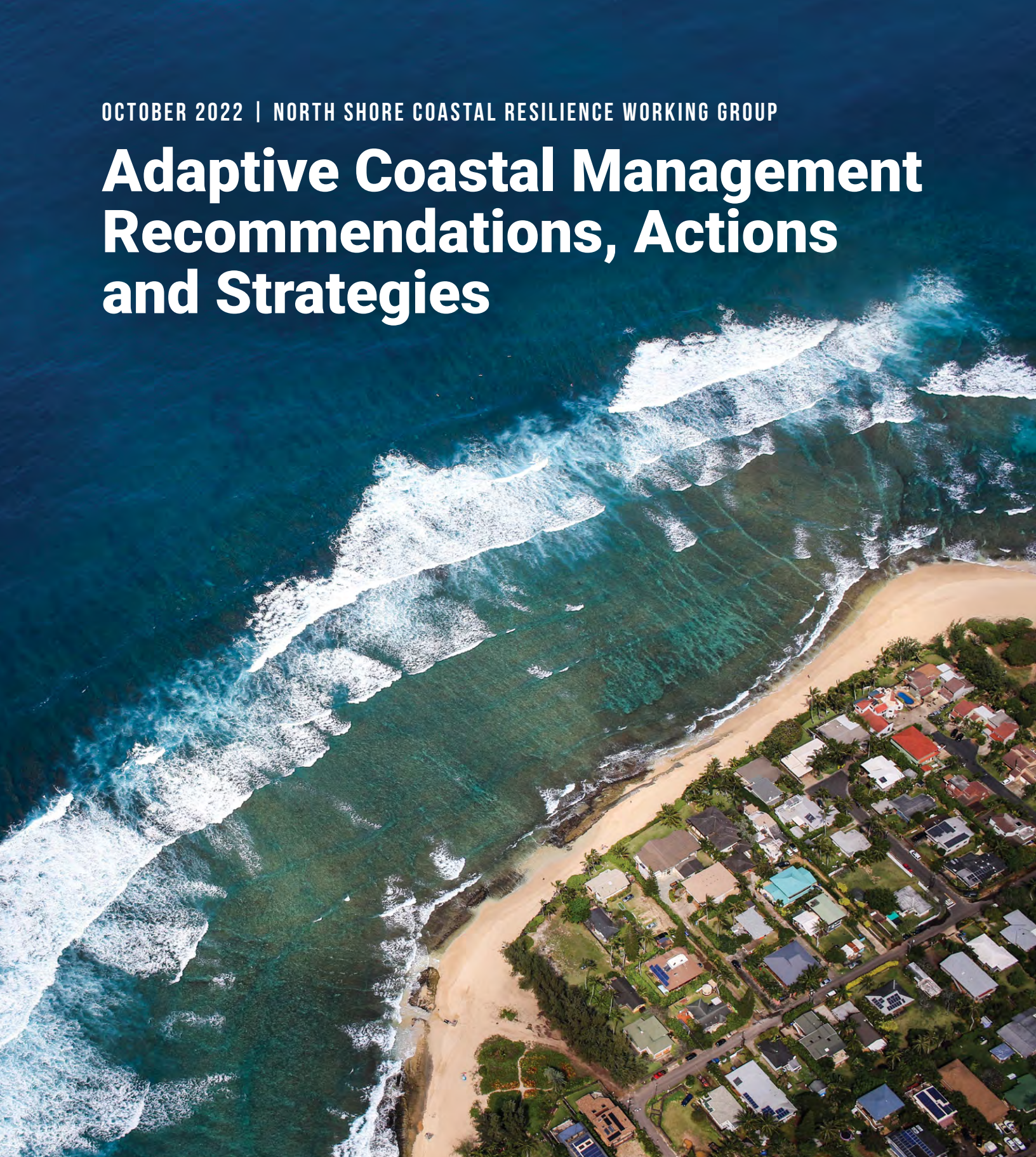


OCTOBER 2022 | NORTH SHORE COASTAL RESILIENCE WORKING GROUP

# Adaptive Coastal Management Recommendations, Actions and Strategies





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The North Shore Coastal Resilience Working Group was convened by the Surfrider Foundation, Surfrider’s O’ahu Chapter, Hawai’i Sea Grant and SSFM International in response to an overwhelming public need to address the immediate threats posed by coastal erosion on the North Shore of O’ahu. The project engaged more than 30 stakeholders, including local residents and landowners, state and local agencies, coastal scientists, policymakers and nonprofits. The project team thanks each member for their willingness to collaborate on this project and share their knowledge, expertise and perspectives. We additionally acknowledge the contributions made by Dr. David Revell who guided the Working Group through the development of the Adaptation Pathways.

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# Abbreviations and Terms

## ABBREVIATIONS

- BLNR** Board of Land and Natural Resources
- CZMA** Coastal Zone Management Act
- COEMAP** State of Hawai'i Coastal Erosion Management Plan
- DLNR** Department of Land and Natural Resources
- FEMA** Federal Emergency Management Agency
- NSCRWG** North Shore Coastal Resilience Working Group
- NSSCP** North Shore Sustainable Communities Plan
- OCCL** Office of Conservation and Coastal Lands
- SID** Special Improvement District
- SMA** Special Management Area
- TDR** Transfer of Development Rights

## DEFINITIONS OF TERMS

**Adaptation Pathways:** Conceptual planning approaches addressing the uncertainty and challenges of climate change decision-making.

**Beach Nourishment:** The process of restoring an eroding beach by adding sand along the shoreline.

**Dune Restoration:** Working with the natural processes of sand accumulation and vegetation growth to encourage buildup of healthy dunes over time.

**Managed Retreat:** A comprehensive coastal erosion and sea level rise adaptation strategy that aims to voluntarily and equitably relocate communities away from vulnerable coastal areas in response to either episodic or chronic threats. Managed retreat is not a single program, as it is comprised of multiple components, financing mechanisms and timelines.

**Phased Adaptation:** Implementing coastal adaptation strategies on a series of short, medium, and long-term timelines. Managed retreat is one type of strategy that fits into a phased adaptation approach, as are dune restoration and beach nourishment.



**Sand Pushing:** Projects that use heavy machinery, such as bulldozers, to rebuild elevated sand berms or dunes at the landward end of a beach by scraping and pushing sand from the lower to the upper beach.

**Shoreline:** The upper reaches of the wash of the waves, other than storm and seismic waves, at high tide during the season of the year in which the highest wash of the waves occurs. This is usually evidenced by the edge of vegetation growth, or the upper limit of debris left by the wash of the waves (i.e., the “administrative” Shoreline, spelled with a capital “S” herein; Hawai'i Revised Statutes (HRS) 205A-1 Definitions).

**Special Improvement Districts:** Areas in which additional fees and/or taxes are collected to fund specific improvements within the area.

**Transfer of Development Rights:** A zoning technique used to permanently protect land with conservation value (such as farmland, community open space, vulnerable shorelines or other natural or cultural resources) by redirecting development that would otherwise occur on this land (the sending area) to an area planned to accommodate growth and development (the receiving area).

# Executive Summary

The North Shore coastline of O'ahu (from the district or moku of Waialua to the northern portion of Ko'olau Loa) faces imminent threats from coastal erosion and flooding, which are worsening with climate change and sea level rise. In an effort to proactively address accelerated beach loss and improve community resilience on the North Shore, and thus ensure the long-term protection of beaches, the Surfrider Foundation, Surfrider's O'ahu Chapter, The University of Hawai'i Sea Grant College Program (Hawai'i Sea Grant), and SSFM International convened the North Shore Coastal Resilience Working Group (NSCRWG) for a series of facilitated discussions in 2021 and 2022.

The NSCRWG is a community-driven, collaborative effort among diverse stakeholders. It was developed to discuss and identify possible solutions and address increased impacts from coastal erosion and flooding within the North Shore planning district, which includes the shoreline from Ka'ena Point to Velzyland. The Working Group, selected by the conveners to represent a cross-section of community stakeholders, included North Shore residents and landowners, state and local government staff, elected officials, coastal scientists, engineers, planners and nonprofits. Overall, NSCRWG members expressed a high degree of concern about the

preservation of beaches, public infrastructure, coastal access and the mitigation of coastal hazard risks on the North Shore. The effort was undertaken concurrently with an update to the North Shore Sustainable Communities Plan (NSSCP), the city's 25-year plan for the district. This offered an opportunity for the outcomes of the Working Group process to help inform policy direction on climate change adaptation, coastal preservation and management, and related topics addressed in the NSSCP.

Over a series of six meetings, Working Group members identified three coastal erosion 'hot spots' on the North Shore, including Rocky Point - Sunset Beach, Laniākea - Chun's and Mokolē'ia. The group also discussed coastal adaptation challenges and explored the relative merits, costs, benefits and feasibility of various solutions. These actions represent a starting point for more detailed evaluation and climate change adaptation planning for the North Shore. As part of these discussions, the group identified seven critical concerns that must be remedied in order to proactively and holistically support the North Shore community in adapting to severe coastal erosion. While the issues identified are specific to the North Shore, they are relevant to beachfront communities statewide and may serve as a starting point for similar discussions in other communities.





