

Toward More Equitable Nature-based Coastal Adaptation in California

RECOMMENDATIONS FOR IMPROVING SOCIAL

EQUITY IN FUNDING, POLICY, AND RESEARCH

JULY 2022

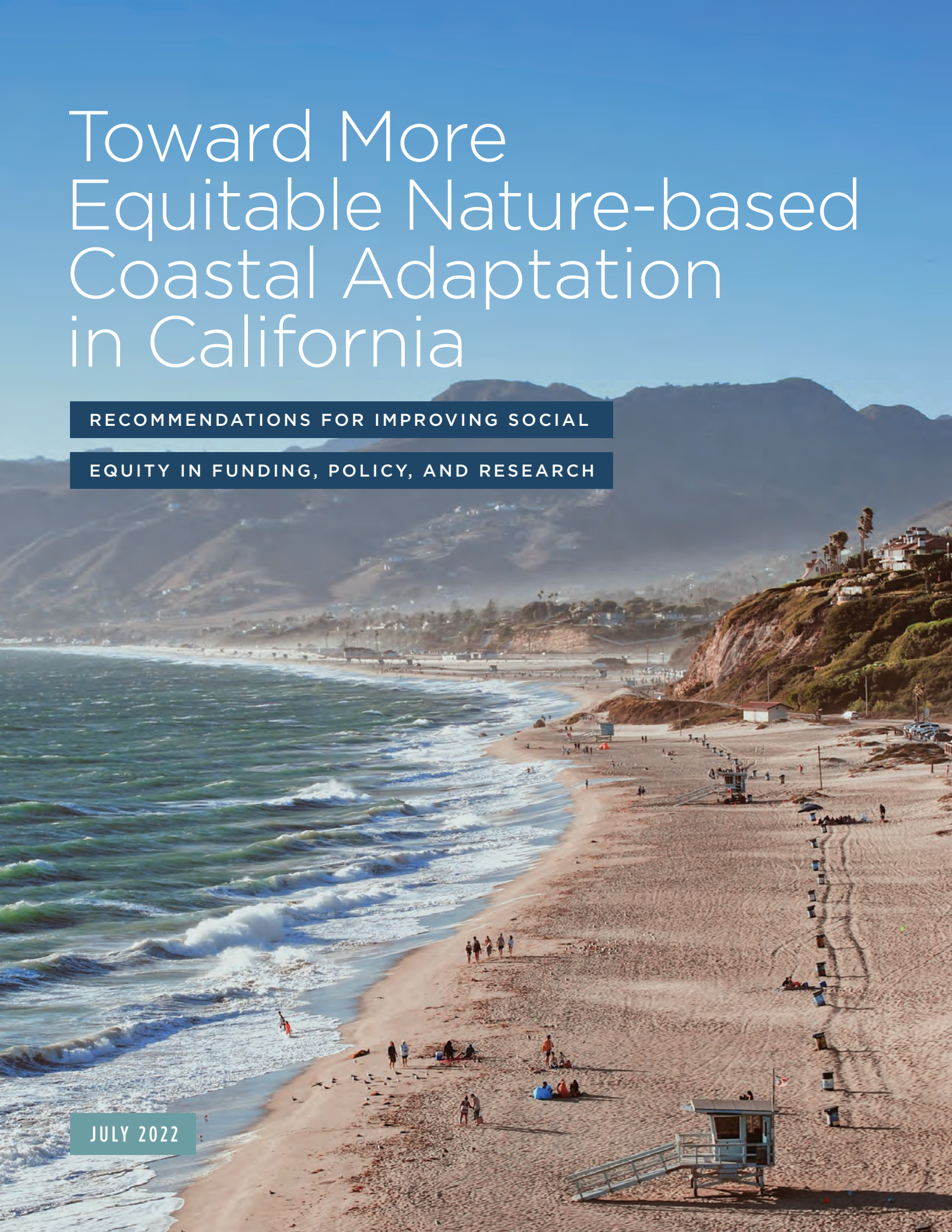


Table of Contents

ABOUT THIS REPORT	3
EXECUTIVE SUMMARY	6
Evidence-based Policy Recommendations	6
Priority Research Needs	8
I. INTRODUCTION	9
II. EVIDENCE-BASED POLICY RECOMMENDATIONS FOR ADVANCING EQUITABLE NATURE-BASED COASTAL ADAPTATION IN CALIFORNIA	17
1. Prioritize coastal adaptation in frontline and tribal communities.	17
2. Plan for meaningful engagement before, during, and after project implementation.	19
3. Address broader structural inequities in California.	21
4. Define context-specific social equity goals early in the process.	23
5. Prioritize projects that improve access and stewardship.	25
6. Incorporate traditional knowledge systems in coastal restoration policies and climate initiatives.	27
7. Evaluate gentrification outcomes of projects and incorporate displacement avoidance strategies.	29
8. Incorporate inclusive education and workforce development opportunities into project implementation.	32
9. Scale up investment in pilot projects and reduce programmatic barriers.	34
III. PRIORITY RESEARCH NEEDS FOR CALIFORNIA	38
REFERENCES	41
APPENDICES	46
Appendix A: Summary of Living Shoreline Habitats and Example Projects in California	



FUNDING

Provided by the Honda USA
Foundation

About the Report

This report was produced by Ocean Science Trust (OST) with funding from the Honda USA Foundation, and is intended to provide framing and insights to support advancement towards more equitable approaches to nature-based coastal adaptation and shoreline management in California. Our project proposal initially focused on exploring how California can implement living shorelines more equitably, as previous research has demonstrated that conservation efforts in California are more likely to occur in more affluent communities. Our initial thinking was that focusing on a specific solution - living shorelines - nature-based coastal management approaches for addressing shoreline change and vulnerabilities - might allow for development of tangible and practical recommendations. We value an adaptive learning approach to our work and highlight that early discussions quickly revealed that this specificity itself presents a barrier to truly applying an equity lens to coastal adaptation. In essence, an 'a priori' focus on living shorelines might inadvertently perpetuate a less equitable solution in some locations, runs the risk of prescribing priorities and approaches for (and not with) communities, or could unintentionally lead to greater barriers or requirements for living shorelines compared with other coastal adaptation approaches.

