in future revisions to the ICRMP.

Section 4: Evaluate Implications for ICRMP Goals and Develop Strategies and Actions to Reduce Climate Risks

The purpose of Section 4 is to help managers evaluate whether and how climate change might compromise the installation's ability to meet key ICRMP goals and objectives, based on the information gathered from assessing the vulnerabilities of target cultural resources and the associated risks to the military mission. This section will also help installations identify, evaluate, and select appropriate adaptation strategies and actions.

The worksheet 4a is completed in Excel.

Include this table(s) in Appendix ___L___ to document thought process.

Worksheet 2. Climate Risks, Effects and Trends			
Has the installation completed a climate change assessment? Note: If yes, indicate where the results are available. **(example: INRMP, maintenance plan, etc.)**			
Information Sources List sources of information used to fill in this table (example: websites, other installation plans, etc.).		Climate Change and Health Profile Report Riverside County, Feb 2017 https://www.noaa.gov/stories/climate-change-in-your-county-plan-with-new-tool Southern California Association Of Governments Climate Change And The Future Of Southern California	
	Key Climate Change Risk What are the key climate change–related risks or threats to the installation, and more specifically for the cultural resources? See table 2-1	**Climatic Change Effects** What are the climatic effects related to those concerns, and which are relevant for the installation and the resources being managed? See table 2-1 (Best to copy from table to select all that apply.)	**Trend/Projections** What is the trend or directionality for this factor, if known (i.e., higher/lower, colder/hotter, etc.)? What are available projections for this variable (i.e., 10 - 20 years, 50 years, etc.)? Notes: Knowing the directionality or trend of a climatic factor can be informative, even without detailed projections of rate or magnitude. Use consistent timeframes for each climate risk if possible.
...	Drought	Increases in extent and duration of droughts Increased wildfire risk infrastructure damage	One simulation of projected future annual total precipitation in Southern California contains a trend approaching 25% less precipitation by 2100 than historical levels. (GFDL simulation)
...	Heat	Increased incidences of heat stress Vegetation transition (species and biome shifts) Wildfire risk Electrical grid stress Degradation of equipment performance	Climate model projections based on lower end emission trajectories indicate that, by 2100, temperature increases will likely exceed 3°F with the upper-warming end of the climate models actually produce warming that is greater than 7°F.

The Case Study worksheets are included in a separate Appendix D folder.

Worksheet 3a. Climate Change Impacts on Historic Landscape, Historic Districts, or Ethnographic Resources

Cultural Resources What are the cultural resource resources within this resource type that are managed at the installation? May want to list individually, or grouped if similar types, or if treatment would be similar. May consider listing separately those that are mission critical from those that are not (see column F)	**Key Climate Change Risk** What are the key climate change–related risks or threats to these cultural resources? See Table 4-1 in guide.		**Climatic Change Impacts** What are the climatic factors or variables related to those concerns, and which are relevant for the installation and the resources being managed? See Table 4-1 in guide. (select all that apply.)	**Degree/Reason for Vulnerability** Rate the current relative vulnerability (e.g., Very High, High, Medium, Low) and describe the reason for that rating. It also may be useful to highlight any uncertainties in the assessment. The vulnerability could change in the future.	**Risks to Installation Mission Requirements** Is the preservation of this cultural resource important to sustaining military mission? What aspect of mission (e.g., training, testing, access, house or support important function, etc.)? How might this cultural resource vulnerability affect the ability of the installation to deliver its military mission? For example, if the district houses important mission function, loss of a building could impact mission activities or damage important	**Strategies-** Choosing among adaptation strategies will depend on a range of factors, depending on the installation's particular needs, funding, stakeholders, compliance, and resources. Resources with higher risks to mission and/or impacts are more imminent will likely receive funding priority. Major categories are illustrative. (See table 4-4)
Lake Norconian Club Historic District - 13 contributing elements: casino/pavilion (Building 201), boathouse (Building 203), laundry/garage building (Building 204), maids' quarters (Building 209), Gas Station Island, two gazebos, a footbridge, and a historic landscape which includes Lake Norconian. The four remaining contributing elements are situated on the adjacent California Rehabilitation Center property and include the Lake Norconian Club Hotel, tearoom/terrace, powerplant, and smokestack	...	Drought/Increased Wildfire	Loss or damage of associated structures Change in vegetation density and composition. Damage to structure and/ or associated cultural landscape/district from fire retardants.	Low Although, vulnerability to an urban wildland fire is relatively low, a fire fueled by wind and drought can cause devastating loss of historic resources.	Testing Buildings 204 and 203 serve important mission functions, although unlikely to jeopardize mission if lost. Other buildings and district features are not critical to mission.	Mitigate for the loss / No Active Intervention or no change to current plans Mitigate for the loss / Document and Release Adapt to reduce the vulnerability of the property and its environs / Offset Stre
Lake Norconian Club Historic District - 13 contributing elements: casino/pavilion (Building 201), boathouse (Building 203), laundry/garage building (Building 204), maids' quarters (Building 209), Gas Station Island, two gazebos, a footbridge, and a historic landscape which includes Lake Norconian. The four remaining contributing elements are situated on the adjacent California Rehabilitation Center	...	Heat/Increased Global Temperature	Heat stress on culturally significant vegetation Increased stress (e.g., desiccation, warping, cracking) on constructed landscape/district features	Low Vulnerability will start out low and damage minimal. As the heat increases, the magnitude of the impacts and the speed of change will increase	Testing Buildings 204 and 203 serve important mission functions, although unlikely to jeopardize mission if lost. Other buildings and district features are not critical to mission.	Mitigate for the loss / No Active Intervention or no change to current plans Mitigate for the loss / Document and Release Adapt to reduce the vulnerability of the property and its environs / Improve Re

The Case Study worksheets are included in a separate Appendix D folder.

Strategies- More than one strategy can be selected. Different strategies may be listed for short- or long-term consideration or available funding, etc. A strategy may already be in place in an existing resources or facilities management program that will also address the climate condition. **(Note, this is a ranking of strategy nothing to complete in this column)**	**Project/Goal -** What project could be carried out to realize the strategy/action? Table 4-4 and section 4.6 offers some ideas. The project maybe an existing, modified or a new project. Be as specific as possible. If cannot be specific, describe goal of project.	**Effectiveness at meeting climate-informed cultural resource goals/ provide reasoning for choice.** Examples: Would enhance survival of the archaeological sites while minimizing changes to the physical setting of the resources. Would not protect resource in situ, but would protect information and artifacts. Would improve chance of surviving a wildland fire.	**Effectiveness in meeting other installation objectives/ provide reasoning for choice. Examples:** Protect other logistics and support operations from flooding. Also reduces natural resources damage from wildfire. Also reduces flooding and erosion.	**Feasibility/ provide reasoning for choice. Examples:** Moderate to high costs depending on design, however, also meet other installation objectives and protect mission. Low to moderate costs, would require consultation with tribes, particularly if human remains are present, curation costs may apply.	**RECOMMEND FOR INCLUSION IN ICRMP?** If multiple strategies are included, select the best recommendation for the current situation. The best "today" may change in the future as conditions change.
Strategy 1	current CR management approach,	Medium Current site and building maintenance plans, can be updated to include climate adaptation approaches	Medium continued maintenance of landscape and buildings	High low costs, additional climate strategies can be incorporated into revised maintenance as plans additional adaptation is needed.	Strategy 1
Strategy 2	HALS documentation. Anticipate loss and document resources to preserve information	Low meet compliance requirements only	Low meets CR compliance only	Low cost would be high, and if no Section 106 trigger to drive compliance, funding	
Strategy 3	Remove trees and other large plants near buildings. Side buildings with flame retardant materials. Landscape to reduce fire fuels and slow fire progress.	Medium proactively protect the resources from climate change; however, may require removal of some historic features.	Low depending on project, could increase or decrease site maintenance needs	Low cost would be high, and if no Section 106 trigger to drive compliance, funding unlikely.	
Strategy 1	current CR management approach	Medium Current site and building maintenance plans, can be updated to include climate adaptation approaches	Medium continued maintenance of landscape and buildings	High low costs, additional climate strategies can be incorporated into revised maintenance as plans additional adaptation is needed.	Strategy 1
Strategy 2	HALS documentation. Anticipate loss and document resources to preserve information	Low meet compliance requirements only	Low meets CR compliance only	Low cost would be high, and if no Section 106 trigger to drive compliance, funding unlikely.	
Strategy 3	Remove trees and other large plants near buildings. Side buildings with flame retardant materials. Landscape to reduce fire fuels and slow fire progress.	Medium proactively protect the resources from climate change; however, may require removal of some historic features.	Low depending on project, could increase or decrease site maintenance needs	Low cost would be high, and if no Section 106 trigger to drive compliance, funding unlikely.	

The Case Study worksheets are included in a separate Appendix D folder.