**Critical Concerns of the NSCRWG Related to Community Vulnerability and Coastal Resource Management:**

1. Immediate erosion threats and impacts to homes, highways and public infrastructure
2. Lack of options and transparent, publicly-shared guidelines for homeowners impacted by shoreline erosion
3. Increasing erosion and flood risks with climate change and sea level rise
4. Damaged and limited public beach access due to erosion, beach loss and inappropriate response measures
5. Environmental impacts of unauthorized and expired materials on the shoreline
6. Lack of cohesive policy framework and financing mechanisms for managed retreat
7. Absence of a comprehensive coastal erosion strategy and long-term vision for the North Shore

**The NSCRWG further identified the following six recommendations for immediate action by relevant organizations, agencies and policymakers:**

1. Improve guidelines and limitations for emergency shoreline erosion management and strengthen enforcement against unauthorized work and materials
2. Establish a statewide managed retreat program, with the North Shore as a pilot area, to provide a pathway for affected landowners to voluntarily vacate affected properties and utilize shoreline areas for public benefit
3. Improve interagency coordination for shoreline erosion and flood management, which overlaps jurisdictional and ownership boundaries
4. Develop a beach and dune management plan for North Shore beach parks and accessways, including guidelines that may be transferable to efforts fronting privately-owned lands
5. Develop a comprehensive climate change and sea level rise vulnerability assessment and adaptation strategy for the North Shore
6. Continue the NSCRWG and expand community discussions, engagement and outreach



Photo: University of Hawai'i Sea Grant

**Lessons Learned and Recommendations for Future Efforts:**

This document provides a starting point for articulating the issues, factors and needs for addressing the chronic coastal erosion hazards on the North Shore of O'ahu. Given the limited scope and size of the effort, it was acknowledged that gaps exist in the group's understanding and the representation of diverse perspectives within the group. Additional planning, technical studies and community involvement are therefore needed to further vet the identified solutions and place them within the context of a climate adaptation plan or framework. The model of convening various community, technical, government and other perspectives to discuss and build a shared understanding and consensus about these complex issues, as well as how to address them, is one that can be replicated and built upon on the North Shore and elsewhere.

In addition to the issues and recommendations identified herein, one of the NSCRWG's key outcomes was building a group of informed and engaged citizens who were connected with technical expertise and government agencies. This project thus expanded the community's capacity to educate others and advocate for action. Ideally, the efforts of the NSCRWG will be continued and expanded to encompass broader community education and involvement, incorporate additional perspectives and establish an implementation framework to allow subcommittees to pursue and track progress on initiatives. Such a structure will require continued funding, commitment to participation, and buy-in from key agencies and community leaders.





# Introduction

A majority of beaches on O'ahu are eroding, with the North Shore representing an epicenter of coastal erosion and impacts for the island. These impacts are playing out in highly visible shoreline erosion episodes that are threatening homes, public infrastructure, public beach access and Hawaiian cultural resources at Mokulē'ia, Laniākea, Pūpūkea, Sunset Beach and elsewhere, as seen on the Location Map (p.11). Seawalls and other shoreline armoring structures further exacerbate and transfer erosion issues and result in widespread beach loss, illustrating the immediate need to develop holistic, long-term solutions for the area.

In an effort to proactively address chronic coastal erosion and the accelerated loss of sandy coastlines along the North Shore, the Surfrider Foundation, Surfrider Foundation's O'ahu Chapter, Hawai'i Sea Grant, and SSFM International partnered to convene the North Shore Coastal Resilience Working Group (NSCRWG). The NSCRWG was a community-driven, collaborative effort to discuss and evaluate options related to chronic coastal erosion and climate change adaptation in the North Shore planning district, which includes the shoreline from Ka'ena Point to Velzyland.

The Working Group was selected by the conveners to represent a cross-section of community stakeholders at a size that would allow for productive discussions. Members included North Shore residents and landowners, state and local government staff, community members, elected officials, coastal scientists, engineers, planners and nonprofits.

This effort represents one of the first community-based coastal adaptation working groups in Hawai'i and can help to inform similar efforts in other coastal communities throughout the state and beyond.

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## WORKING GROUP GOALS

The primary goals of the Working Group discussions were to establish a shared understanding of coastal erosion issues, identify and discuss potential solutions, develop preliminary recommendations driven by needs and begin building community consensus toward preferred coastal erosion mitigation and adaptation solutions on the North Shore of O'ahu. This process focused on finding ways to improve community resilience, conserve the natural beach ecosystem and the nearshore marine environment, and protect public access, recreational resources, cultural resources and water quality by:

1. Developing a shared understanding of coastal erosion, beach loss and projected sea level rise risks for the North Shore of O'ahu by utilizing the best available science
2. Identifying coastal hazard 'hot spots' and priority areas for implementing adaptive management solutions along the North Shore
3. Developing a shared understanding of a range of adaptation options and emerging policy and financing solutions that can support implementation
4. Documenting stakeholder perspectives on coastal hazards and potential solutions
5. Cultivating champions for coastal resilience and climate adaptation efforts on the North Shore
6. Gathering input to inform campaign goals and strategies for the North Shore coastal protection efforts of the Surfrider Foundation's O'ahu Chapter



Location Map of the North Shore of O'ahu. Locations in red are erosion 'hotspots' identified by the working group.

## WORKING GROUP COMPOSITION AND PROCESS

The NSCRWG was a 'by invitation' voluntary working group. Members were selected by the conveners to represent a range of perspectives and expertise from the North Shore community, city and state resource agencies, and technical experts. A recruitment process was undertaken and a total of 23 individuals committed to participating in the Working Group. A list of Working Group members and their affiliations is included in Appendix C. To ensure that a range of perspectives were represented at meetings, Working Group members were able to designate alternates to attend in their place.

Members were asked to sign and adhere to a Charter of Commitments. The charter outlined the purpose, goals and objectives of the Working Group. It also established the expectations and ground rules for the project team and Working Group members. Members were asked to contribute

input and perspectives that represented the interests and concerns of their respective organizations or stakeholder groups. The Working Group utilized the Chatham House rules which does not attribute comments made to specific individuals. Participating members also provided input on drafts of the recommendations and report.

The Working Group met six times between September 2021 and April 2022. Meetings were organized, facilitated and documented by professional planners from SSFM International. In light of the public health risks and various mandates from the state, city, and county governments from the COVID-19 pandemic, the majority of meetings were hosted virtually through video calls. One in-person site visit was convened in October 2021 and the final Working Group meeting was held in person in April 2022. Meeting summaries are included in Appendix B.

**Members were selected by the conveners to represent a range of perspectives and expertise from the North Shore community, city and state resource agencies, and technical experts.**



## ACCOMPLISHMENTS

Over the course of the six meetings, the Working Group accomplished several key goals. Specifically, it:

- Identified and documented issues and opportunities for three coastal erosion 'hot spots' on the North Shore to focus immediate efforts and solutions: Sunset Beach Park to Rocky Point; the vicinity of Laniākea and Chun's Reef surf breaks; and Mokolē'ia
- Identified seven critical concerns related to community vulnerability and coastal resource management (p.20)
- Developed six recommendations for immediate action that should be implemented to address urgent and severe coastal erosion impacts and risks (see Recommendations section, p.28)
- Applied the conceptual planning approach of Adaptation Pathways to identify short, medium, and long-term adaptation solutions to explore for each hot spot (Appendix A)
- United diverse stakeholder groups in developing and discussing solutions to address North Shore coastal erosion (Appendix C)
- Strengthened relationships and increased capacity to address coastal resilience within the North Shore community
- Gathered input to inform the North Shore Sustainable Communities Plan update
- Established a model of a community-based interdisciplinary working group
- Expanded community outreach and education related to coastal erosion and climate change adaptation on the North Shore

## LESSONS LEARNED AND NEEDS TO BE ADDRESSED MOVING FORWARD

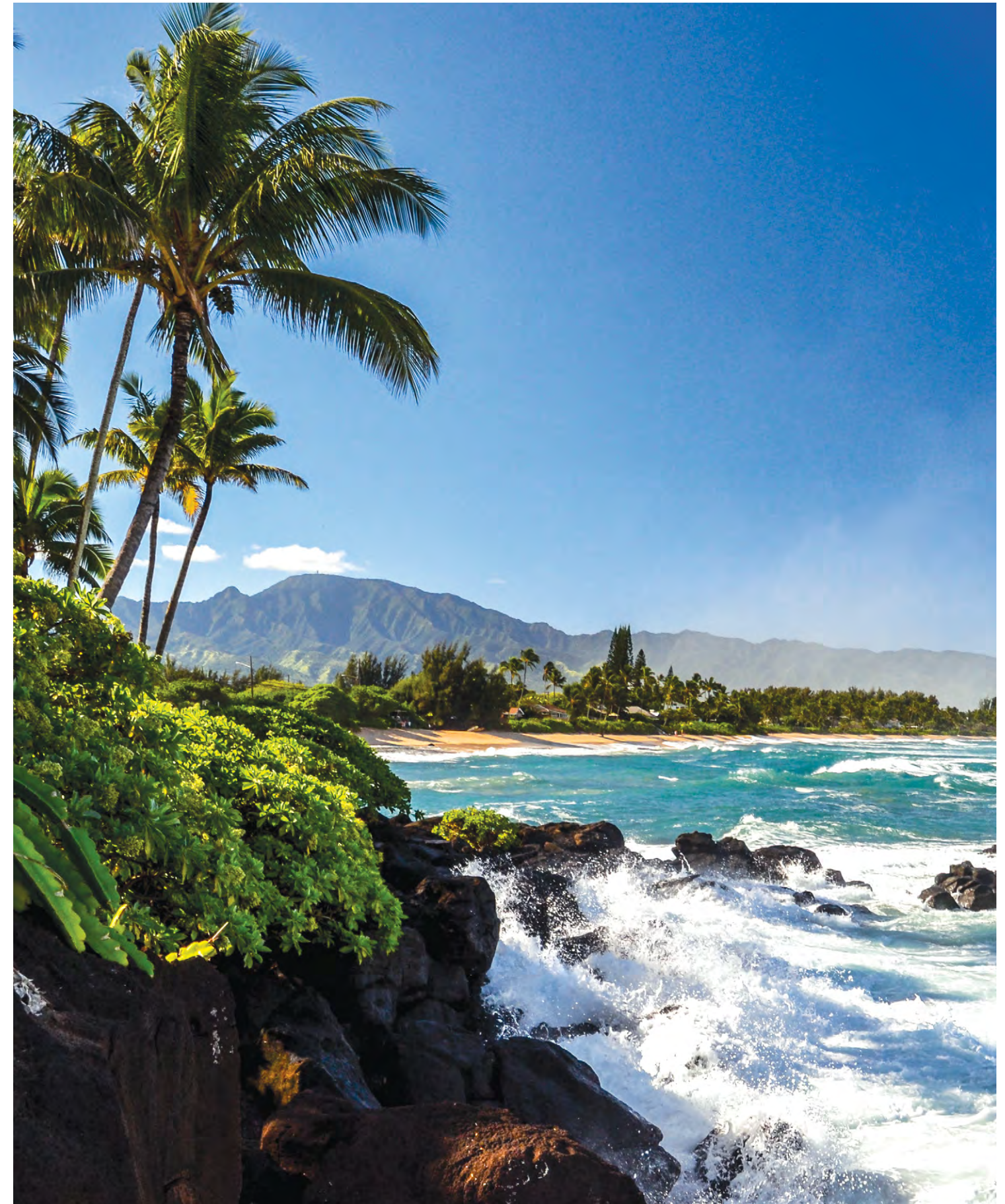
NSCRWG members noted that some of the beneficial outcomes of the effort, in addition to the issues and recommendations identified herein, included establishing a group of informed and engaged citizens, building relationships between stakeholders, and connecting community knowledge with technical expertise, governmental agencies and regulatory perspectives. It enhanced the community's capacity to educate others and advocate for action around coastal resilience.