This evolution in our learning and our project is reflected in the report recommendations. We have included several recommendations and science needs specific to social equity in the context of living shorelines to help guide investments in projects that avoid negative community impacts and ensure equitable distribution of benefits as the body of practice advances. In addition, many of the recommendations and science needs discussed throughout also apply to advancing equity within broader categories of coastal adaptation and shoreline management.

The primary audience for this report is the California State Legislature, given the increasing state and private interest in nature-based climate solutions. OST sought advice and input from an interdisciplinary expert science panel and advisors from State agencies throughout the project. The expert panel was convened from June 2021 through June 2022, and members participated in a series of individual and group meetings with OST staff, whose discussions and feedback informed the development of this report. Panelists also provided review of the final product. Recommendations within this report were also informed by representatives from state government, environmental justice researchers, living shoreline practitioners, local community-based organizations, tribal members, and other thought leaders in a series of compensated interviews.

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ABOUT OCEAN SCIENCE TRUST

California Ocean Science Trust (OST) is a non-profit organization dedicated to accelerating progress towards a healthy and productive ocean future for California. Created by state legislation, OST bridges the gap between cutting-edge scientific research and sound ocean management. OST brings solution-focused science guidance to executive branch agencies and, through the Legislative Science Services Program, to California Lawmakers and their staff.

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ACKNOWLEDGEMENTS

Funding was provided by the Honda USA Foundation. We are grateful for the opportunity to host, collaborate with and learn from graduate students from multiple institutions and acknowledge their important contributions and perspectives, including:

- Amanda Chiachi, California State University, Northridge
- Taylor Pantiga, San Francisco State University
- Olivia Won, University of California, Santa Cruz

OST would like to thank our state agency partners for their guidance and engagement during this project:

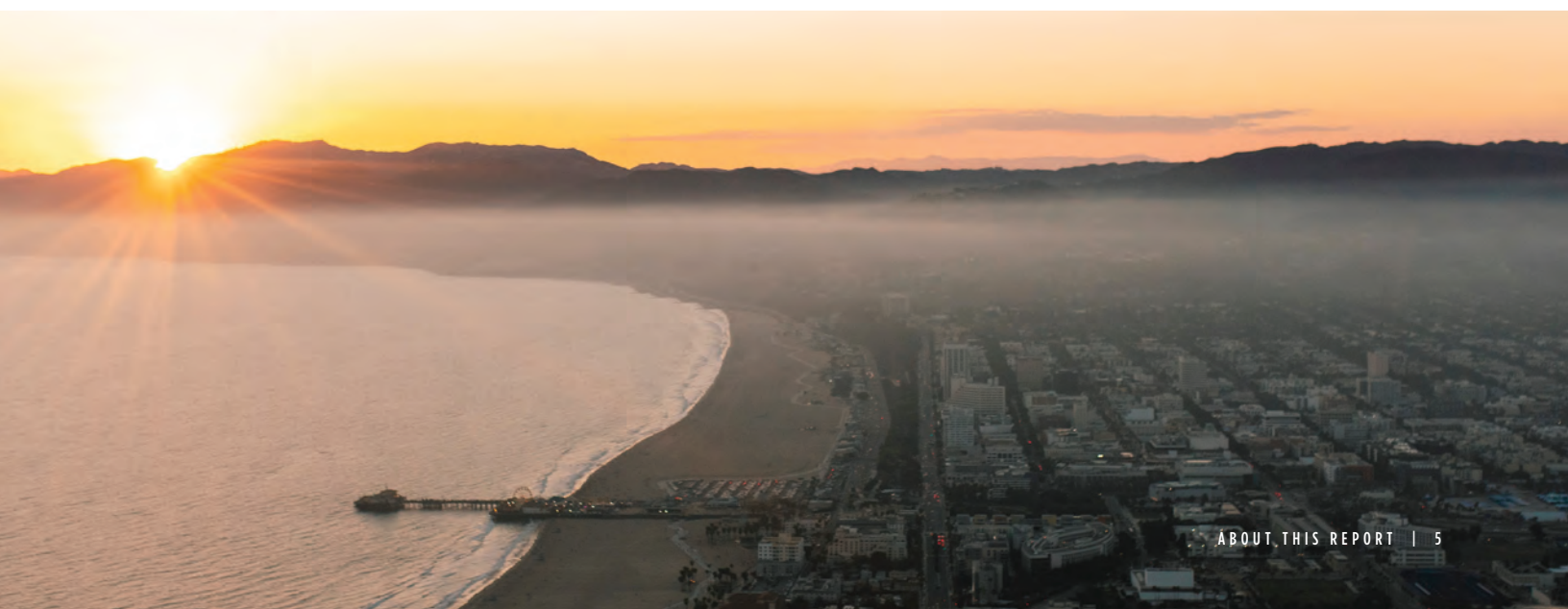
- Marilyn Latta, California State Coastal Conservancy
- Dr. Chuck Striplin, California Fish and Game Commission

We also appreciate the valuable insights and feedback provided during a series of compensated interviews and in the review of this report from the following individuals:

- Dr. Cutcha Risling Baldy, Cal Poly Humboldt
- Dr. Marcus Griswold, Calm Waters Group
- Dr. Beth Rose Middleton Manning, University of California, Davis
- Sona Monet and Nicole Wong, The Greenlining Institute
- Teresa Romero, Santa Ynez Band of Chumash Indians
- Lucas Zucker, Central Coast Alliance United for a Sustainable Economy

SUGGESTED CITATION

Toward More Equitable Nature-based Coastal Adaptation in California: Recommendations for Improving Social Equity in Funding, Policy, and Research. California Ocean Science Trust, June 2022.



Executive Summary

Nature-based coastal management approaches are increasingly being recognized as climate adaptation options that offer co-benefits beyond the original goal of shoreline protection in response to rising seas and other shoreline threats. In coastal regions, these include living shorelines, which are composed of natural or mostly natural elements and are designed to address shoreline change and vulnerabilities through the preservation, restoration, or enhancement of biodiversity, habitat, and other environmental and shoreline processes. The growing interest in these climate adaptation options in California presents an opportunity to invest in approaches that emphasize not only ecological and physical outcomes, but also advance social equity for frontline communities and California Native American tribes who have experienced a legacy of discrimination in land use planning and development.