Worksheet 4a. Implementation of Adaptation Strategies/Actions for Historic Landscape, Historic Districts, or Ethnographic Resources and Climate Risks					
Cultural Resources **From column 1 in worksheet 3a** **(linked)**	**Recommended Strategies/Actions** **List selected strategies/actions recommended for incorporation into the ICRMP (from Worksheet 3a, column N).** **(linked)**	**Responsible Parties** Who would have responsibility for or be involved in implementing the strategy/action?	**Relationship to Existing ICRMP Strategies** Does this fit within a current ICRMP effort, or is it a new activity/project?	**Project Planning Needs** What preparations or requirements would be necessary before carrying out the recommended strategies/ actions?	**Timing and Sequencing** When should the action/project be implemented (immediately or at some future time)?
		Notes: Identify whether this project could be done in-house, via contract, or through partnering.		*Notes:* List permitting, funding, design, methods development, scientific research, etc. Are there any unique implementation challenges (e.g., legal, social, technical)?	*Notes:* Identify when the project should be started. Consider dependencies that may require project sequencing, or any ecological thresholds that may trigger needed action.
Lake Norconian Club Historic District - 13 contributing elements: casino/pavilion (Building 201), boathouse (Building 203), laundry/garage building (Building 204), maids' quarters (Building 209), Gas Station Island, two gazebos, a footbridge, and a historic landscape which includes Lake Norconian. The four remaining contributing elements are situated on the adjacent California Rehabilitation Center property and include the Lake Norconian Club Hotel, tearoom/terrace, powerplant, and smokestack	Strategy 1	Facilities management with input from CRM. Work with adjacent landowners to reduce fire fuels.	Status Quo	periodic monitor of change to buildings and landscape features, determine additional measures to be included in the maintenance program to address change	begin monitoring for changes to district driven by climate, add appropriate measures when plans are revised.
Lake Norconian Club Historic District - 13 contributing elements: casino/pavilion (Building 201), boathouse (Building 203), laundry/garage building (Building 204), maids' quarters (Building 209), Gas Station Island, two gazebos, a footbridge, and a historic landscape which includes Lake Norconian. The four remaining contributing elements are situated on the adjacent California Rehabilitation Center	Strategy 1	Facilities management with input from CRM	Status Quo	periodic monitor of change to buildings and landscape features, determine additional measures to be included in the maintenance program to address change	begin monitoring for changes to district driven by climate, add appropriate measures when plans are revised.

The Case Study worksheets are included in a separate Appendix D folder.

Det. Fallbrook - ICRMP Adaptation Planning Worksheets

Worksheet 1. Background Information

Section of ICRMP – Introduction/General Information/Overview:

Section number(s) in existing ICRMP (these could be all under one section heading or slightly different section headings):

In the following bullets, add the appropriate section number and draft statements to be added to those sections. Pick from statements provided or write new ones:

- Purpose of the Plan section #___1.1___.

Add statements about preservation and /or management in a dynamic environment.

_____

New threats to cultural resources are emerging from climate-driven changes in the environment, which could compromise the capacity of military facilities and lands that support the military mission. This updated ICRMP includes adaptation strategies for managing these risks. _____
_____

_____

- Goals and Objectives is in section #___1.2___.

Note: May need to work through additional worksheets prior to developing plan goals.

Assess emerging risks and vulnerabilities to cultural resources from climate-driven changes in the environment. Incorporate climate risk strategies into best management practices. _____

_____

- Organization of the ICRMP section #___2.0___.

Add statements about where specific information can be found. This might include any of the following:

Overview of Laws and Regulations section #___2.1___.

Add overarching climate change Executive Orders, DoD directives, DoD guidance, and Service-specific guidance. Descriptions can be found in Sections 2.1 (DoD directives and Executive Orders); and Service-specific guidance in Section 4.1.

Select the appropriate requirements to be added to the ICRMP:

Executive Orders, DoD directives, DoD guidance

- [x] Executive Order (EO) 13653, 1 November 2013, *Preparing the United States for the Impacts of Climate Change*
- [x] EO 13693, 19 March 2015, *Planning for Federal Sustainability in the Next Decade*
- [x] EO 14008, 27 January 2021, *Tackling the Climate Crisis at Home and Abroad*
- [x] DoD Directive 4715.21, *Climate Change Adaptation and Resilience* (2018)
- [x] DoD Roadmap (DoD 2014)
- [x] Updated Unified Facilities Criteria (UFCs)
- [ ] Other _____
- [ ] Other _____
- [ ] Other _____

Service-Specific Guidance on Climate Adaptation

- [ ] Army Climate Resilience Handbook, 2020
- [x] NAVFAC Climate Change Planning Handbook Installation Adaptation and Resilience, 2017
- [ ] Air Force Civil Engineer Severe Weather/Climate Hazard Screening and Risk Assessment Playbook, 202

Relationships to Other Installation Plans section #___4.2___.

These plans would include master plans, sustainability plans, Integrated Natural Resources Management Plan (INRMPs), range management plans, and/or building maintenance procedures. The two most likely plans are the INRMP and facilities maintenance plans. These other plans will identify program goals and strategies. Some of these goals and strategies may be applicable to cultural resources. For example, restoring the function of a wetlands may reduce erosion of an archaeological site. However, some goals or strategies may conflict with cultural resources management goals. For example, installation of a seawall may impact submerged cultural resources, or replacing the siding on a historic building could impacts its eligibility for listing in the NRHP. It is important for the CRM to work with other program leads to ensure common goals and that program-specific strategies to not conflict or inadvertently inflict harm to other resources or program areas.

Review of any climate-related assessments carried out for other installation planning processes, and any strategies developed. Complete the following table with relevant plans. Delete those that are not appropriate. This process can be time consuming, so users may want to focus on the most relevant for one's installation. If more archaeological sites, the INRMP may be a good start. If most historic buildings and structures, the maintenance plans may be more

important. These other plans may provide mechanisms for funding. Also, the State Historic Preservation Office may have climate change guidance for cultural resources.

In some cases, these plans may already be included in the Fallbrook ICRMP and describe relationship to cultural resources management. Add a statement describing any climate strategies that might benefit cultural resources management.

Relationship to Other Plans		
Plan Title/ Originating Department	**How it relates to CR management** *Identify plan goals and strategies that are applicable to cultural resources management.*	**Does plan address climate change and Strategies?** *List any strategies that would be appropriate for cultural resources.*
Fallbrook Integrated Natural Resources Management Plan (INRMP) 4.2.2 of ICRMP	The INRMP includes an inventory and mapping of natural resources, program implementation guidance and procedures, and goals and objectives. In some ways the cultural and natural resources programs are complementary in the way they protect similar areas and are both land-use constraints. General maintenance of natural resources management actions and wildland fire management, such as cattle grazing, has the potential to affect cultural resources. The two programs can also complement each other since they both essentially represent a mission and facilities planning constraint that discourages development to avoid adverse effects to areas which contain both historic properties and sensitive habitats.	– Yes – Restoration of groundwater recharge and percolation to maintain water availability for drought and fire. – Protection of California gnatcatcher habitat refugia from fire – Targeted grazing to reduce the biomass of to reduce wildfire risks.
Wildland Fire Management Plan for Detachment Fallbrook 4.2.4 of the ICRMP	The WFMP is a core component of the Detachment's natural resources program and wildland fire management is of paramount importance to both the mission and natural resources. Wildland fires can also impact cultural resources. Archaeologically sensitive areas are also mapped and labeled as sensitive areas to afford cultural resources some level of protection as well.	Fire management to protect vegetation and prevent erosion

Cultural Resources Management Responsibilities section #___3.3___.

Add additional Cultural Resources Manager's responsibilities those that apply. Add any additional responsibilities or edit those below as needed:

- Assess climate change risks and threats to cultural resources.
- Discuss climate vulnerabilities and risks with installations planners, engineers, maintenance personnel, range managers, natural resources managers, and tenants.
- Assist with developing strategies to manage climate change risks with installation planners and managers.

Stakeholders – Other consulting parties Section #3.4.5

The ICRMP should already identify stakeholders with cultural resources interests. This step would be to identify additional key internal and external stakeholders for assessing climate impacts and carrying out adaptation planning. This step can also be to add the subject of climate change and potential impacts into the existing dialog with current stakeholders. Both internal and external partnerships provide an important mechanism for acquiring expertise, building capacity for climate adaptation, and implementing climate adaptation strategies in the ICRMP. Implementation of climate adaptation initiatives can benefit greatly from the subject matter expertise of other federal and state agencies and other non-governmental organizations.

Collaborative partnerships with internal stakeholders can also greatly facilitate the implementation of climate adaptation projects. The expertise of internal stakeholders in their subject matter will be crucial for identifying opportunities to adapt to climate change. For example, facilities engineers may have innovative ideas about reducing erosion under the threat of increasing storm intensity. Leveraging these types of projects may provide an engineered solution for preservation or restoration projects.

- Internal stakeholders would include personnel from public works, facility maintenance, range control, environmental programs (natural resources), and emergency responders. Educate internal stakeholders on awareness of plans, what to look for as far as resource degradation, and who to contact. Also provide training on what to do and not do during emergencies and what to do post-emergency. Maintenance staff may have input on current climate effects to historic structures, buildings, and infrastructure.
- External stakeholders include the SHPO, neighbors, communities, and tribes and Native organizations. Develop strategies and inform the stakeholders on approaches and strategies. The CRM can use on-going consultation to inform stakeholder of climate change concerns, strategies, and mitigation. If a strategy or action falls under the definition of an "undertaking" as defined in 36 CFR 800.16, consultation is required with the SHPO, ACHP, and tribes. Other opportunities for consultation with external stakeholders would arise during revisions and updates to the ICRMP, or development of a master plan, sustainability plan, INRMP, or range management plan. NEPA and Section 106 of the NHPA have consultation requirements. Some installation may also have annual or ongoing meetings with external stakeholders. These meetings also offer opportunities to discuss climate concerns, strategies, and lessons learned that may also benefit the community.
- It would be very important to consult with internal and external stakeholders if it is determined that particular cultural resources cannot be saved. Stakeholders can then weigh in on mitigation strategies that benefit the stakeholder group, or plan for the loss.