In addition, it also improved governmental agencies' awareness and understanding of community needs and concerns. The process benefited from the use of professional meeting designers and facilitators that helped to structure, guide and document the discussions. Given the controversial nature of the topic and immediate impacts experienced by many within the group, this was an important part of creating and maintaining a safe and productive space for dialogue to occur.

Members in the group agreed that the effort was valuable and should be continued to advance the priorities identified, incorporate community education and involvement, expand participation and perspectives in the group, and establish an implementation framework with subcommittees to pursue and track progress on initiatives. This type of structure will require continued funding, commitment to participation, and buy-in from key agencies and community leaders.

Given the limited scope and size of the effort, it was acknowledged that gaps existed in the group's understanding and representation of diverse perspectives. Additional planning, technical study and community involvement are thus necessary to further vet the identified solutions and place them within the context of a climate adaptation plan or framework. Some of the key gaps and needs identified incorporated:

- Inclusion of additional Native Hawaiian perspectives and practitioners in the group and greater representation from all geographic areas of the North Shore
- Additional participation and engagement with key agencies representing planning, transportation, infrastructure and other sectors
- Additional technical study to evaluate costs, benefits and feasibility of various solutions
- A climate adaptation planning framework to ensure that measures are considered strategically on a regional basis
- Expanded community engagement and education around coastal resilience issues
- Discussion and analysis of equity considerations
- A sustained implementation structure and source of funding to enable the group to continue to meet, expand participation and benefit from professional facilitation, meeting design and documentation





# North Shore Coastal Hazards and Climate Science

North Shore beaches are highly dynamic due to extremely large and persistent waves in winter months that drive both seasonal and long-term coastal erosion and flooding from wave overwash. Currently, 73% of North Shore beaches are undergoing chronic erosion, which is the progressive landward movement of shorelines.<sup>1</sup> The result is seasonal and permanent beach loss in front of seawalls and other development. This long-term erosion is likely driven by a combination of natural sand movement from large waves, sea level rise over the past century, degradation of natural dune systems from development, and the removal of sand from some beaches by sand mining operations and shoreline armoring.

Dense coastal development and highways make the North Shore especially vulnerable to hazards, particularly erosion and flooding. Climate change and sea level rise are also increasing erosion rates and flooding incidents, which lead to disproportionate impacts to shoreline populations and Native Hawaiian communities with strong identity and place-based ties to coastal resources.

According to federal interagency reports, at least one foot of sea level rise is expected for Hawai'i by 2050, with three to four feet of sea level rise anticipated by the end of this century (in an "intermediate" or mid-range scenario relative to a baseline year of 2000)<sup>2</sup>. However, more than 90% of North Shore beaches are projected to be in a state of chronic erosion with just 10 inches (0.25m) of mean sea level rise, a scenario that is likely to occur within the next 30 years.<sup>3</sup>

## KEY TAKEAWAYS: COASTAL HAZARDS AND CLIMATE SCIENCE

- The majority (73%) of beaches on the North Shore are presently undergoing chronic erosion, which is the progressive landward movement of shorelines; this is leading to seasonal and permanent beach loss in front of seawalls and other development<sup>1</sup>
- Seasonal and interannual shoreline erosion events acting 'on top of' long-term erosion trends increase threats to shorefront development on the North Shore
- More than 90% of North Shore beaches will be eroding with just 10 inches (0.25 m) of mean sea level rise, a scenario that is likely to occur before mid-century<sup>3</sup>
- Approximately 2.5 miles or about 28% of beachfront residential North Shore properties presently have a home within 20 feet or less of the Shoreline<sup>3</sup>
- Along the North Shore, 3.2 feet of sea level rise will lead to chronic flooding or land loss from erosion on 1,083 acres of land, potentially impacting 1,310 buildings, displacing 2,192 residents, and flooding 2.9 miles of state coastal highway and 5.8 miles of city roads<sup>4</sup>
- High tide flooding will affect low-lying coastal areas decades before the global mean sea level reaches these benchmarks; these impacts are expected to rapidly increase beginning in the mid-2030s from accelerating global mean sea level rise combined with natural variations in the highest tides<sup>6</sup>
- Sea level rise and coastal erosion is leading to disproportionate impacts to shoreline populations and Native Hawaiian communities with strong identity and place-based ties to coastal resources

**Currently, 73% of North Shore beaches are undergoing chronic erosion, which is the progressive landward movement of shorelines.**

Previous studies (Fletcher et al., 2012) and NSCRWG discussions identified a number of priority erosion 'hot spots' on the North Shore. At Mokulē'ia, near Dillingham Airfield, decades of erosion and seawall construction have led to permanent beach loss and the loss of public shoreline access. Homes are intermittently threatened by erosion along Crozier Drive in Mokulē'ia and in Waialua. The beach at the north end of Hale'iwa Beach Park has been completely lost to erosion due to impacts from a seawall. In response to severe erosion over the last several years, temporary erosion protection (both permitted and unpermitted) in the forms of tarps and sandbags have been installed in front of dozens of homes fronting Laniākea and between 'Ehukai and

Sunset Beach Parks. Occasionally, the shoreline in these areas becomes inaccessible to the public and lifeguards when waves wash away the sandy beach, leaving only sandbags, tarps and more permanent seawalls. Shoreline erosion between Rocky Point and Sunset Beach Park culminated in the winter of 2022 with the highly publicized loss of a shorefront home off of the sand dune onto the beach below. Kamehameha Highway is also threatened by shoreline erosion and overwash during high waves in the vicinity of Laniākea, Chuns, Rockpile and Sunset Beach surf breaks. In 2019, after severe erosion damage and repeated attempts to repair, the shorefront bike path at Sunset Beach Park was additionally relocated inland.



Collapsed home, tarps and other temporary erosion control measures, and impaired beach access between Rocky Point and Sunset Beach Park, North Shore, 2022. Photo: Shellie Habel, Sea Grant/DLNR



# North Shore Efforts to Address Erosion Hazards

## HISTORICAL EROSION RESPONSE

The North Shore has a long history of impacts and efforts to address erosion hazards. Coastal erosion is an ongoing concern, especially considering the dense residential development along this stretch of coastline. For example, approximately 2.5 miles (28%) of beachfront residential North Shore properties presently have a home within 20 feet or less of the Shoreline<sup>3</sup>. With 2.4 feet of sea level rise, this is projected to increase to about 3.4 miles (40%) of beachfront residences within 20 feet or less of the Shoreline.<sup>3</sup>

The historical response to coastal erosion in Hawai'i and on the North Shore has typically been to armor the back of the beach with concrete or stone seawalls, or sloping rock revetments. More than two miles, or 10,000 feet, of privately-owned coastal properties and state-owned coastal highways are armored along the North Shore.<sup>5</sup>

Armoring properties on eroding beaches has resulted in the permanent loss of about 2,000 feet of beach at Mokulē'ia (in the vicinity of Ho'omanā Place) and at Hale'iwa Beach Park. This figure does not include sections of beach that are intermittently lost during seasonal erosion, including a section between Rocky Point and Sunset Beach Park. Beach loss occurs in front of coastal armoring as the beach is 'pinched-off' between a landward moving water line with ongoing erosion and a hardened backshore. Coastal armoring should not be considered to be permanent protection. Improperly designed or maintained seawalls and revetments on the North Shore have failed or become ineffective in recent years when undermined by erosion or overtopped by wave action. Even if properly designed and

maintained, these structures would be inappropriately sited on the sandy beaches of the North Shore as they would ultimately result in the loss of public beaches.