This report provides **NINE EVIDENCE-BASED POLICY RECOMMENDATIONS** and **SEVEN RESEARCH NEEDS** for improving social equity in coastal management, funding decisions, and research related to nature-based coastal adaptation, and can help inform alignment between the State of California's equity, biodiversity, and coastal resilience¹ goals.

Evidence-based Policy Recommendations

1. **Prioritize appropriate coastal adaptation in frontline and tribal communities, and invest in approaches that elevate community values and needs while maximizing social and environmental outcomes.** Climate change is expected to exacerbate existing inequities, increase environmental health burdens, and reduce opportunities for communities and tribes on the frontlines of climate change. Many communities of color were restricted to low-lying flood-prone areas which were

also targeted for pollution from industry, emphasizing the importance of focusing investments and engagement in communities facing a legacy of historic inequities.

2. **Plan for meaningful engagement with frontline communities and tribes, and incorporate their values and needs before, during, and after project implementation.** Meaningfully incorporating frontline community and tribes' needs and input can help ensure a project is useful and relevant for a particular community, is culturally sensitive, and can lead to greater long-term stewardship. Community capacity and funding limitations need to be addressed simultaneously to increase the ability of communities to engage in shoreline planning processes.
3. **Work to address broader structural inequities in California that impact frontline coastal communities and effective ocean and coastal policy and management.** Coastal adaptation not a priority for coastal communities facing other social and economic challenges. Improving equity within the implementation of nature-based coastal adaptation specifically requires working to address broad structural and systemic inequities, for example by increasing representation in government and addressing other environmental or social justice issues first or simultaneously, such as pollution reduction and remediation, affordable housing, workforce development, and wealth building opportunities.

1. Executive Order N-82-20 <https://www.gov.ca.gov/wp-content/uploads/2020/10/10.07.2020-EO-N-82-20-.pdf>; Senate Bill 11 https://leginfo.ca.gov/faces/billTextClient.xhtml?bill_id=20210220SB1; Sea-Level Rise Leadership Team. (January 2022). State Agency Sea-Level Rise Action Plan for California https://www.opc.ca.gov/webmaster/_media_library/2022/02/Item-7_Exhibit-A_SLR-Action-Plan-Final.pdf; Ocean Protection Council Strategic Plan to Protect California's Ocean and Coast 2020 - 2025 http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20200226/OPC-2020-2025-Strategic-Plan-FINAL-20200228.pdf; Pathways to 30x30: Accelerating Conservation of California's Nature <https://www.californianature.ca.gov/pages/30x30>

4. Define context-specific social equity goals early in the process and establish clear equity metrics to evaluate project outcomes.

Community needs are diverse and potential project impacts and benefits of projects can vary significantly. Existing community screening tools are available and utilize a range of environmental and demographic indices, but do not capture all facets of equity and should be paired with proactive frontline community outreach and engagement. Projects should include clear equity metrics, monitoring, and evaluation.

5. Prioritize projects that improve access and stewardship by historically excluded frontline communities and tribes in California.

California's history of coastal development and land use includes significant displacement and disenfranchisement of frontline communities and tribes. Incorporating access and ownership elements into projects, where suitable, may provide the most direct benefits to communities and aligns with the State's designation of the coast as a public trust resource.

6. Incorporate traditional knowledge systems in coastal restoration policies and climate initiatives.

Tribes have a long history of coastal management and relationships with marine species in California for subsistence and cultural practices and thus they should be involved in efforts to safeguard and restore the coastline. Nature-based coastal adaptation approaches have the potential to help mitigate the risk posed by sea level rise to tribal resources and heritage sites.

7. Evaluate potential gentrification outcomes of projects and incorporate displacement avoidance strategies where appropriate.

Public investment in green spaces and shoreline improvements have been shown to exacerbate gentrification, however research and data are lacking for nature-based adaptation in California. The State should seek to evaluate potential gentrification outcomes of nature-based coastal projects and ensure that

increasing investments are not paired with community displacement and other changes.