Stakeholders			
Stakeholder	**Climate Change Interest or Expertise**	**Internal or External**	**POC Information (Name, Email, Phone)**
Public health officials and local emergency planners	Emergency preparedness	External	North County Fire Administrative Offices 330 South Main Avenue, Fallbrook CA 92028-2938 (760) 723-2005
NOAA	Climate change forecasting tools	External	https://www.climate.gov/ 1401 Constitution Avenue NW Washington, DC 20230
USACE	Coastal hardening; sea level rise strategies	External	https://www.spl.usace.army.mil/ USACE, Los Angeles District 915 Wilshire Blvd. Los Angeles, CA 90017

Worksheet 2. Climate Risks, Effects and Trends

The following information should be included in Section #___5.1___ of the ICRMP.

This worksheet completed in Excel file.

5.1.1 Climate Change

Global warming has the potential to raise the sea level from 9cm to 88cm by 2100. The coastal wetlands of NAVWPNSTA Seal Beach and most of the Station are at risk from inundation in a mild to worse case sea level rise scenario. Because the surrounding areas are so heavily developed, low-lying zones of NAVWPNSTA Seal Beach between dikes and the sea would likely flood. Combining a detailed elevation map for the Station with the maximum predicted sea level rise of 88 centimeters (INRMP 2014). Other trends include increase in temperature and drought conditions (Orange County 2017). Table 5-X below summarizes the climate risks and trends for NAVWPNSTA Seal Beach.

Worksheet 2 was completed in Excel and is included at the end of this case study section 4.

Section 3 - Installation Areas of Concern/Actions Impacting Cultural Resources

The purpose of Section 3 is to identify target cultural resources; describe internal and/or external threats on the installation's cultural resources; assess the impacts of those changes on cultural resources and the resulting climate vulnerabilities of those resources; and finally, determine how those resource vulnerabilities may pose risks to the installation's ability to sustain specific military mission requirements.

Complete the worksheet and include in Appendix ___L___.

Worksheet 3b completed in Excel and is included after section 4 of this case study. Two sites are located in mission critical area, the remainder are not and are treated wholistically.

Section 4: Evaluate Implications for ICRMP Goals and Develop Strategies and Actions to Reduce Climate Risks

The purpose of Section 4 is to help managers evaluate whether and how climate change might compromise the installation's ability to meet key ICRMP goals and objectives, based on the information gathered from assessing the vulnerabilities of target cultural resources and the associated risks to the military mission. This section will also help installations identify, evaluate, and select appropriate adaptation strategies and actions. As stated above, users may carry forward all of the cultural resources, or just those that are of high and medium risk to military mission.

Worksheet 4b completed in Excel.

Worksheet 2. Climate Risks, Effects and Trends			
Has the installation completed a climate change assessment? Note: If yes, indicate where the results are available. **(example: INRMP, maintenance plan, etc.)**		INRMP	
Information Sources List sources of information used to fill in this table (example: websites, other installation plans, etc.).		INRMP	
Key Climate Change Risk What are the key climate change–related risks or threats to the installation, and more specifically for the cultural resources? See table 2-1		**Climatic Change Effects** What are the climatic effects related to those concerns, and which are relevant for the installation and the resources being managed? See table 2-1 (Best to copy from table to select all that apply.)	**Trend/Projections** What is the trend or directionality for this factor, if known (i.e., higher/lower, colder/hotter, etc.)? What are available projections for this variable (i.e., 10 - 20 years, 50 years, etc.)? Notes: Knowing the directionality or trend of a climatic factor can be informative, even without detailed projections of rate or magnitude. Use consistent timeframes for each climate risk if possible
...	Heat	Increased incidences of heat stress Vegetation transition (species and biome shifts) Wildfire risk Electrical grid stress Degradation of equipment performance	<< enter trend info>>
...	Land Degradation	Increases in extent and duration of droughts Increased wildfire risk Altered burn regimes Loss of vegetative cover Impacted soil function and resilience (desertification) Soil loss	<< enter trend info>>
	Increasing storm frequency and intensity	Increases in number and severity of extreme precipitation events Soil and vegetation loss Transportation infrastructure damage	<< enter trend info>>

The Case Study worksheets are included in a separate Appendix D folder.

Worksheet 3b. Climate Change Impacts on Archeological Resources and Sites

Cultural Resources What are the cultural resource resources within this resource type that are managed at the installation? May want to list individually, or grouped if similar types, or if treatment would be similar. May consider listing separately those that are mission critical from those that are not (see column F)	**Key Climate Change Risk** What are the key climate change–related risks or threats to these cultural resources? See Table 4-2 in guide.	**Climatic Change Impacts** What are the climatic factors or variables related to those concerns, and which are relevant for the installation and the resources being managed? See Table 4-2 in guide. (select all that apply.)	**Degree/Reason for Vulnerability** Rate the current relative vulnerability (e.g., Very High, High, Medium, Low) and describe the reason for that rating. It also may be useful to highlight any uncertainties in the assessment. The vulnerability could change in the future.	**Risks to Installation Mission Requirements** Is the preservation of this cultural resource important to sustaining military mission? What aspect of mission (e.g., training, testing, access, house or support important function, etc.)? How might this cultural resource vulnerability affect the ability of the installation to deliver its military mission? For example, if the district houses important mission function, loss of a building could impact mission activities or damage important	**Strategies-** Choosing among adaptation strategies will depend on a range of factors, depending on the installation's particular needs, funding, stakeholders, compliance, and resources. Resources with higher risks to mission and/or impacts are more imminent will likely receive funding priority. Major categories are illustrative. (See table 4-4)
CA-SDI-15133	... Storm frequency or intensity/More Precipitation and/or Heavier Precipitation	Site erosion from overflow and new flood channels Soil destabilization/shifting (ground heave, landslide, subsidence) Damage to unexcavated artifact and site integrity from direct force of water	High area of very erodible soils	House or support important function loss of use of an important storage and maintain area	Adapt to reduce the vulnerability of the property and its environs / Improve R Mitigate for the loss / Document and Release Mitigate for the loss / No Active Intervention or no change to current plans
CA-SDI-158	... Storm frequency or intensity/More Precipitation and/or Heavier Precipitation	Site erosion from overflow and new flood channels Soil destabilization/shifting (ground heave, landslide, subsidence) Damage to unexcavated artifact and site integrity from direct force of water	High area of very erodible soils	Access loss of an important transportation artery	Adapt to reduce the vulnerability of the property and its environs / Improve R Mitigate for the loss / Document and Release Mitigate for the loss / No Active Intervention or no change to current plans
remaining 125 known archeological sites (degradation of these sites would not be critical to the mission)	... Storm frequency or intensity/More Precipitation and/or Heavier Precipitation	Site erosion from overflow and new flood channels Soil destabilization/shifting (ground heave, landslide, subsidence)	Medium sites throughout installation, soil erodability is variable and can be high	Other most sites are inareas that do not pose a risk to the mission	Mitigate for the loss / No Active Intervention or no change to current plans

The Case Study worksheets are included in a separate Appendix D folder.

Strategies- More than one strategy can be selected. Different strategies may be listed for short- or long-term consideration or available funding, etc. A strategy may already be in place in an existing resources or facilities management program that will also address the climate condition. **(Note, this is a ranking of strategy nothing to complete in this column)**	**Project/Goal -** What project could be carried out to realize the strategy/action? Table 4-4 and section 4.6 offers some ideas. The project maybe an existing, modified or a new project. Be as specific as possible. If cannot be specific, describe goal of project.	**Effectiveness at meeting climate-informed cultural resource goals/ provide reasoning for choice.** Examples: Would enhance survival of the archaeological sites while minimizing changes to the physical setting of the resources. Would not protect resource in situ, but would protect information and artifacts. Would improve chance of surviving a wildland fire.	**Effectiveness in meeting other installation objectives/ provide reasoning for choice. Examples:** Protect other logistics and support operations from flooding. Also reduces natural resources damage from wildfire. Also reduces flooding and erosion.	**Feasibility/ provide reasoning for choice. Examples:** Moderate to high costs depending on design, however, also meet other installation objectives and protect mission. Low to moderate costs, would require consultation with tribes, particularly if human remains are present, curation costs may apply.	**RECOMMEND FOR INCLUSION IN ICRMP?** If multiple strategies are included, select the best recommendation for the current situation. The best "today" may change in the future as conditions change.
Strategy 1	add erosion controls and manage runoff	High Action will enhance survival of resource	High protect use of mission critical area	Medium would have moderate costs, however, area critical to mission	Strategy 1
Strategy 2	document, data recovery	Low would protect data but not resource in situ	Low may open up areas for use current avoided due to presence of resource	Low unlikely to get funding , would require SHPO and tribal consultation	
Strategy 3	no action, periodic monitoring after catastrophic event	N/A would be managed under current programs without change for climate	N/A no change	High no change, periodic monitoring	
Strategy 1	add erosion controls and manage runoff	High Action will enhance survival of resource	High protect use of mission critical area	Medium would have moderate costs, however, area critical to mission	Strategy 1
Strategy 2	document, data recovery	Low would protect data but not resource in situ	Low may open up areas for use current avoided due to presence of resource	Low unlikely to get funding , would require SHPO and tribal consultation	
Strategy 3	no action, periodic monitoring after catastrophic event	N/A would be managed under current programs without change for climate	N/A no change	High no change, periodic monitoring	
Strategy 1	no action, periodic monitoring after catastrophic event, can move to another strategy at a later date if conditions change	N/A would be managed under current programs without change for climate	N/A no change	High no change, periodic monitoring	Strategy 1

The Case Study worksheets are included in a separate Appendix D folder.