Beaches, coastal environments, and shoreline access are protected by law in Hawai'i by Article XI of the State Constitution, which states that "for the benefit of present and future generations, the State and its political subdivisions shall conserve and protect Hawai'i's natural beauty and all natural resources." Protections for coastal environments are further codified by the State Coastal Zone Management Act (CZMA) in HRS 205A-2 Objectives and Policies that directs the state to:

- "Protect valuable coastal ecosystems, including reefs, beaches, and coastal dunes, from disruption and minimize adverse impacts on all coastal ecosystems"
- "Prohibit construction of private shoreline hardening structures, including seawalls and revetments, at sites having sand beaches and at sites where shoreline hardening structures interfere with existing recreational and waterline activities"
- "Minimize the construction of public shoreline hardening structures"

The State Department of Land and Natural Resources (DLNR) enforces these protections for beaches and coastal environments through Conservation District Statutes (HRS 183-C) and Administrative Rules (HAR 13-5), while the counties administer the CZMA primarily through their shoreline setback and Special Management Area (SMA) Regulations.

**Approximately 28% of beachfront residential North Shore properties presently have a home within 20 feet or less of the Shoreline. With 2.4 feet of sea level rise, this is projected to increase to about 40% of beachfront residences within 20 feet or less of the Shoreline.**



## COASTAL ARMORING

Coastal armoring is generally prohibited in Hawai'i, particularly fronting private beachfront property, by the State Coastal Zone Management Act (Hawai'i Revised Statutes 205A). These prohibitions and protections for beach resources and public access were recently strengthened through State Act 16 (Senate Bill 2060, Session Laws Hawai'i 2020). Recognizing the negative impacts of coastal armoring on beaches, the State Board of Land and Natural Resources (BLNR) has a no-tolerance policy for unpermitted coastal armoring, which has been carried out through numerous civil enforcement actions and court cases on the North Shore and elsewhere.

## EMERGENCY EROSION CONTROL

In an effort to provide affected homeowners some temporary options for erosion control, the DLNR has authorized 'softer' temporary emergency erosion control measures under (HAR) 13-5-35. This allows private property owners to apply for these Emergency Permits, which may be authorized on a discretionary basis by the Chairperson of the BLNR, if habitable structures or critical infrastructure are within 20 feet of the Shoreline.<sup>14</sup>

'Softer' temporary emergency erosion control measures have included geotextile blankets draped over eroded dunes and sand pushing (rebuilding sand berms at the back of the beach using heavy machinery) at several sites on the North Shore to protect homes threatened by extreme erosion. These projects are paid for and conducted by private residents with authorization from the state. However, severe erosion events have also prompted some property owners to undertake these measures without the proper permits or authorization.

These 'soft' erosion control approaches may have negative environmental effects if not designed, implemented and managed appropriately. Examples include potentially transferring erosion to neighboring unprotected properties, restricting lateral public access and shedding materials onto the active beach and marine environment when temporary structures fail.

While emergency erosion control measures have become more commonplace along chronically eroding shorelines, the intent of (HAR) 13-5-35 is to alleviate emergency situations on a temporary basis, not to provide long-term protection from chronic shoreline erosion. It is unknown how long the state will continue to provide these increasingly controversial and discretionary authorizations as the number of critically vulnerable properties increases and supposedly temporary materials accumulate on beaches.

## SAND PUSHING

Sand pushing refers to projects that use heavy machinery, such as bulldozers, to rebuild elevated sand berms or dunes at the landward end of a beach by scraping and pushing sand from the lower to the upper beach. These projects typically use sand from the beach immediately in front of the project area after the lower beach has recovered some sand following an erosion episode.

In limited cases, the sand can be pushed from adjacent areas of seasonal accumulation to eroded areas. This is also referred to as sand backpassing. The City and County of Honolulu regularly conducts sand pushing fronting North Shore beach parks and public access ways to restore beaches and dunes damaged by seasonal wave and foot traffic erosion. Sand pushing was also used to restore Sunset Beach Park, which led to a successful dune restoration project in 2019 (see Beach Nourishment and Coastal Dune Restoration on p.18).





## BEACH NOURISHMENT

Beach nourishment restores an eroding beach by adding sand along the shoreline to widen and elevate a beach. These projects may utilize sand imported from another location, or more typical in recent decades, use sand dredged and pumped from a nearby offshore sand field. Hale'iwa Beach Park is the only example of a major beach nourishment project on the North Shore. The beach, offshore breakwater, and perpendicular shore rock groin were constructed in 1965. Through cooperation between the U.S. Army Corps of Engineers and Hawai'i Department of Transportation, these structures were repaired several times in the 1960s and 1970s after storms and large wave events. The city and state DLNR Office of Conservation and Coastal Lands (OCCL) are currently working with the Army Corps of Engineers to develop a beach restoration project at Hale'iwa Beach Park utilizing beach-quality sand recovered by dredging the neighboring harbor entrance.

Beach nourishment has not been conducted on other segments of the North Shore due to the typical high-energy ocean conditions and risk that a multi-million dollar nourishment project may be washed away by the next large winter swell. Historical shoreline studies and beach profile surveys show that beach widths can vary by 100 feet or more from summer to winter and year to year, particularly between Ke Iki Beach and Sunset Beach Park. In addition, waves regularly wash up through shoreline vegetation, demonstrating the high degree of mobility in the beach systems along the North Shore and challenges with stabilizing a beach nourishment project in this area.

## COASTAL DUNE RESTORATION

Dune restoration is the process of working with the natural development of sand accumulation and vegetation growth to encourage buildup and stability of healthy dunes over time. Sand dunes absorb wave energy and protect the coastline from high waves and storms. Sand pushing and beach nourishment are two methods used to restore coastal dunes in Hawai'i. Together, sand nourishment and revegetation can help to stabilize coastal dunes and provide a natural buffer for seasonal shoreline erosion. In 2019, a successful community project at Sunset Beach Park was carried out to revegetate the sand dunes by using native dune plant species and fencing fronting the beachfront bike path. Initially, the sand dunes had been restored by a sand pushing effort from the city. In addition, following erosion damage, the bike path was relocated slightly farther inland. Note that the DLNR generally prohibits the planting of vegetation seaward of the shoreline, which is defined as the annual high wash of the waves. This includes prohibitions of planting vegetation in front of private properties to conserve shoreline access and prevent landowners from claiming portions of the public beach.

Increased studies of the historical beach formations, sand sources, sand sinks, sand movement pathways, wave, wind and water levels along the North Shore may help to inform the viability of beach and dune restoration. The potential for regional sand replenishment efforts may also be explored as an intermediate option to buy valuable time for community-wide, long-term adaptation to the projected climate change impacts.





# Critical Concerns Related to Community Vulnerability and Beach Management

## Immediate Erosion Threats and Impacts to Homes, Highways and Public Infrastructure

Chronic erosion is an immediate and significant threat to residential communities and public infrastructure on the North Shore. The urgency became most apparent on February 28, 2022 when a beachfront home at Rocky Point collapsed onto the sand. Currently, 28% of North Shore beachfront residential properties sit within 20 feet or less of the Shoreline.<sup>3</sup> The North Shore will experience increasing damage and loss of shorefront homes in the absence of a program to facilitate the removal or relocation of these imminently threatened structures.

Public infrastructure, particularly Kamehameha Highway, is also precariously close to the coastline. While it provides access to 13,000 cars per day (Hawai'i Department of Transportation-Highways Division), Kamehameha Highway at Laniākea is threatened by chronic erosion and frequently floods during large swell events. This results in the closure of vital lifelines for the North Shore community and highlights the immediate nature of erosion threats.



While it provides access to 13,000 cars per day (Hawai'i Department of Transportation-Highways Division), Kamehameha Highway at Laniākea is threatened by chronic erosion and frequently floods during large swell events. Photo: Dolan Eversole

## Lack of Options and Transparent, Publicly-Shared Guidelines for Homeowners Impacted by Shoreline Erosion

Participants in the NSCRWG shared that there appears to be a lack of clear and publicly available guidelines for homeowners whose homes are directly impacted by shoreline erosion. As such, coastal homeowners are often not sure who to turn to. The lack of a clear and comprehensive coastal erosion policy has, in some cases, led to desperate homeowners not abiding by the state's Rules for Emergency Permits or installing unauthorized erosion control measures, ranging from sandbags to boulders to concrete walls. These actions appear to be increasing in frequency and can negatively impact the public beach and exacerbate erosion to nearby parcels, posing a public safety risk and threatening coastal ecosystems.

## Increasing Erosion and Flooding Risks with Climate Change and Sea Level Rise

Increasing global temperatures are warming the ocean (causing ocean expansion) and melting polar ice sheets, both of which contribute to rising sea levels. In turn, sea level rise erodes shorelines, inundates low-lying areas, and contributes to coastal flooding during high waves and storms.<sup>7</sup> Long-term measurements from tide gauges show that the sea level is already rising around O'ahu. As a result of global sea level rise and regional sea level variability, record-high monthly and daily extreme sea levels were measured at the Honolulu tide gauge in the summer and fall of 2020 and in early 2021.<sup>9</sup> Beginning in the mid-2030s, accelerating sea level rise, combined with natural variations in tidal heights, are expected to rapidly increase high tide flooding impacts.<sup>5</sup> By 2050, typically damaging flooding is expected to occur, on average, more than 10 times as often as it does today and can be intensified by local factors.<sup>2</sup>

## Damaged and Limited Public Beach Access Due to Erosion, Beach Loss and Inappropriate Response Measures

Healthy beaches are critical to coastal communities in Hawai'i that depend on the ability to access the shoreline for cultural practices, sustenance, recreation, mental and physical health, and celebration. As such, beaches are considered a public trust and the state is constitutionally obligated to protect them (Article XI of the Hawai'i State Constitution). Chronic erosion, shoreline armoring, and unauthorized erosion control measures, however, have led to significant losses of public sandy beaches, both on the North Shore and throughout the state. Nearly a quarter of O'ahu beaches have already been lost or significantly narrowed. A 2020 report further warns that if coastal management policies are not changed to better protect sandy shorelines, up to 40% of the island's beaches could disappear within the next 30 years.<sup>3</sup> The loss of sandy beaches not only has profound environmental and economic impacts, but it also threatens the existence of an essential public coastal resource.