8. Incorporate inclusive education and workforce development opportunities into project implementation.

Coastal restoration can contribute to training and workforce development and provide long-term economic gains. Building workforce development opportunities into living shorelines can help ensure economic benefits stay in the local community, thus reducing risk of displacement, but also provide the benefit of building place-based stewardship.

9. Scale up investment in a strategic suite of living shoreline pilot projects and explore opportunities to reduce programmatic barriers to increasing living shorelines as a coastal adaptation tool.

Implementation of living shorelines is in its infancy in California, with existing projects operating at small geographic scales and with limited emphasis on social outcomes. Strategic investments in a range of pilot projects, in alignment with the recommendations above, would rapidly expand understanding of living shorelines and their potential as equitable adaptation approaches to address sea level rise and other climate impacts. Scaling up living shoreline approaches will also require streamlining of government processes, where possible.

Priority Research Needs

California's coastlines, climate vulnerabilities, and communities are diverse, and therefore the potential social equity considerations for individual nature-based adaptation options can vary significantly. Filling priority research gaps, summarized below, can help support implementation of the recommendations in this report and inform equitable responses to sea level rise and other hazards in different contexts for frontline communities and tribes.

1. **Social equity outcomes across the spectrum of coastal adaptation approaches** to inform more equitable responses to sea level rise and other hazards.
2. **Shoreline management challenges, perceptions, and barriers to pursuing nature-based adaptation strategies within frontline and tribal communities** to guide opportunities for meaningful collaboration, outreach, and alignment of goals.
3. **Conditions under which nature-based approaches are feasible (and not) in California** and where they can be used to improve frontline and tribal community resilience.
4. **Distribution of current and historic coastal adaptation investments** in frontline communities and tribes to understand historic inequities and inform more equitable funding prioritization.
5. **Opportunities to incorporate traditional knowledge systems in restoration** techniques and outcomes to inform more just and inclusive projects.
6. **Avenues for reducing programmatic barriers** for implementing nature-based coastal adaptation projects.
7. **Potential for incorporating workforce development and education opportunities** within nature-based adaptation and restoration to provide more empirical evidence for these approaches as avenues for just transition.

The full list of research questions are presented in Table 4, including suggested analyses or projects that can be completed within the three to five years, ranging from expert convenings, qualitative and quantitative social science studies, mapping needs, community surveys, and decision-maker tool development.



I. Introduction

AS CALIFORNIA SEEKS TO ADAPT TO increasingly intense coastal storms, nuisance flooding, rising water tables, and other hazards, shoreline management approaches that provide benefits for both nature and people are needed to support resilient socio-ecological communities. The increasing state, federal, and private interest in nature-based climate solutions² presents an opportunity to invest in coastal adaptation approaches that emphasize not only ecological and physical outcomes, but also advance social equity (Box 1). Climate change is expected to magnify existing racial and income disparities, increase environmental health burdens, and reduce opportunities for communities on the frontlines of climate change (Martinich et al., 2013; Otto et al., 2017; Shonkoff et al., 2011). Frontline communities³ and California Native American tribal governments, tribal-led organizations, and tribal communities (hereafter referred to as “tribes”) face numerous social, economic, and environmental inequalities resulting from a legacy of discrimination and are and will continue to be disproportionately impacted by climate change (Michelle Roos, 2018; Norton-Smith et al., 2016). Many coastal frontline communities were historically restricted to low-lying flood-prone areas which were also targeted for pollution from industry, leaving these communities at higher risk of health and safety impacts from sea level rise and other climate stressors. Equitable coastal adaptation is needed in California to reverse and offset a legacy of forced displacement, environmental racism, disinvestment, and unjust land use.

2. *Nature-based climate solutions* are actions that work with and enhance nature to build climate resilience and/or contribute to carbon neutrality.