Worksheet 4b. Implementation of Adaptation Strategies/Actions for Archeological Sites					
Cultural Resources **From column 1 in worksheet 3b (linked)**	**Recommended Strategies/Actions** **List selected strategies/actions recommended for incorporation into the ICRMP (from Worksheet 3b, column N). (linked)**	**Responsible Parties** Who would have responsibility for or be involved in implementing the strategy/action?	**Relationship to Existing ICRMP Strategies** Does this fit within a current ICRMP effort, or is it a new activity/project?	**Project Planning Needs** What preparations or requirements would be necessary before carrying out the recommended strategies/ actions?	**Timing and Sequencing** When should the action/project be implemented (immediately or at some future time)?
		Notes: Identify whether this project could be done in-house, via contract, or through partnering.		*Notes:* List permitting, funding, design, methods development, scientific research, etc. Are there any unique implementation challenges (e.g., legal, social, technical)?	*Notes:* Identify when the project should be started. Consider dependencies that may require project sequencing, or any ecological thresholds that may trigger needed action.
CA-SDI-15133	Strategy 1	Facilities Management, likely contracted out	new project	design, consultation with SHPO and tribes	project planning should begin within 5 years with completion planned for 10 years
CA-SDI-158	Strategy 1	Facilities Management, likely contracted out	new project	design, consultation with SHPO and tribes	project planning should begin within 5 years with completion planned for 10 years
remaining 125 known archeological sites (degradation of these sites would not be critical to the mission)	Strategy 1	CRM	status quo	N/A	sites should be monitored after catastrophic events. If indications show a major shift in climate change, may want to consider additional strategies.

The Case Study worksheets are included in a separate Appendix D folder.

A U.S. Army National Guardsman runs through floodwater from Hurricane Gustav on Sept. 1, 2008, in New Orleans, LA (Source: Mario Tama/Getty Images)

APPENDIX E

WAKE ISLAND – ICRMP ADAPTATION WORKSHEETS

Note: This case study was developed to test the worksheets in Word and for another Service. It has not been vetted by the Air Force.

ICRMP Adaptation Planning Worksheets

The following worksheets support installation-level application of the ICRMP planning process and are modeled after the worksheets in the Climate Adaptation for DoD Natural Resource Managers (Stein et al. 2019). They provide a structured means for managers to gather, evaluate, and analyze adaptation-relevant information, and the worksheets are designed to build on and draw from one another with earlier sections in the process informing subsequent worksheets. Because adaptation planning is an iterative process, the worksheets also provide an opportunity to "show your work" to document decisions and facilitate future assessments or refinements.

The worksheets are intended to serve as an aid for carrying out adaptation planning; they are not intended to be prescriptive. Although the worksheets are designed to be used sequentially, users should not feel compelled to fill out all of the worksheets or each cell in a given worksheet. Additionally, the level of detail entered into the worksheets may vary, depending on the availability of relevant information, and on whether the worksheets are being used to inform a preliminary screening of adaptation needs and options, or to support in-depth decision-making and allocation of resources. These worksheets may be adapted or modified (for instance, adding additional rows or columns) to support the planning needs of particular installations most effectively.

Managers may also find it useful to initially focus on a limited number of resources, risks, or strategies and keep a "parking lot" of items to address in subsequent passes through the adaptation planning process. At any point in filling out the worksheets do not linger—for instance, due to incomplete information or knowledge—make an informed conjecture (documenting any assumptions) to keep moving through the planning process. Should additional information become available, then revisit and refine the relevant worksheet and outcomes.

ICRMP Section 1: Introduction/General Information/Overview

Section 1 sets the context for incorporating climate change considerations into the installation's ICRMP. The Section 1 worksheet is intended to help identify stakeholders and expertise, and available information resources.

Worksheet 1. Planning Scope and Background Information offers a framework for identifying key stakeholders and available information and expertise. Taking climate into consideration often necessitates planning at larger geographic scales and longer time frames than are typically represented in ICRMPs.

Instructions for Worksheet 1.

1. The Introduction/General Information/Overview (or comparable) section of the ICRMP is intended to set the overall context for the plan. It usually includes the purpose of the plan, organization of the ICRMP, overview of laws and regulations, cultural resources management, and roles and responsibilities. It may also include a section on relationships to other installation plans and stakeholders. The overview section lays the framework for why climate change is included in the ICRMP.

2. Stakeholders/Partners: Identify key stakeholders/participants to engage in the adaptation planning process. Relevant participants are expected to come from within and outside of the installation. To the extent feasible, identify individuals or specify organizations to engage. Involving knowledgeable climate scientists and other relevant experts early on can help installations navigate the process more effectively.
3. Available Information/Expertise: Compile existing background information and identify available expertise. Identify and compile any existing studies or resources for understanding regional or local climate projections and cultural resource responses. Existing information can include regional climate summaries, such as included in the National Climate Assessment, state-level assessments, and other adaptation plans. Many state and federal agencies and universities have climate science and adaptation experts available. Chapter 4.2 and Appendix A of the guidance manual offer starting points for available information.

Worksheet 1. Background Information

Section of ICRMP – Introduction/General Information/Overview:

Section number(s) in existing ICRMP (these could be all under one section heading or slightly different section headings):

In the following bullets, add the appropriate section number and draft statements to be added to those sections:

- Purpose of the Plan section #___1.0___.

Add statements about preservation and /or management in a dynamic environment.

New threats to cultural resources are emerging from climate-driven changes in the environment, which could compromise the capacity of military facilities and lands that support the military mission. This updated ICRMP includes adaptation strategies for managing these risks. _____
_____

- Goals and Objectives is in section #___1.1.2___.

Add Goal: Assess emerging risks and vulnerabilities to cultural resources from climate-driven changes in the environment.

Objective: Develop strategies for adapting to climate risks.

_____

- Organization of the ICRMP section #___N/A___.

Add statements about where specific information can be found. This might include any of the following:

Overview of Laws and Regulations section #___1.2.3 Regulatory Framework___.

Add overarching climate change Executive Orders, DoD directives, DoD guidance, and Service-specific guidance. Descriptions can be found in Sections 2.1 (DoD directives and Executive Orders); and Service-specific guidance in Section 4.1.

Select the appropriate requirements to be added to the ICRMP:

Executive Orders, DoD directives, DoD guidance

- [x] Executive Order (EO) 13653, 1 November 2013, *Preparing the United States for the Impacts of Climate Change*
- [x] EO 13693, 19 March 2015, *Planning for Federal Sustainability in the Next Decade*
- [x] EO 14008, 27 January 2021, *Tackling the Climate Crisis at Home and Abroad*
- [x] DoD Directive 4715.21, *Climate Change Adaptation and Resilience* (2018)

- [x] DoD Roadmap (DoD 2014)
- [x] Updated Unified Facilities Criteria (UFCs)
- [ ] Other _____
- [ ] Other _____
- [ ] Other _____

Service-Specific Guidance on Climate Adaptation

- [ ] Army Climate Resilience Handbook, 2020
- [ ] NAVFAC Climate Change Planning Handbook Installation Adaptation and Resilience, 2017
- [x] Air Force Civil Engineer Severe Weather/Climate Hazard Screening and Risk Assessment Playbook, 202

Relationships to Other Installation Plans section # 1.1 .

These plans would include master plans, sustainability plans, INRMPs, range management plans, and/or building maintenance procedures. These other plans will identify program goals and strategies. Some of these goals and strategies may be applicable to cultural resources. For example, restoring the function of a wetlands may reduce erosion of an archaeological site. However, some goals or strategies may conflict with cultural resources management goals. For example, installation of a seawall may impact submerged cultural resources, or replacing the siding on a historic building could impacts its eligibility for listing in the NRHP. It is important for the CRM to work with other program leads to ensure common goals and that program-specific strategies to not conflict or inadvertently inflict harm to other resources or program areas. Complete the following table with relevant plans. Delete those that are not appropriate.

Review of any climate-related assessments carried out for other installation planning processes, and any strategies developed.

These plans are already included in the Wake Island ICRMP and describe relationship to cultural resources management. Add a statement in section 4.2 describing any climate strategies that might benefit cultural resources management.

Relationship to Other Plans		
Plan Title/ Originating Department	**How it relates to CR management** *Identify plan goals and strategies that are applicable to cultural resources management.*	**Does plan address climate change and Strategies?** *List any strategies that would be appropriate for cultural resources.*
General Plan	ICRMP is a source plan for the General Plan (GP). The Wake Island GP is a document that brings together data from three component areas: Composite Constraints and Opportunities, Infrastructure, and Capital Improvements. Combined with the Integrated Natural Resources Management Plan, this ICRMP provides essential data for the Composite Constraints and Opportunities Component of the GP	?
Integrated Natural Resources Management Plan (INRMP)	The Integrated Natural Resources Management Plan and the ICRMP provides essential data for the Composite Constraints and Opportunities Component of the GP	?

- Cultural Resources Management Responsibilities section #___4.0___.

CRM (611 CES/CEIE/CRM) –

Add additional Cultural Resources Manager's responsibilities to address climate change to installation cultural resources. This may include creating additional awareness for climate vulnerabilities; assisting with developing strategies to manage this risk; and consulting with installations planners, engineers, maintenance personnel, range managers, and natural resources managers on these strategies.

Section 3.3.2.6 - Cultural Resources Managers would be responsible for creating additional awareness for climate vulnerabilities and assist with developing strategies to manage this risk. This would be done in consultation with base planners, engineers, maintenance personnel, and natural resources manager.

Add to other responsibilities:

- Assess climate change risks and threats to cultural resources.
- Discuss climate vulnerabilities and risks with base planner, engineer, maintenance personnel, natural resources manager, BOS Wake Environmental Manager.
- Assist with developing strategies to manage climate change risks with base planner and manager.