## Environmental Impacts of Unauthorized and Expired Materials on the Shoreline

According to a 2021 report by ProPublica, the state DLNR has approved 28 applications for emergency permits for temporary erosion control in the forms of tarps and sandbags, from Mokulē'ia to Sunset Beach, since the year 2000.<sup>9</sup> According to the DLNR, all of these permits have expired as of August, 2022. While emergency permits are usually limited to three years, they are often granted extensions. Furthermore, sandbags are rarely removed once the permits expire. Some homeowners have also employed unauthorized sandbags, boulders and sand pushing to protect their properties. Though considered 'soft' erosion control measures, sandbags and other materials added to the shoreline essentially act as seawalls. If left for an extended period of time, they accelerate the erosion of adjacent beaches and can ultimately lead to beach narrowing and loss. Improper placement of materials, combined with large swell events, can lead to sandbags and other debris littering the beach and nearshore reef environment. This debris also poses a public health hazard and can consist of sharp wood, construction materials with nails and large rocks or bags.

**A 2020 report warns that if coastal management policies are not changed to better protect sandy shorelines, up to 40% of the island's beaches could disappear within the next 30 years.**

## Lack of a Cohesive Policy Framework and Financing Mechanisms for Managed Retreat

Erosion response in Hawai'i is largely reactionary and piecemeal. Aside from shoreline setbacks, there has been little to no planning for long-term shoreline change. The North Shore is now at a point where homes are actively collapsing onto the beach, erosion is accelerating due to climate change and sea level rise, public infrastructure is being threatened, and public beaches are being lost. Despite these growing issues and hazards, neither the state of Hawai'i nor its counties have a complete policy framework or financing mechanisms in place to support managed retreat. Without a proactive and comprehensive plan to aid the most vulnerable property owners in moving away from the coastline and restoring shorefront lands to natural conditions, we will continue to see the loss of properties, coastal habitats, cultural resources, and public beaches.

## Absence of a Comprehensive Coastal Erosion Strategy and Long-Term Vision for the North Shore

The North Shore lacks both a long-term vision and an integrated coastal erosion strategy. The State of Hawai'i Coastal Erosion Management Plan (COEMAP), for example, was last updated in 1999. COEMAP provides an important framework for assessing coastal erosion in beach loss across the state. It also outlines recommendations, tools, and mechanisms, some of which have been identified in this document, to protect and restore Hawai'i beaches. Updates to COEMAP could further drive proactive planning and interagency coordination on coastal erosion strategies for the North Shore. An understanding of the shared community vision for the North Shore is also necessary for guiding future planning efforts and management strategies.



# Discussion of Adaptation Options for the North Shore

NSCRWG members voiced strong interest in further exploring coastal adaptation options for the North Shore, including advancing discussions of managed retreat strategies toward actionable solutions and implementation. With the urgency of beachfront homes presently on the brink of collapse on North Shore beaches, the most critically vulnerable ‘hot spots’ identified by the Working Group can serve as demonstration sites for adaptation, including managed retreat. In some areas, phased adaptation or retreat may prove feasible, while in others, retreat may be the most viable option in the short-term.

## ADAPTATION PATHWAYS

Working Group members overwhelmingly agreed on the importance of identifying phased adaptation options, including exploring short-term solutions like sand management and dune restoration. As such, two meetings were dedicated to exploring and applying the approach of adaptation pathways to North Shore erosion hot spots at Rocky Point - Sunset Beach, Laniākea - Chun’s, and Mokulē’ia (Appendix A). Adaptation pathways are conceptual planning approaches addressing the uncertainty and challenges of climate change decision-making. Adaptation triggers provide guideposts along pathways to determine when certain actions are intended to be implemented based on predefined benchmarks or thresholds. Adaptation triggers can include: sea level rise thresholds, erosion impacts or beach widths, coastal flooding frequency and infrastructure damage.

One benefit of developing adaptation pathways is the opportunity to facilitate community discussion and input. Adaptation pathway planning allows community members to collaborate on the long-term vision of their coastline while identifying funding, legal and policy needs. As a long-term planning strategy with built-in triggers and lead times, adaptation pathways also provide coastal stakeholders, from private property owners to city planners, with a clear understanding of how future coastal impacts will be addressed.<sup>10</sup> Santa Cruz, California is an example

of how city planners are utilizing adaptation pathways to identify and implement coastal management options over phased time frames, with robust community input.<sup>10</sup>

Building on the need for a phased adaptation approach, the Working Group discussed conceptual adaptation pathways for four separate planning horizons for each identified hot spot. For example, ‘current’ is considered immediate, ‘near-term’ is 0-5 years, ‘mid-term’ is 5-25 years and ‘long-term’ is more than 25 years (Appendix A). Sample strategies were discussed and evaluated, and are envisioned to be part of future coastal land use and for management planning purposes. These strategies reflect a phased approach based on the planning horizons identified. It is important to recognize that each strategy has trade-offs and should be evaluated in terms of not off-setting the application of crucial longer-term strategies, as well as the appropriateness of the conceptual strategy to the values and priorities of the community. The adaptation pathways provided are a starting point and will need to be further vetted through technical analysis and community engagement. The goal is that they will be more fully developed by city agencies in coordination with the North Shore community. Note that the Working Group did not identify triggers for these pathways which is a critical next step for utilizing adaptation pathways.

In addition to the development of adaptation pathways for Rocky Point - Sunset Beach, Laniākea - Chun’s, and Mokulē’ia, the Working Group summarized the priority phased adaptation needs and implementation actions. The draft Timeline (p.23) identifies key needs and actions that are complementary to the Recommendations for Immediate Action identified further in this document.

**Adaptation pathway planning allows community members to collaborate on the long-term vision of their coastline while identifying funding, legal and policy needs.**



Beach loss due to shoreline hardening and seawalls in Mokulē’ia. Photo: Hawai’i Department of Land and Natural Resources, Office of Conservation and Coastal Lands

## SUMMARY OF NORTH SHORE PHASED ADAPTATION PRIORITIES

### Key Needs

- Identify long-term vision for North Shore coastline and steps to get there
- Explore feasible short-term solutions, particularly for Kamehameha Highway
- Identify triggers and time frames to move between phases of adaptation
- Understand economic benefits of the North Shore to the public, and value of property and infrastructure
- Establish state county, and federal coordination and create an emergency action plan for the short and long-term (need to identify who takes the lead); include protocols for addressing situations like Rocky Point
- Develop consensus and vision on what managed retreat looks like for the North Shore
- Enhance guidance and communication from regulatory agencies to homeowners
- Identify entities charged with gathering the local community’s involvement and input (i.e. North Shore Neighborhood Board, a Special Improvement District Association, etc.)
- Establish a unified coastal permitting system and guidelines for property owners
- Include the Department of Planning and Permitting (DPP) in future conversations

### Implementation Actions

- Regional climate adaptation planning for the North Shore
- Dune restoration pilot project at Sunset/Ehukai
- Risk and vulnerability assessment for Sunset Beach
- Economic valuation study of public trust resources, recreation, surf contests, etc. on North Shore
- Study, survey and design for sand management options (i.e. sand pushing, sand backpassing and sand bypassing)
- Identify triggers and time frames for different adaptation options
- Memorandum of Understanding for city, state and federal agencies for handling private property falling into the ocean
- Utilize the State Small-Scale Beach Restoration Program
- Explore establishing a statewide Coastal Commission and/or Coastal Conservancy
- State Planning Options:
  - Update COEMAP
  - Develop scope of work consistent with the objectives of SB3027 (Statewide beach assessment study, and beach and shoreline restoration and conservation plan) and HB2229 (known as the ‘burrito bill’)
  - University of Hawai’i funded climate adaptation study (Community Design Center)



## EXPLORING A STATEWIDE PROGRAM TO FACILITATE MANAGED RETREAT

Managed retreat is a comprehensive coastal erosion and sea level rise adaptation strategy made up of multiple components, financing mechanisms and timelines. It aims to voluntarily and equitably relocate communities away from vulnerable coastal areas in response to either episodic or chronic threats.<sup>11</sup> While it has been employed in coastal communities with varying degrees of success, the complexities involved have made a statewide program to support managed retreat difficult to develop and implement thus far. Managed retreat may be considered a phased adaptation strategy that can be utilized in conjunction with other approaches for in-place erosion and flooding mitigation.

Prior to the 2019 Sunset Beach Park dune restoration project, the City and County of Honolulu relocated a failed section of the beachfront bike path landward following repeated damage to the path from beach erosion. This is potentially the first example of landward relocation, or ‘managed retreat,’ of public infrastructure on the North Shore in response to increasing erosion impacts.

In 2021, the state passed State Act 179 (Senate Bill 474, 2021) that requires sellers to disclose sea level rise risk (up to 3.2 feet) in real estate transactions. This disclosure requirement may further enable retreat by removing some level of “reasonable expectation of use” that, prior to the disclosure bill, could be cited in potential takings claims.

In 2019, the State of Hawai‘i Coastal Zone Management (CZM) Program conducted a study assessing the feasibility and implications of managed retreat strategies for vulnerable coastal areas in Hawai‘i.<sup>12</sup> Key findings of the study include:

- Case studies of managed retreat programs from outside Hawai‘i showed more success when the community was supportive, relocation was voluntary and priorities were determined locally
- State and county long-range plans must provide for managed retreat, including identifying lands where it is possible to retreat to
- Catastrophic disaster events result in greater impetus for retreat
- Funding mechanisms will have to be instituted by the government for retreat to occur
- New laws will need to be adopted to implement and facilitate retreat. This may include, but is not limited to, increased shoreline setbacks and rebuilding restrictions, as well as legal mechanisms, such as transfer of development rights, land exchanges and rolling easements
- Areas retreated from should be left as open space for a resilient coastline

The CZM Program is conducting a study to address some of the next steps identified in the 2019 report. The study, which will begin in late 2022, will assess two components of managed retreat, including legal impacts and funding mechanisms. The goals are to identify existing laws and policies that impact managed retreat, analyze amendments or new policies that could facilitate the implementation of managed retreat, and identify potential funding and financing mechanisms to support implementation efforts.

While implementing managed retreat as a result of a coastal disaster may be the most effective long-term adaptation vehicle, it requires having post-disaster redevelopment scenarios and alternatives in place. These scenarios or alternatives may be discussed and retained through the development of a pre-disaster recovery plan for the North Shore.<sup>13</sup>

More advanced policy and application work is needed beyond the current discussions to evaluate managed retreat as a viable option. The 2019 Office of Planning report recommended convening a “multi-prong statewide leadership committee” with subject matter expertise in social science, coastal hazards, economics and tax, law and land use, and planning to “devise a comprehensive, cohesive managed retreat plan with identified implementable pilot projects at the end of its limited term.”

## FINANCING MANAGED RETREAT

A key component of managed retreat strategies is funding for transferring or acquiring and restoring coastal lands. By transferring powers from privately-owned to publicly-owned land, more land can be held for the benefit of communities and the environment. Land acquisition of private property was a point of contention amongst the NSCRWG. Community members may be hesitant to ‘buyout’ expensive ocean-front properties, particularly at the expense of taxpayers. Community outreach and discussion as part of, or building on, regional land use and coastal management plans may provide further opportunities to gauge community sentiment about using public funds or financing options for purchasing prioritized private beachfront properties for eventual conversion to public park and beach areas.

The Georgetown Climate Center’s Managed Retreat Toolkit suggests that the following is taken into consideration when evaluating funding for managed retreat programs and projects<sup>14</sup>:

- View funding for managed retreat holistically and seek to leverage and combine funding and in-kind support from multiple sources, including both public and private. This allows local municipalities to support different components of a comprehensive managed retreat strategy over time (i.e. planning, community engagement, acquisitions, relocation assistance, and ecosystem restoration and conservation).
- Create sustainable state and local funding sources and other revenue streams for climate adaptation and managed retreat (i.e. grants, loans, bonds and taxes). Local context and community needs will help governments assess which types of local funding will be politically feasible while also meeting managed retreat goals.
- Evaluate new opportunities to finance managed retreat strategies. Tools like wetland mitigation banks and Transfer of Development Rights (TDR) programs, for example, can create a potential market to finance some components of managed retreat.

According to the 2019 managed retreat report, property buyouts to facilitate managed retreat can be problematic.<sup>13</sup> High real estate values on the North Shore may make widespread buyouts at market value particularly challenging. On the other hand, discounted or lower value buyouts can provide some relief to affected landowners and an opportunity to expand lightly developed or undeveloped (restored) beachfront parklands on the North Shore for the community’s benefit. By prioritizing and tiering geographic areas for buyouts, initial program costs could be significantly reduced (for example, by buying out 10 priority coastal properties versus 800 coastal properties).

Recent State and County Legislation is providing some expanded pathways for financing and implementing managed retreat. State Act 208 (House Bill 1672, 2022) expands the purpose and rationale for creating Special Improvement Districts (SIDs) that may provide supplemental community-generated and community-directed financial support, including natural resource management and climate change and sea level rise adaptation.





State Act 223 (House Bill 1436, 2022) expands the authority of the counties to utilize Transfer of Development Rights (TDR) to address areas at risk of coastal erosion and flooding with climate change and sea level rise. Further action and legislation is needed at the city and county levels to implement SIDs and TDR based on these pieces of enabling state legislation. Bill 10, which at the writing of this document is under consideration by the Honolulu City Council, would add a section to the city's Land Use Ordinance enabling TDR of entitlements. Under this bill, the number of dwellings and allowable floor area could be transferred from a 'donor' lot in an environmentally sensitive area (i.e., an area experiencing coastal erosion) to a 'receiving' lot outside of the Sea Level Rise Exposure Area (Bill 10 (2022), CD1; Relating to Use Regulations).

Federal funding may also be leveraged to finance managed retreat. The Federal Emergency Management Agency (FEMA), for example, offers the Building Resilient Infrastructure and Communities (BRIC) grant program that is designed to support state, territorial and local governments in efforts to undertake pre-disaster hazard mitigation projects.<sup>11</sup> BRIC funding is available on an annual basis in states that have received a presidential disaster declaration in the past seven years from the date when FEMA issues a Notice of Funding Opportunity. According to the Georgetown Climate Center's Managed Retreat Toolkit, BRIC funds can be used to support on-the-ground projects like the acquisition of properties through voluntary floodplain buyouts and the implementation of other nature-based solutions that mitigate flood risk.<sup>11</sup>

FEMA also administers the Hazard Mitigation Grant Program (HMGP) that provides grants to state, territorial and local governments to implement long-term hazard mitigation measures after a major disaster declaration. Local governments can use HMGP funds to purchase vulnerable properties through hazard mitigation buyouts instead of relying on eminent domain. The funds can also be used to relocate or demolish structures to reduce or eliminate the losses from future disasters.<sup>11</sup> HMGP funding, however, is only available to applicants that reside within a presidentially declared disaster area. This limits the ability of local governments to apply this funding to pre-disaster managed retreat plans.<sup>11</sup>

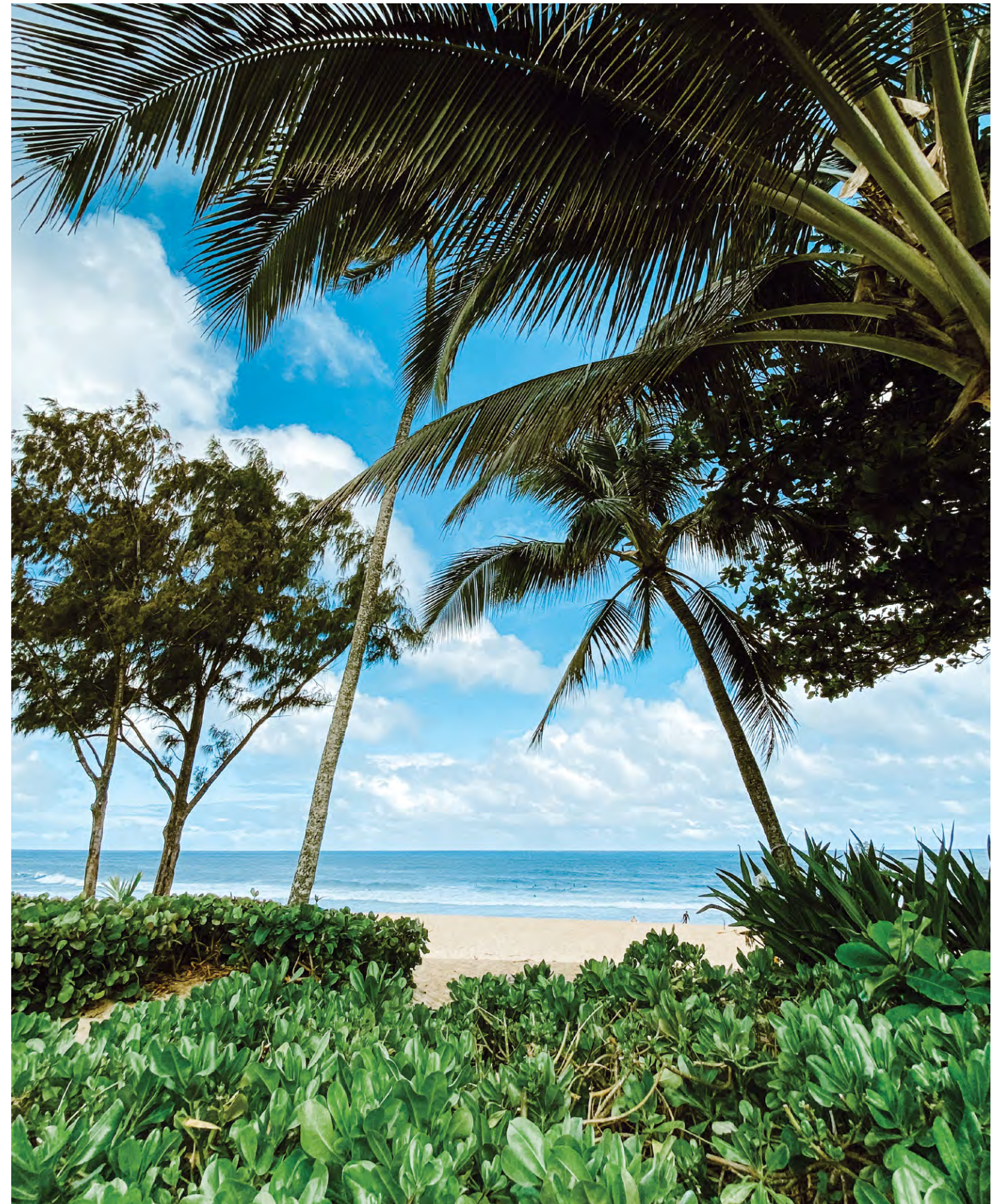
Most recently, the federal Inflation Reduction Act includes \$369 billion for climate action and coastal resilience. The act will fund coastal restoration grants for states and tribes, reduce emissions at ports, enhance critical weather forecasting and preparedness, and support the environmental review of projects on our coasts. It also provides critical opportunities for better coastal zone planning through grants administered by the federal government to states for resilience and restoration. In Hawai'i, there is the potential to utilize these funds to support managed retreat efforts.