Stakeholders – Other consulting parties 7.9 ***Management and Coordination*** - Identify key internal and external stakeholders for assessing climate impacts and carrying out adaptation planning. To the extent feasible, identify specific individuals or organizations. Involving climate scientists and other relevant experts early on may help installations navigate the process more effectively.

Consider adding:

Stakeholders		
Stakeholder	**Climate Change Interest or Expertise**	**Internal or External**
NOAA	Climate change forecasting tools	External
USACE	Coastal hardening; sea level rise strategies	External
Other US DoD military installations on islands	Climate adaptation strategies	External

Section 2. - Installation Profile/Physical/Natural Setting

The purpose of this ICRMP section is to identify key climate concerns for the installation and understand how relevant climatic factors are projected to change over time. Installation-specific climate change information may already be available through other plans, such as an Integrated Natural Resources Management plan or Sustainability Plan. This information would be including the section of the ICRMP that describes the installation and its physical and natural setting.

Section 2 is supported by this worksheet:

- Worksheet 2. Climate Risks, Effects and Trends

Worksheet 2. Climate Risks, Effects and Trends assists with documenting the higher-level elements of climate concerns and projections drawing from existing information and forecasting tools (see section 4.1 of the guidance). The amount of detail installations is able to complete will likely vary. For all factors, be sure to document the source for the specific projections, whether literature, data sets, organizations, DoD offices or analyses, individual experts, in sufficient detail to allow future validation and updates.

Worksheet 2. Climate Risks, Effects and Trends

The following information should be included in Section #___5.1.1___ of the ICRMP. Also, may want to include in Appendix P

The following table (Table 5-1) summarizes the potential climate change risks and trends.

Worksheet 2. Climate Risks, Effects, and Trends		
Has the installation completed a climate change assessment? Note: If yes, indicate where the results are available.	?	
Information Sources List sources of information used to fill in this table.	ICRMP. https://openknowledge.worldbank.org/bitstream/handle/10986/35881/Legal-Dimensions-of-Sea-Level-Rise-Pacific-Perspectives.pdf?sequence=5 Predicting Sea Level Change at Wake Atoll (Wake Island Airfield), 611th CES/CEIE, Joint Base Pearl Harbor Hickam, HI 13 November 2018	
Key Climate Change Risk *What is the key climate change–related risks or threats to the installation, and more specifically for the cultural resources? See table 2-1.*	**Climatic Change Effects** *What are the climatic effects related to those concerns that are relevant for the installation and the resources being managed? See table 2-1*	**Trend/Projections** *What is the trend or directionality for this factor, if known? What are available projections for this variable?* *Notes: Knowing the directionality or trend of a climatic factor can be informative, even without detailed projections of rate or magnitude.* Use consistent timeframes for each climate risk if possible.
Heat	– Increased incidences of heat stress – Vegetation transition (species and biome shifts) – Electrical grid stress – Degradation of equipment performance	Increase in Pacific by about 2.7 to 6.7 degrees F

Worksheet 2. Climate Risks, Effects, and Trends		
Land Degradation/Drought	– Increases in extent and duration of droughts – Loss of vegetative cover – infrastructure damage – Water supply constraints – Protected species stress – erosion	5 to 10% decrease
Increasing storm frequency and intensity	– Increases in number and severity of extreme precipitation events – Increased flooding – Water quality issues – Soil and vegetation loss – Damage to physical infrastructure (roads, buildings, runway) – Habitat loss & damage	Increased intensity of storms
Flooding/Sea level rise	– Loss of coastal land – Damage to physical infrastructure (roads, targets, ranges) and protected ecosystem resources – Land subsidence – Saltwater intrusion – Habitat loss & damage	Broad range of 7 to 10.2 feet (0.2-3.1m) for expected sea level rise and coastal flooding. Wake Airfield will be moderately to severely impacted by Global Climate Change and sea level rise by the turn of the century.

Section 3 - Installation Areas of Concern/Actions Impacting Cultural Resources

The purpose of Section 3 is to identify target cultural resources and existing goals for the installation; describe internal and/or external threats on the installation's cultural resources; assess the impacts of those changes on cultural resources and the resulting climate vulnerabilities of those resources; and finally, determine how those resource vulnerabilities may pose risks to the installation's ability to sustain specific military mission requirements.

Instructions for Worksheet 3

1. Installation Cultural Resource(s): List the cultural resources to be assessed for climate vulnerability. Cultural resource may be archaeological sites, building, structures, historic districts or landscapes, or items. The resources identified here should reflect resources that are of particular management concern for exposure to climate change.
2. Key Climate Change Risk: For each of the cultural resources listed, identify the key climate change–related risks or threats to this cultural resource. Chapter 4 of this guide present the types of climate-related risks to DoD cultural resources, including archaeological sites (Table 4-1); buildings and structures (Table 4-2); and historic landscapes, historic districts, and ethnographic resources (Table 4-3). Understanding the risk and potential consequences to cultural resources will allow managers to determine appropriate strategies for addressing the impacts.
3. Climate-Related Impacts: For each resource listed, identify the impacts that may occur due to the climate change risk. This information may be derived from Tables 4-1 through 4-3 in Chapter 4 of this guide manual, as well as through input from resource experts both within and outside of the installation, and existing vulnerability assessments or other scientific literature.
4. Degree/Reason for Vulnerability: Estimate the relative degree of vulnerability for individual cultural resources and describe why they are considered vulnerable. Being specific about the reasons a resource is vulnerable will be useful in identifying possible risk reduction approaches and developing management responses. To assess vulnerability, estimate how and to what degree the resource would be affected by and respond to expected climate-related changes (sensitivity), and estimate the degree to which the cultural resource is likely to be subjected to the change to which it is sensitive (exposure). What is the overlap between the threat and the exposure? For example, buried archaeological sites may be highly sensitive to flooding, but if it is found outside current and projected flood zones on the installation, it would not be considered vulnerable to that threat.
5. Military Mission Risks from Cultural Resource Vulnerabilities links the risks and vulnerability of cultural resources to the sustainability of military mission and its requirements. Based on the cultural resource vulnerabilities identified in the worksheet below, consider what effect these vulnerabilities may have on the mission requirements. Although there may be direct climate impacts affecting the installation's ability to meet its mission (e.g., temperatures too hot for training, wind damage to structures), the focus here is how climate-vulnerable cultural resources may pose risks to the mission.

Describe how the cultural resource is important to the installation's military mission. For example, historic coastal infrastructure could be used for vital training, or the military logistics activities.

Complete the worksheet and include in Appendix P

Worksheet 3A. Archeological Resources and Climate Risks					
Cultural Resources *What are the cultural resource features (e.g., archaeological sites, buildings, historic district) that are managed at the installation?*	**Key Climate Change Risk** *What is the key climate change–related risks or threats to archeological resource? See Tables 4-1, 4-2, and 4-3 in guide.*	**Climatic Change Impacts** *What are the climatic What are the climatic factors or variables related to those concerns, and which are relevant for the installation and the resources being managed? See Tables 4-1, 4-2, and 4-3 in guide.*	**Degree/Reason for Vulnerability** *Rate the relative vulnerability (e.g., Very High, High, Medium, Low) and describe the reason for that rating.* *It also may be useful to highlight any uncertainties in the assessment.*	**Risks to Installation Mission Requirements** *What are the climatic factors or variables related to those concerns, and which are relevant for the installation and the resources being managed? See Tables 4-1, 4-2, and 4-3 in guide*	**Rate the Risk to Mission**
Notes: Combined all resources into one spread sheet					
National Historic Landmark – 335 features	Heat	– Microcracking of site contents from thermal stress – Faster deterioration of newly exposed features – More rapid decay of organic materials – Increased risk of damage due to decline/loss of protective vegetation or soil	Temperature increase is in the long term is moderate. Risk to resources from heat damage is low, as resources are already exposed a marine climate.	Loss or damage to the features would not jeopardize military mission; however, it would not be into compliance with cultural resources policy to preserve and protect the cultural resources, in particular – a national landmark Would also result in less effective and efficient operations and compliance.	Low

Worksheet 3A. Archeological Resources and Climate Risks					
	Land Degradation/ Drought	– Fracturing of concrete resources – Paint oxidation, color change – Physical damage, loss of integrity and spatial coherence	Added risk to resources is currently low to medium as resources are already exposed to harsh marine environment and climatic conditions. As the land degrades, the risk to sites from heat, exposure, and fire will increase, and could cause damage or destruction to some features.	Loss or damage to the features would not jeopardize military mission; however, it would not be into compliance with cultural resources policy to preserve and protect the cultural resources, in particular – a national landmark Would also result in less effective and efficient operations and compliance.	Low
	Increasing storm frequency and intensity/ increased winds	– Erosion, deflation, or abrasion to features due to stronger winds – Disturbance or removal during emergency response and clean-up – Increased moisture penetration into porous materials – Increased susceptibility to erosion and flooding – Burial or exposure through redistribution of soil	Extreme weather events such as drought, heavy rainfall, and severe winds, are projected to increase in frequency, though precipitation projections are less certain. Risk to resources from storm events is medium, but less certain.	Loss or damage to the features would not jeopardize military mission; however, it would not be into compliance with cultural resources policy to preserve and protect the cultural resources, in particular – a national landmark Would also result in less effective and efficient operations and compliance.	Low
	Sea level rise	– Erosion, deflation, or abrasion to features due to higher tides – Increased moisture penetration into porous materials – Inundation, permanent flooding	Risk to resources from rising sea level is medium to high considering the low profile of the atoll.	Loss or damage to the features would not jeopardize military mission; however, it would not be into compliance with cultural resources policy to preserve and protect the cultural resources, in particular – a national landmark Would also result in less effective and efficient operations and compliance.	Low

Worksheet 3A. Archeological Resources and Climate Risks					
Two historic buildings	Heat	– Microcracking of site contents from thermal stress – Faster deterioration of newly exposed features – More rapid decay of organic materials – Increased risk of damage due to decline/loss of protective vegetation or soil	Temperature increase is in the long term is moderate. Risk to buildings from heat damage is low to medium in the short term, as resources are already exposed a marine climate. High increases in temperature could cause damage to buildings.	Loss or damage to the buildings would not jeopardize military mission but could impeded operations. It would also not be into compliance with cultural resources policy to preserve and protect the cultural resources. Would also result in less effective and efficient operations and compliance.	Medium
	Land Degradation/ Drought	– fracturing of concrete resources – Paint oxidation, color change – infrastructure damage – Water supply constraints – Physical damage, loss of integrity	Added risk to resources is currently low to medium as resources are already exposed to harsh marine environment and climatic conditions. As the land degrades, the risk to sites from heat, exposure, and fire will increase, and could cause damage or destruction to the buildings.	Loss or damage to the buildings would not jeopardize military mission but could impeded operations. It would also not be into compliance with cultural resources policy to preserve and protect the cultural resources. Would also result in less effective and efficient operations and compliance	Medium
	Increasing storm frequency and intensity/ increased winds	– Erosion, deflation, or abrasion to features due to stronger winds – Disturbance or removal during emergency response and clean-up – Increased moisture penetration into porous materials – Water damage, structural damage	Extreme weather events such as drought, heavy rainfall, and severe winds, are projected to increase in frequency, though precipitation projections are less certain. Risk to resources from storm events is medium, but less certain.	Loss or damage to the buildings would not jeopardize military mission but could impeded operations. It would also not be into compliance with cultural resources policy to preserve and protect the cultural resources. Would also result in less effective and efficient operations and compliance.	Medium

Worksheet 3A. Archeological Resources and Climate Risks					
	Sea level rise	– Structural damage – Increased moisture penetration into porous materials – Inundation and flooding, water damage	Risk to resources from rising sea level is medium to high considering the low profile of the atoll.	Loss or damage to the buildings would not jeopardize military mission but could impeded operations. It would also not be into compliance with cultural resources policy to preserve and protect the cultural resources. Would also result in less effective and efficient operations and compliance.	Medium
6 shipwrecks	Increasing storm frequency and intensity/ increased winds	– Destabilization/damage to underwater sites through movement of sediment and/ or protective vegetation – Erosion of coastal sites due to higher, stronger storm surges – Disturbance/exposure/burial due to stronger wave action	Extreme weather events such as drought, heavy rainfall, and severe winds, are projected to increase in frequency, though precipitation projections are less certain. Risk to resources from storm events is medium, but less certain.	Loss or damage to the shipwrecks would not jeopardize military mission; however, it would not be into compliance with cultural resources policy to preserve and protect the cultural resources. Could result in increased compliance efforts.	Low
5 memorials	Heat	– Microcracking of site contents from thermal stress	Temperature increase is in the long term is moderate. Risk to resources from heat damage is low, as resources are already exposed a marine climate.	Loss or damage to the memorials would not jeopardize military mission; however, it would not be into compliance with cultural resources policy to preserve and protect the cultural resources. Could result in increased compliance efforts.	Low

Worksheet 3A. Archeological Resources and Climate Risks					
	Land Degradation/ Drought	– fracturing of concrete resources – Paint oxidation, color change – Physical damage, loss of integrity	Added risk to resources is currently low to medium as resources are already exposed to harsh marine environment and climatic conditions. As the land degrades, the risk to memorials will increase, and could cause damage or destruction to some memorials.	Loss or damage to the memorials would not jeopardize military mission; however, it would not be into compliance with cultural resources policy to preserve and protect the cultural resources. Could result in increased compliance efforts.	Low
	Increasing storm frequency and intensity/ increased winds	– Erosion, deflation, or abrasion to features due to stronger winds – Disturbance or removal during emergency response and clean-up – Increased moisture penetration into porous materials – Increased susceptibility to erosion and flooding	Extreme weather events such as drought, heavy rainfall, and severe winds, are projected to increase in frequency, though precipitation projections are less certain. Risk to resources from storm events is medium, but less certain.	Loss or damage to the memorials would not jeopardize military mission; however, it would not be into compliance with cultural resources policy to preserve and protect the cultural resources. Could result in increased compliance efforts.	Low
	Sea level rise	– Erosion, deflation, or abrasion to features due to higher tides – Increased moisture penetration into porous materials – Inundation, permanent flooding	Risk to resources from rising sea level is medium to high considering the low profile of the atoll.	Loss or damage to the memorials would not jeopardize military mission; however, it would not be into compliance with cultural resources policy to preserve and protect the cultural resources. Could result in increased compliance efforts.	Low

Section 4: Evaluate Implications for ICRMP Goals and Develop Strategies and Actions to Reduce Climate Risks

The purpose of Section 4 is to help managers evaluate whether and how climate change might compromise the installation's ability to meet key ICRMP goals and objectives, based on the information gathered from assessing the vulnerabilities of target cultural resources and the associated risks to the military mission. This section will also help installations identify, evaluate, and select appropriate adaptation strategies and actions.

Section 4 is supported by four worksheets:

- Worksheet 4.1. Identification of Possible Adaptation Strategies and Actions
- Worksheet 4.2. Evaluation and Selection of Adaptation Strategies and Actions
- Worksheet 4.3. Implementation of Adaptation Strategies/Actions

Worksheet 4.1 Identification of Possible Adaptation Strategies and Actions is designed to help managers articulate a range of potential management strategies/actions to address climate-related vulnerabilities to specific cultural resources. The concept here is to be as inclusive as possible and not be constrained by factors such as cost (that comes in Worksheet 4.2). Here, strategies are the broadest level management efforts (e.g., avoidance, minimization, mitigation measures, adopt a historic landscape approach), and actions are specific activities/projects in support of the strategy (e.g., develop maintenance plans, harden a shoreline, relocate a resource, documentation). Managers may identify current management actions, potential modifications to those actions, and/or new actions that may enable the installation to meet climate-informed goals for those resources and then articulate the specific assumptions and rationale for why proposed strategies and actions will reduce relevant risks and vulnerabilities.

As possible adaptation strategies and actions to reduce climate risks are being identified and evaluated, "no action" could also be considered. Depending on the magnitude of risk and level of uncertainty, passive (hands-off) or status quo management may be the most prudent approach.

1. **Risk:** ***Identify the specific climate-related risks to be addressed.*** Copy the specific climate change risk from worksheet 3, column 2 for strategies and actions are being designed.
2. **Adaptation Reduction Strategies:** ***Identify potential strategies to reduce the climate risks identified in Worksheet 3.*** Strategies constitute general approaches for addressing a problem, and are supported by specific actions and projects, which are identified in the next column on Worksheet 4.1. Strategies are in Table 4-4 of the guide, although this list is not all inclusive. List all that are feasible.
3. **Supporting Actions/Projects:** ***Identify specific actions and/or projects that would help to achieve the strategies identified under Column 3 in the worksheet.*** Again, the strategies and actions identified in these columns may include existing efforts, modifications of those efforts, and/or new strategies/actions that might be capable of reducing the relevant risks and enabling the installation to meet its climate-informed goals. There may be one or more actions or projects available to support a given strategy. List all the actions/projects that are appropriate.

4. See Table 4-4 for ideas, although this list is not all inclusive. List all that are feasible.
5. **Rationale and Assumptions:** ***Describe why a given strategy or action could be effective in addressing the risk or vulnerability.*** Laying out how the strategy/action is designed to reduce a specific risk, along with the assumptions behind that hypothesis, are key for evaluating the likely effectiveness of the strategy in Worksheet 4.2. Additionally, being able to "connect the dots" by linking actions to climate impacts is an overarching principle for effective climate adaptation. Documenting the rational also provides a record of this thought process for future managers and decision makers.

Include this table in Appendix P to document thought process.

Worksheet 4.1. Identification of Possible Adaptation Strategies and Actions				
Cultural Resources *Copy cultural resources column (column 1) from worksheet 3 and paste in this column*	**Climate Change Risk** *Copy the specific column 2 from Worksheet 3)*	**Risk Reduction Strategies/ Actions** *What strategies/action could reduce these vulnerabilities and risks? Table 4-4*	**Project** *What projects could be carried out to realize a given strategy/action? Table 4-4.*	**Rationale and Assumptions** *How is this strategy or set of actions likely to reduce these vulnerabilities or risks?*
	Notes: Describe the specific vulnerability (to cultural resources) or risk (to military mission) to be addressed by the strategy and their associated actions/projects.	*Notes: List possible strategies for reducing the vulnerability or risk. Strategies can be general in nature, since more detailed supporting actions/ projects are listed in the next column.*	Notes: For each strategy identified in the column to the left, list the actions or projects—or suite of actions—that could help to achieve its intended risk reduction benefits. Be as specific as possible. These can be existing, modified, or new actions/projects.	Notes: Describe why this strategy (and its associated actions/projects) may be capable of reducing the stated vulnerabilities and risks. Note any assumptions or uncertainties.
National Historic Landmark – 335 features	Heat	NA	NA	Risk from heat low, other strategies would be sufficient to cover impacts
	Land Degradation/ Drought Increasing storm frequency and intensity Sea Level Rise	Strategy 1. Mitigate for the loss	No Action - monitoring of resource condition and climate change	With uncertainty in change and magnitude of risk, may be prudent to monitor change and determine most vulnerable features.
		Strategy 2. Mitigate for Loss	Document and release	Not all sites may be able to be preserved or protected.
		Strategy 3. Adapt to reduce the vulnerability of the features	improve resiliency - repair or replace damaged or degraded materials with in-kind materials	Action will enhance survival of a resource while minimizing changes to the physical materials.