It should be noted that each of the federal funding options described above has individual merits and challenges that should be further assessed by state and local agencies and incorporated into a holistic managed retreat plan. Any managed retreat financing plan should furthermore be layered to include multiple sources of funding and support for different components of managed retreat.

## **NORTH SHORE SUSTAINABLE COMMUNITIES PLAN**

In addition to the state's 2019 managed retreat report, the North Shore Sustainable Communities Plan (NSSCP) is an important guidance document for prioritizing the development of a sea level rise and coastal hazards adaptation strategy for the North Shore, including managed retreat where appropriate. The NSSCP is the city's 25-year land use and policy plan for the North Shore planning district. As such, it can guide decision-making about what uses are permitted near the shoreline and how land use and infrastructure can support a resilient and sustainable community. The plan can also identify ways of rethinking land use patterns to adapt to potential climate change impacts, including relocating development and infrastructure, protecting and restoring vulnerable areas, and conserving agricultural lands and open space outside the community growth boundary.

**Any managed retreat financing plan should furthermore be layered to include multiple sources of funding and support for different components of managed retreat.**





# Recommendations for Immediate Action

Based on the ongoing severe impacts of coastal erosion and the certainty of increased erosion and flooding with climate change and sea level rise as discussed by the NSCRWG and described in this paper, the Working Group has the following recommendations for immediate action in no particular order to be taken by elected and agency officials through community-engaged processes:

1. Improve guidelines and limitations for emergency shoreline erosion management and strengthen enforcement against unauthorized work and materials.
2. Establish a statewide managed retreat program, with the North Shore as a pilot area, to provide a pathway for affected landowners to voluntarily vacate affected properties and with clear public benefit.
3. Improve interagency coordination for shoreline erosion and flooding management, which overlaps jurisdictional and ownership boundaries.
4. Develop a beach and dune management plan with a near to mid-term outlook for North Shore beach parks and accessways with guidelines that may be transferable to efforts fronting privately-owned lands.
5. Develop a detailed and comprehensive climate change and sea level rise vulnerability assessment and adaptation strategy for the North Shore.
6. Continue the Working Group and expand community discussions, engagement and outreach.

# Conclusion

The North Shore of O’ahu is one of the most unique and special places on Earth. Within the North Shore community, there is an overwhelmingly shared respect for the ocean and shorelines. The NSCRWG sought to facilitate meaningful, community-driven discussions related to the future of coastal management on the North Shore. The NSCRWG effort has laid important groundwork to protect and manage shared coastal resources that can, and should, be further refined, developed and expanded. While the Working Group’s efforts resulted in identifying both critical concerns and recommendations for immediate action, there is much work to be done in order to create a shared, long-term vision and strategy for the North Shore coastline. Developing these shared visions

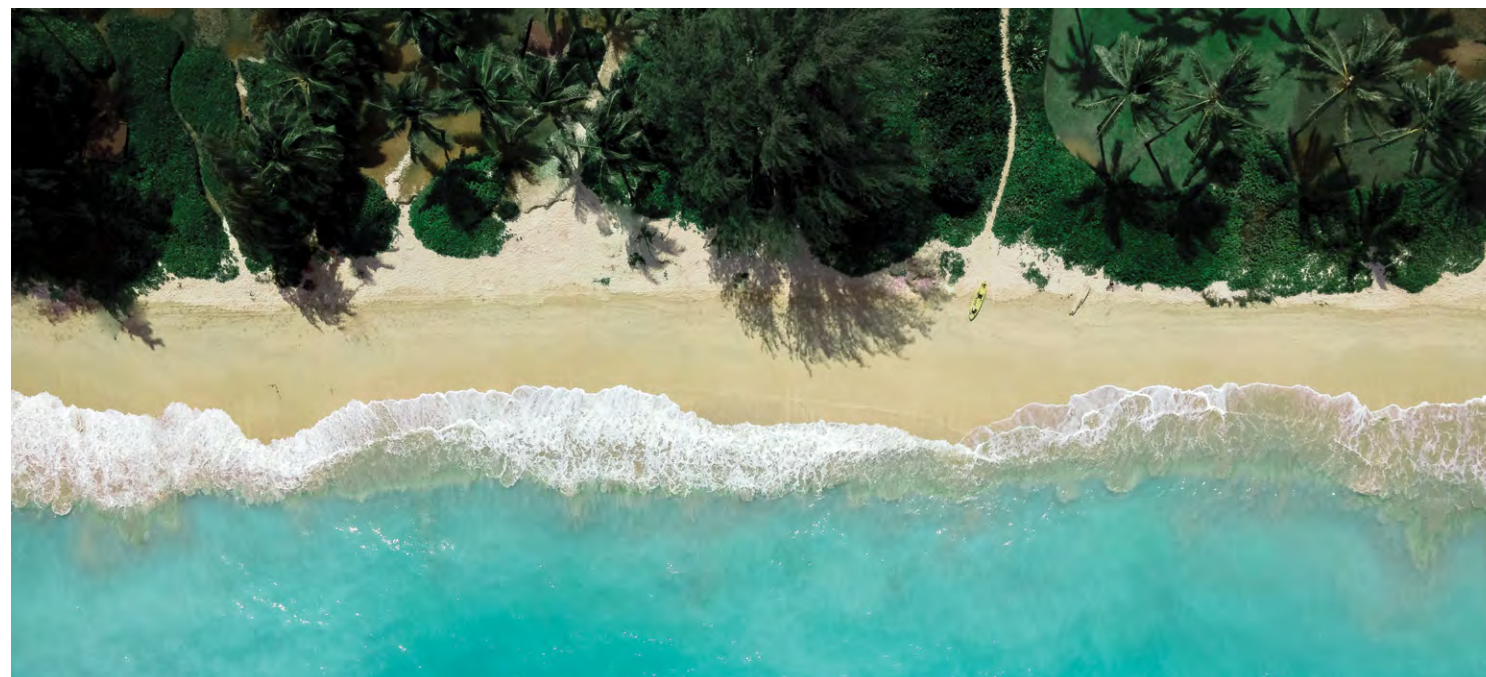
and strategies will require an ongoing iterative process that continues to be driven by community engagement and input. One of the NSCRWG’s key outcomes, in addition to the issues and recommendations identified herein, was the building of a group of informed and engaged citizens and connecting them with technical expertise and government agencies, thereby helping the community’s capacity to educate others and advocate for action. Ideally, the effort will be continued and expanded to encompass broader community education and involvement, incorporate more diverse perspectives, and establish an implementation framework to allow subcommittees to pursue and track progress on initiatives.





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# Appendix A

## ADAPTATION PATHWAYS AND TRIGGERS

For each hot spot (Rocky Point - Sunset Beach, Laniākea - Chun's, and Mokulē'ia), the Working Group identified key strategies, needs and next steps for four separate planning horizons: current (immediate), near-term (0-5 years), mid-term (5-25 years), and long-term (25+ years) time frames that could be applied through an 'Adaptation Pathways' approach. Example strategies were discussed and evaluated and are envisioned to be part of future coastal land use and management planning purposes. These strategies reflect a phased approach based on the planning horizons identified. It is important to recognize that each strategy has trade-offs and should be evaluated in terms of avoiding off-setting the application of crucial longer-term strategies as well as the appropriateness of the strategy to the values and priorities of the community. Additionally, while some hot spots had specific considerations (i.e. highway protection

at Chun's/Laniākea), the strategies, needs and next steps were generally the same for each location. The adaptation pathways for each hot spot have therefore been combined into a single spreadsheet (below). While the Working Group did not identify specific triggers or lead agencies within these adaptation pathways, this preliminary work provides the basis from which agencies and organizations can refine and complete the adaptation pathways process for the North Shore.

In addition to identifying the strategies, needs and next steps, the Working Group evaluated factors for each strategy, including project costs, monitoring costs, environmental impacts, social impacts, recreational impacts, duration and responsible agencies. For simplicity, we are only presenting the term, strategy, needs and next steps in this paper. A complete evaluation of the factors described are available upon request.

## ADAPTATION PATHWAYS FOR NORTH SHORE Current Term (Immediate)

Strategies	Needs and Next Steps
<b>Improved Sand Management/Emergency Sand Pushing</b>	<ol style="list-style-type: none"> <li>1. Develop a beach management plan based on the understanding of sand transport</li> <li>2. Evaluate the ability and funding for the city to push sand along the affected areas rather than property owners</li> </ol>
<b>Dune Restoration</b>	<ol style="list-style-type: none"> <li>1. Dune restoration manual and permitting process</li> <li>2. Dune crest elevation investigation</li> <li>3. Pass dune protection ordinance to prevent new development on primary coastal dunes (Maui County has an ordinance)</li> <li>4. Allow vegetation of appropriate sections of dune</li> <li>5. Identify funding sources to support permitting and implementation of dune restoration projects</li> </ol>
<b>Policy Changes to Limit Shoreline Development and Plan for Climate Adaptation</b>	<ol style="list-style-type: none"> <li>1. Adopt updated SMA and shoreline setback requirements (Chapter 23 and 25, ROH)</li> <li>2. Adopt policies in North Shore Sustainable Communities Plan to limit development in vulnerable areas and conduct regional vulnerability assessment/climate adaptation plan</li> <li>3. Develop statewide climate adaptation framework</li> <li>4. Will require city initiative, political will, planning, funding</li> </ol>



## Near-Term (Next 5 years)

Strategies	Needs and Next Steps
<b>Emergency shoreline protection (removable at beach accessways)</b>	<ol style="list-style-type: none"> <li>1. Clarify requirements and strengthen enforcement for the removal of emergency protection once permits expire</li> <li>2. Identify areas where emergency protection is allowed or not, based on longer-term adaptation strategy</li> </ol>
<b>Foot traffic erosion control at beach parks and access ways</b>	<ol style="list-style-type: none"> <li>1. Develop a strategic beach management plan based on the understanding of sand transport</li> <li>2. City-led management and improvements to right-of-ways and beach parks</li> <li>3. Identify cost-benefits of solutions (i.e. adding stairs and access control vs. sand pushing) for erosion control measures at beach access points</li> <li>4. Identify limited places for access/wash stations</li> <li>5. Provide better guidance on directing foot traffic</li> <li>6. Enhance community education about beach access areas (i.e. signage and reasons for limiting access points)</li> <li>7. Identify funding sources</li> <li>8. Get community buy-in</li> </ol>
<b>Infrastructure adaptation planning and interim protection for key roadway segments/bridges/paths</b>	<ol style="list-style-type: none"> <li>1. Identify short and long-term adaptation strategies for priority bridges, paths and highway segments</li> <li>2. Obtain funding for implementation</li> <li>3. Coordinate planning with other utilities (water, sewer, electric, etc.)</li> </ol>
<b>Planning for relocation/removal of individual wastewater systems</b>	<ol style="list-style-type: none"> <li>1. Provide guidance and enabling regulations for removal or relocation of threatened wastewater systems</li> <li>2. Identify/create funding source for implementation</li> </ol>
<b>Reef Management (maintaining/improving health)</b>	<ol style="list-style-type: none"> <li>1. Need to develop a coral reef management plan and identify funding</li> <li>2. Opportunity for a pilot project (Turtle Bay?)</li> </ol>
<b>Retreat mechanism/funding system</b>	<ol style="list-style-type: none"> <li>1. Economic valuation study of public trust resources, recreation, surf contests, etc. on North Shore</li> <li>2. Regional vulnerability assessment and climate adaptation plan</li> <li>3. Develop state and/or county regulatory mechanisms for managed retreat (buyouts, lease-back programs, TDR, improvement districts, etc.)</li> <li>4. Explore community-based solutions (community financing districts, strategic buyouts/conservation easements of priority areas, etc.)</li> <li>5. Disaster trigger for retreat and federal support to implement; need a disaster recovery plan ahead of time</li> </ol>

## Mid-term (5-25 years)

Strategies	Needs and Next Steps
<b>Resilient design standards</b>	<ol style="list-style-type: none"> <li>1. Coordination among city agencies on mechanisms for adopting and implementing design standards for existing and new development. This may include updates to building codes/flood hazard ordinances to incorporate SLR; adoption of additional design standards and/or zoning overlays, etc.</li> <li>2. Prohibition on grading or development of the primary coastal dune</li> <li>3. No slab on-grade construction in dune areas</li> <li>4. Explore ways to incorporate elevation or other interim measures to protect existing structures in the short to mid-term as part of a climate adaptation strategy. This may occur as part of updating Ch 23/25 and adopting resilient design standards</li> </ol>
<b>Elevating/protecting structures</b>	<ol style="list-style-type: none"> <li>1. Explore ways to incorporate elevation or other interim measures to protect existing structures in the short to mid-term as part of a climate adaptation strategy. This may occur as part of updating Ch 23/25 and adopting resilient design standards</li> </ol>
<b>Beach stabilization (lower crested structures)</b>	<ol style="list-style-type: none"> <li>1. Identify appropriate areas/time frames for beach stabilization through climate adaptation planning; conduct planning/permitting/engineering studies</li> </ol>
<b>Shoreline armoring</b>	<ol style="list-style-type: none"> <li>1. Identify appropriate areas/time frames for hardening through climate adaptation planning</li> <li>2. Conduct planning/permitting/engineering studies considering State and City law</li> </ol>

## Long-Term (25+ years)

Strategies	Needs and Next Steps
<b>Strategic highway and infrastructure relocation</b>	<ol style="list-style-type: none"> <li>1. Develop a mechanism for agency coordination</li> <li>2. Develop a plan for addressing individual wastewater systems</li> </ol>
<b>Retreat (Implementation)</b>	<ol style="list-style-type: none"> <li>1. Comprehensive relocation of most-vulnerable roads, infrastructure, and development</li> </ol>
<b>Shoreline armoring</b>	<ol style="list-style-type: none"> <li>1. Implement any shoreline hardening of public infrastructure deemed to be in public interest and according to State law</li> </ol>



# Appendix B

## WORKING GROUP MEETING SUMMARIES

### Meeting 1: Framing the Issues (September 9, 2021)

The objective of the first meeting was to develop a shared understanding of coastal erosion, beach loss and projected sea level rise risks for the North Shore based on climate science. The meeting included introductions by the conveners and each Working Group member, discussion on North Shore climate change impacts, the sharing of North Shore community perspectives, and discussion of planning efforts for climate adaptation on the North Shore and across O’ahu.

### Meeting 2: Sunset Beach Field Trip (October 14, 2021)

The field trip enabled the group to observe the conditions at Ehukai to Sunset Beach and share experience and knowledge around current and historical coastal erosion. The group also observed and discussed different erosion control measures.

### Meeting 3: Hot spots and Adaptation Solutions (November 17, 2021)

The third meeting established group consensus around climate change hot spot locations and impacts on the North Shore, and initiated a discussion on the range of available adaptation options. The meeting included a recap of the field trip, overview and discussion of three hot spots – Mokulē’ia, Laniākea - Chun’s and Rocky Point - Sunset Beach – and possible climate adaptation solutions for each hot spot.

### Meeting 4: Adaptation Pathways (January 13, 2022)

The objective of the fourth meeting was to apply an ‘adaptation pathways’ approach to the hot spots, including discussing triggers, factors and timelines. The meeting included an overview of technical and policy considerations, a presentation on the adaptation pathways approach, and a discussion-based exercise exploring the application of adaptation pathways to each of the North Shore hot spots.



### Meeting 5: Adaptation Pathways, continued (February 17, 2022)

The fifth meeting continued the exercise of applying adaptation pathways to the North Shore hot spots. It also included a briefing and discussion on the emergency situation that had recently emerged at Rocky Point, with a home collapsing onto the beach. Finally, Sea Grant provided updates on legislation-related coastal and beach protection, and climate change moving through the state legislature at that time.

### Meeting 6: Implementation Steps (April 14, 2022)

The final Working Group meeting was conducted in-person with the objective of identifying priority next steps for the Working Group. The meeting included a legislative update following the close of the legislative session, a debrief discussion on lessons learned from the Rocky Point emergency, and a summary of the solutions and needs discussed throughout the Working Group sessions. The meeting concluded with a discussion on priority solutions and actions for the North Shore community, and a discussion on next steps related to the summary white paper and opportunities for continued involvement and action.

# Appendix C

## PROJECT TEAM

### Surfrider Foundation:

Lauren Blickley, Michael Foley (O’ahu Chapter), Elizabeth Benyshek (O’ahu Chapter), Doorae Shin (O’ahu Chapter), Stefanie Sekich-Quinn

### Hawai’i Sea Grant:

Dolan Eversole, Brad Romine, Shellie Habel

### SSFM International:

Jared Chang, Melissa May, Malachi Krishok, Matt Fernandez

## CRWG MEMBERS

- Adam Borrello, North Shore Community Land Trust
- Brad Romine, Hawai’i Sea Grant
- Dolan Eversole, Hawai’i Sea Grant
- Chip Fletcher, UH School of Ocean and Earth Science and Technology
- Colin Lee, UH School of Ocean and Earth Science and Technology
- Alice Terry, UH Institute for Sustainability and Resilience
- Makena Coffman, UH Institute for Sustainability and Resilience
- Denise Antolini, UH William S. Richardson School of Law
- Doug Cole, Realtor/Attorney
- Gil Riviere, Hawai’i State Senator
- Reed Matsuura, City Councilmember Tsuneyoshi
- Kathleen Pahinui, North Shore Neighborhood Board
- Larry McElheny, Resident
- Randolph Moore, Resident
- Steven Albert, Resident, North Shore Trails, Outdoor Circle
- Lauren Blickley, Surfrider Foundation
- Michael Foley, Surfrider Foundation, O’ahu Chapter
- Mike Takahashi, Keep the North Shore Country
- Moana Bjur, Conservation Council for Hawai’i
- Alex Yee, Office of Climate Change, Sustainability, and Resiliency (City of Honolulu)
- Andrew Wycklendt, Hawai’i Shore and Beach Preservation Association
- Sarah Chang, Office of Planning and Sustainable Development, Coastal Zone Management
- Tiger Mills, State Office of Conservation and Coastal Lands
- Trevor Fitzpatrick, Office of Conservation and Coastal Lands
- Shellie Habel, Hawai’i Sea Grant
- Michael Cain, State Office of Conservation and Coastal Lands







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