Worksheet 4.1. Identification of Possible Adaptation Strategies and Actions				
Two historic buildings	Heat Land Degradation/Drought Increasing storm frequency and intensity/increased winds Sea Level Rise	Strategy 1. Mitigate for the loss	No Action - monitoring of resource condition and climate change	With uncertainty in change and magnitude of risk, may be prudent to monitor change and when a threshold is reached implement a new strategy.
		Strategy 2. Mitigate for Loss	Document and release	Not all sites may be able to be preserved or protected.
		Strategy 3. Adapt to reduce the vulnerability of the property and its environs	Improve Resilience. Examples include: Treatment of structural materials to better withstand increased moisture and wind. Incorporate design measures for temporary flooding. Incorporate shade structures or plants	May result in possible impacts on the integrity of the resource, but ultimately save the historic property.
Shipwrecks	Increasing storm frequency and intensity/increased winds	Strategy 1. Mitigate for the loss	No Action - monitoring of resource condition and climate change	With uncertainty in change and magnitude of risk, may be prudent to monitor change and determine most vulnerable sites.
		Strategy 2. Mitigate for Loss	Document and release (data recovery, excavation)	Not all sites may be able to be preserved or protected.
		Strategy 3. Prevent hazards from happening	Relocate wrecks into protected lagoon	Action will enhance survival of the remaining portion of the resource. Although the resource would no longer have integrity of location. All resources may not be able to be moved.

Worksheet 4.1. Identification of Possible Adaptation Strategies and Actions				
Memorials	Land Degradation/ Drought/ fire Increasing storm frequency and intensity/increased winds Sea Level rise	Strategy 1. Mitigate for the loss	Document and release	Not all memorials may be able to be preserved or protected.
		Strategy 2. Mitigate for Loss	Interpret the change	Not all memorials may be able to be preserved or protected. As part of interpretation, include story of climate change
		Strategy 3. Adapt to reduce the vulnerability of the property and its environs.	Improve Resilience – maintain finishes, repair damage, explore treatments Add erosion controls, manage water runoff, install wind breaks.	Action will enhance survival of a resource while minimizing changes to the physical materials and setting of the resource.

Worksheet 4.2 Evaluation and Selection of Adaptation Strategies and Actions is intended to help installations reduce a broad list of possible actions down to those that are most likely to be successful at reducing climate risks, achieving ICRMP goals, and supporting broader military mission requirements. The intent of this "consequence table" is to identify those strategies or actions that should be considered as priorities for incorporation into the ICRMP and subsequent implementation. A separate worksheet or consequence table can be filled out to evaluate strategies that address different risks/vulnerabilities. Similarly, a separate consequence table can be filled out to evaluate different actions that may support a given strategy.

Instructions for Worksheet 4.2

1. Focus of worksheet. Note on the worksheet what the consequence table is being used to evaluate. The worksheet can be used to focus on a particular risk/vulnerability, comparing potential strategies for reducing that risk. The worksheet can also be used to carry out a more in-depth exploration of a particular strategy, comparing potential actions or projects that might support implementation of that strategy. As noted above, multiple versions of this worksheet, focusing on different risks or strategies, may be filled out depending on specific installation planning needs.
2. List a set of management strategies/actions for evaluation (derived from Worksheet 4.1). These strategies or actions should be inserted in the head the columns (i.e., "Strategy/Action 1") on the worksheet. Modify the worksheet to include as many columns as needed to accommodate all strategies or actions to be evaluated, including taking no action, if appropriate. These strategies/actions can reflect options where the intent is to select the best among them, or they may reflect a suite of strategies or actions where the intent is to include multiple actions that meet certain criteria.
3. Create criteria for evaluating the strategies/actions. Criteria for evaluating the strategies/actions should be inserted in the left-hand columns. Modify the worksheet to include as many rows as needed to accommodate all criteria to be used in the evaluation. Choosing among adaptation strategies will depend on a range of factors, depending on the installation's particular needs, interests, and resources. Defining explicit criteria for use in evaluation and comparison of alternatives helps clarify what really matters, not just with respect to desired ecological outcomes, but also in terms of other important values or benefits. In particular, it is important to make sure users address risk, tradeoffs, and uncertainties. Illustrative evaluation categories are included on Worksheet 4.2.
4. Evaluate and score the strategies/actions based on agreed-upon criteria. Worksheet 4.2 is based on a structured decision-making "consequence table" approach and is designed to help managers evaluate options or alternatives identified in Worksheet 4.1. There are many ways in which to conduct scoring under this approach. For example, either rank options on a relative scale (e.g., low, medium, high) for how the options meet the criteria, or rank them numerically and tally scores (e.g., low = 1, medium = 2, high = 3). In these instances, it is important to be clear about whether higher scores are "better" or "worse." For transparency, it may also be useful to qualify one's choice with a reason

for choosing the particular rank. This type of "consequence table" is just one approach for evaluation and comparison of options; installations should feel free to use other approaches based on their existing capacities and planning procedures.

5. Determine which strategies/actions merit incorporation into the ICRMP. Based on evaluation against the agreed-upon criteria, managers are in a position to select the strategies/actions that best meet their needs and are feasible to implement. Selecting which alternatives to include in the ICRMP can be based on a number of techniques, which can range from quantitative techniques (i.e., highest total values) to selecting alternatives that optimize one or more particular criteria. There is no right or wrong way but use of a consequence table such as this allows managers to be transparent and explicit about their selection process. Identify action to be carried forward.

Include this table(s) in Appendix __P__ to document thought process.

Worksheet 4.2.A Evaluation and Selection of Adaptation Strategies and Actions			
Focus of Worksheet: Resource and Specific Risk (create additional tables for each resource and risk)			
Strategy/Action/Project to Evaluate List strategy/action/project to be evaluated in columns at right. These should carry over from Worksheet 4.1. Add columns for additional strategies/actions as needed.	Strategy/Action 1	Strategy/Action 2	Strategy/Action 3
Notes: Choosing among adaptation strategies will depend on a range of factors, depending on the installation's particular needs, interests, and resources. Major categories below are illustrative.	Mitigate for the loss/ No Action - monitoring of resource condition and climate change	Mitigate for the loss/ Document and release	Adapt to reduce the vulnerability of the feature/ improve resiliency - repair or replace damaged or degraded materials with in-kind materials
Criteria for Evaluation Identify and list below relevant criteria for evaluating/comparing proposed strategies-actions/projects. Add rows for additional criteria as needed.			
Effectiveness at meeting climate-informed cultural resource goals/ provide reasoning for choice	Low Would allow for additional data collection and monitoring to determine better approach in the future when change is more certain.	Low Would preserve information for future study, but would not protect resource in situ	Medium Would enhance survival of the landmark features while minimizing changes to the physical setting of the resources.
Effectiveness in meeting other installation objectives/provide reasoning for choice	Medium Would provide additional information about climate change trends to info other program decisions.	Low Would not provide any additional protections to natural resources although may lessen restrictions on other uses in site-specific areas	Low Would not provide any additional protections to natural resources although may lessen restrictions on other uses in some areas
Feasibility/provide reasoning for choice Note: Wake Island is a very remote island. Here costs are for comparison to each strategy. In general, costs are higher on Wake than other installations. Logistics are more complex.	Yes Costs relatively low.	Yes Costs moderate - will depend on the level of recordation and number of sites	Yes Moderate to high cost depending on number of sites and access to sites.
Recommend for Inclusion in INCRMP?	Adequate in short-term	Adequate	Best

Worksheet 4.2.B Evaluation and Selection of Adaptation Strategies and Actions			
Focus of Worksheet: Two historic buildings – Heat/Land Degradation/ Increase storm intensity/sea level rise			
Strategy/Action/Project to Evaluate List strategy/action/project to be evaluated in columns at right. These should carry over from Worksheet 4.1. Add columns for additional strategies/actions as needed.	Strategy/Action 1	Strategy/Action 2	Strategy/Action 3
Notes: Choosing among adaptation strategies will depend on a range of factors, depending on the installation's particular needs, interests, and resources. Major categories below are illustrative.	Mitigate for the loss/ No Action - monitoring of resource condition and climate change	Mitigate for the loss/ Document and release	Adapt to reduce the vulnerability of the property and its environs/ Improve resiliency Examples include: – Treatment of structural materials to better withstand increased moisture and wind. – Incorporate design measures for temporary flooding. – Incorporate shade structures or plants
Criteria for Evaluation Identify and list below relevant criteria for evaluating/comparing proposed strategies-actions/projects. Add rows for additional criteria as needed.			
	Low	Low	Medium
Effectiveness at meeting climate-informed cultural resource goals	Would allow for additional data collection and monitoring to determine better approach in the future when change is more certain.	Would preserve information for future study, but would not protect resource in situ	Would enhance survival of the buildings minimizing changes to the physical setting of the resources.

Worksheet 4.2.B Evaluation and Selection of Adaptation Strategies and Actions			
	Low	Low	Moderate
Effectiveness in meeting other installation objectives	Would provide additional information about climate change trends to info other program decisions.	Would not provide any additional protections to natural resources although may lessen restrictions on other uses in site-specific areas	Would not provide any additional protections to natural resources. Would support on-going mission activities that are housed within these buildings.
Feasibility	Yes	Yes	Yes
Note: Wake Island is a very remote island. Here costs are for comparison to each strategy. In general, costs are higher on Wake than other installations. Logistics are more complex.	Costs relatively low.	Costs low to moderate - will depend on the level of recordation and number of sites	Moderate to high costs - can partially be incorporated into overall maintenance and repairs.
Recommend for Inclusion in INCRMP?	Adequate in short-term	Adequate	Best

Worksheet 4.2.B Evaluation and Selection of Adaptation Strategies and Actions			
Focus of Worksheet: Shipwrecks/storm intensity			
Strategy/Action/Project to Evaluate List strategy/action/project to be evaluated in columns at right. These should carry over from Worksheet 4.1. Add columns for additional strategies/actions as needed.	Strategy/Action 1	Strategy/Action 2	Strategy/Action 3
Notes: Choosing among adaptation strategies will depend on a range of factors, depending on the installation's particular needs, interests, and resources. Major categories below are illustrative.	Mitigate for the loss/No Action - monitoring of resource condition and climate change	Mitigate for the loss/Document and release (data recovery, excavation)	Prevent hazards from happening/ Relocate wrecks into protected lagoon
Criteria for Evaluation Identify and list below relevant criteria for evaluating/comparing proposed strategies-actions/projects. Add rows for additional criteria as needed.			
Effectiveness at meeting climate-informed cultural resource goals	Low	Low	Low
	Would allow for additional data collection and monitoring to determine better approach in the future when change is more certain.	Would preserve information for future study, but would not protect resource in situ	Would enhance survival of the ship remains, would result in adverse effect to integrity of location, and could cause damage to fragile ship remains. However, may provide better opportunities for interpretation.
Effectiveness in meeting other installation objectives	Low	Medium	Medium
	Would provide additional information about climate change trends to info other program decisions.	Would not provide any additional protections to natural resources or mission although may lessen restrictions on other uses in site-specific areas	Would not provide any additional protections to natural resources or mission although may lessen restrictions on other uses in site-specific areas

Worksheet 4.2.B Evaluation and Selection of Adaptation Strategies and Actions			
Feasibility Note: Wake Island is a very remote island. Here costs are for comparison to each strategy. In general, costs are higher on Wake than other installations. Logistics are more complex.	Yes Costs relatively low.	Yes Costs low to moderate depending on the level of data recovery and number of sites	Yes High costs and could result in damage to the resource.
Recommend for Inclusion in INCRMP?	Adequate in short-term	Adequate	Adequate

Worksheet 4.2.B Evaluation and Selection of Adaptation Strategies and Actions			
Focus of Worksheet: Memorials – land degradation/ increased storm intensity/sea level rise			
Strategy/Action/Project to Evaluate List strategy/action/project to be evaluated in columns at right. These should carry over from Worksheet 4.1. Add columns for additional strategies/actions as needed.	Strategy/Action 1	Strategy/Action 2	Strategy/Action 3
Notes: Choosing among adaptation strategies will depend on a range of factors, depending on the installation's particular needs, interests, and resources. Major categories below are illustrative.	Mitigate for the loss/No Action – document and release	Mitigate for the loss/Interpret change	Adapt to reduce the vulnerability of the property and its environs / Improve Resilience Maintain finishes, repair damage, explore treatments Add erosion controls, manage water runoff, install wind breaks
Criteria for Evaluation Identify and list below relevant criteria for evaluating/comparing proposed strategies-actions/projects. Add rows for additional criteria as needed.			
Effectiveness at meeting climate-informed cultural resource goals	Low	Low	High
	Would preserve information for future study, but would not protect resource in situ	Would preserve information for future study, also provide opportunity to educate about climate change	Would enhance survival of the memorials.
Effectiveness in meeting other installation objectives	Low	Medium	Low
	Would not provide any additional protections to natural resources or mission	Would not provide any additional protections to natural resources although may also allow for additional interpretation regarding natural resources and climate change	Would not provide any additional protections to natural resources or mission

Worksheet 4.2.B Evaluation and Selection of Adaptation Strategies and Actions			
Feasibility	yes	yes	yes
	Costs relatively low.	Costs low to moderate depending on the level of data recovery and interpretation methods	Higher and on-going costs. Could be part of on-going maintenance.
Recommend for Inclusion in INCRMP?	Adequate	Adequate	Best

Worksheet 4.3 Implementation of Adaptation Strategies/Actions provides a general framework to help installations identify: who will carry out the implementation of the adaptation strategies and actions/projects; whether and how the relevant strategies and actions fit within existing DoD program implementation; what decisions are especially relevant to get the strategies and actions ready to implement; and when various element of the strategies and actions should be implemented. The order is to go from strategy to action to projects.

Instructions for Worksheet 4.3

1. **Recommended Strategies/Actions:** ***List the strategies, actions, or projects identified in Worksheet 4.1 for incorporation into the ICRMP.***
2. **Responsible Parties:** ***Identify who has responsibility or needs to be involved in carrying out this action or project.*** For example, can it be done in-house, or will it be done via contract?
3. **Relationship to Existing ICRMP Strategies:** ***Determine whether and how the action or project fits into existing efforts.*** Is the action within the installation's authority or will it fit within an approved project?
4. **Project Planning Needs:** ***Identify what needs to be done to get this project ready to implement.*** Note here what would be necessary to put in place prior to projection implementation, such as regulatory permits, funding mechanisms, engineering work, detailed project design, or scientific research to validate the approach or solve technical issues. Are there any unique adaptation barriers (e.g., legal, social)?
5. **Timing and Sequencing:** ***Identify when the project is needed or should be carried out.*** Identify when the project should be started. Are there any dependencies that would influence the timing or sequencing of implementation? In some cases, specific dates may be relevant (e.g., start "phase 1" in FY 19). In others, it may be necessary to identify specific management trigger points (e.g., actions to be implemented in response to a specific climate threshold, such as a certain extent of sea-level rise).

Incorporate into ICRMP Implementation Table. Once a project has been adequately defined, incorporate it into the ICRMP's implementation table or the ICRMP Program Planning objectives. Section # 10.1 and 10.2

Worksheet 4.3. Implementation of Adaptation Strategies/Actions

Cultural Resources *From column 1 in worksheet 4.1*	**Recommended Strategies/Actions** *List selected strategies/ actions recommended for incorporation into the ICRMP (from Worksheet 4.2).*	**Responsible Parties** *Who would have responsibility for or be involved in implementing the strategy/action?*	**Relationship to Existing ICRMP Strategies** *Does this fit within a current ICRMP effort, or is it a new activity/ project?*	**Project Planning Needs** *What preparations or requirements would be necessary before carrying out the recommended strategies/ actions?*	**Timing and Sequencing** *When should the action/project be implemented (immediately or at some future time)?*
		Notes: Identify whether this project could be done in-house, via contract, or through partnering.		*Notes: List permitting, funding, design, methods development, scientific research, etc. Are there any unique implementation challenges (e.g., legal, social, technical)?*	*Notes: Identify when the project should be started. Consider dependencies that may require project sequencing, or any ecological thresholds that may trigger needed action.*
National Landmark Historic buildings Shipwrecks Memorials	Strategy 1. Mitigate for the loss/ No Action - monitoring of resource condition and climate change	Cultural Resources Management	new action	develop protocol for consistent monitoring	short-term, 0 – 10 years
National Landmark Historic buildings Shipwrecks	Strategy 2. Mitigate for Loss/ Document and release	Cultural Resources Management	new action – some smaller items could be included as part of Museum/visitor center displays, as appropriate	Develop programmatic agreement with SHPO and for level of data recovery and curation	Short-term, 0 – 10 years, as individual sites are at risk of loss

Worksheet 4.3. Implementation of Adaptation Strategies/Actions					
Memorials	Strategy 2. Mitigate for Loss/ Interpret change	Cultural Resources Management	new action – could be included as part of Museum/visitor center displays, as appropriate	Develop programmatic agreement with SHPO and for message and methods	Short-term, 5 – 10 years, as individual sites are at risk of loss and budget allows
National Landmark Historic buildings Memorials	Strategy 3. Adapt to reduce the vulnerability of the feature/ improve resiliency - repair or replace damaged or degraded materials with in-kind materials Treatment of structural materials to better withstand increased moisture and wind. Incorporate design measures for temporary flooding. Incorporate shade structures or plants Maintain finishes, repair damage, explore treatments Add erosion controls, manage water runoff, install wind breaks	PRSC Detachment 1, Program Manager, USAF BOS Contractor, Cultural Resources Management; and Natural Resources Management	New action	– Plan and design – Environmental compliance (NEPA, NHPA) – Identify funding	Short-term: Planning and design should begin in upcoming years to determine appropriate building materials. On-going: Implementation should occur as materials or planting needs to be repaired or replaced. Long-term: Monitor for changing climatic conditions. Establish climate change thresholds and implement when thresholds are reached.

Worksheet 4.3. Implementation of Adaptation Strategies/Actions					
Shipwrecks	Strategy 3. Prevent hazards from happening/ Relocate wrecks into protected lagoon	PRSC Detachment 1, Program Manager, USAF BOS Contractor, Cultural Resources Management; and Natural Resources Management	New action	– Plan and design – Environmental compliance (NEPA, NHPA) – Identify funding	Short-term: Planning and design should begin in upcoming years to determine appropriate methods and equipment needed for move, and fragility of the resources. Implementation medium to long-term (5 to 20 years), as funding and equipment are available.

Climate Adaptation Guide for Cultural Resources

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