3. For the purposes of this document, *frontline communities* are defined to “include lower-income communities, communities of color, Indigenous peoples and Tribal nations, and immigrant communities who are especially vulnerable to the impacts of climate change because of decades-long, pervasive socioeconomic conditions that are perpetuated by systems of inequitable power and resource distribution” (Mohnot, Bishop, and Sanchez, 2019). While “frontline communities” includes Indigenous people and Tribal nations, tribes are often named separately throughout this document to recognize distinct histories and lived experiences within the California coastline.

Presently, there has been accelerating interest in the use of nature-based approaches to coastal adaptation and shoreline management - referred to here as *living shorelines* - as alternatives to “gray” or “hard” infrastructure approaches (e.g., seawalls, revetments, bulkheads) because they offer co-benefits beyond the original goal of coastal protection (Box 2). In coastal regions, living shorelines are composed of natural or mostly natural elements and are designed to address shoreline change and vulnerabilities through the preservation, restoration, or enhancement of biodiversity, habitat, and other environmental and shoreline processes (see Appendix B for a list of living shoreline projects and locations in California). There is growing evidence for the suite of ecological and societal benefits provided by living shoreline projects in California and beyond, including physical protections, increased habitat and biodiversity, recreational opportunities and more (see Table 2 and reference therein). However, to date, many gaps remain in our understanding of the social equity outcomes associated with the spectrum of coastal adaptation responses, including living shorelines.

Coastal adaptation planning must evaluate many physical and ecological factors (e.g., geomorphology of the shoreline, the sea level rise impact predicted, technical feasibility), as well as socio-economic considerations (e.g., community interests, funding available, land access, financial cost associated with the intervention). *Equitable* coastal adaptation, including the use of nature-based approaches, requires prioritizing adaptation efforts, investments, and engagement in frontline communities and tribes who experience higher levels of environmental degradation and social vulnerability as a result of historic policy choices. The potential social equity outcomes of individual projects can vary significantly and determining an equitable approach for a particular location requires attention to pre-existing historical, social, and economic conditions and inequities in communities where a project is occurring or planned. Practitioners and planners should evaluate the potential environmental justice⁴ implications of a proposed project or activity relative to the potential impacts of alternative strategies, and pursue approaches that consider the well-being

of frontline communities and tribes by avoiding exacerbating existing injustices, first, but also seeking to rectify them.

Research shows that greater consideration of social equity in marine conservation and management can improve both environmental and social outcomes (Bennett et al., 2021). Figure 1 provides an example conceptual framework for simultaneously advancing equity and living shoreline character. However, equity is dependent on the local socio-cultural context, and nature-based approaches may not be feasible or the most desired shoreline management approach for every community. For example, some living shoreline projects may require spatial closures to protect endangered nesting seabirds or critical habitat, prioritizing ecological outcomes but removing public access. In other cases, a community may prefer “grayer” infrastructure approaches if they protect a valuable community resource at imminent risk of sea level rise or coastal flooding. Understanding the local context via social science and community engagement is essential to informing equitable coastal adaptation planning and management that benefits both nature and people. Community needs and lived experience should be distinctly prioritized in the decision making process.

Lastly, scaling up living shorelines will require advancements in scientific learning, training and workforce development, and streamlining of government processes, where possible. Implementation of living shorelines is in its infancy in California. Existing projects operate at small geographic scales, many of which do not have a physical nexus with human communities, and primarily assess physical and ecological performance, with minimal emphasis on social outcomes (see Appendix B for a list of living shoreline projects in California). Increased investments in demonstration projects across a range of habitats and communities are needed to inform the conditions and timescales under which

4. In California, *environmental justice* is defined by state law as the “the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation and enforcement of environmental laws, regulations, and policies” (Gov. Code, § 65040.12, subd. (e)).

living shorelines are feasible as shoreline management approaches, as they are not likely to be resilient to all climate scenarios. Expanding living shoreline efforts statewide also requires improving efficiencies in granting and permitting, given that some restoration efforts have taken a decade or more to begin construction (Grenier et al., 2021). In contrast, some experts suggest that gray infrastructure, like seawalls, have fewer barriers compared with living approaches that require extensive monitoring and maintenance. Reducing lag times and improving efficiency of California’s granting and permitting processes are necessary for implementing nature-based coastal adaptation approaches that can keep pace with sea level rise and maximize socio-ecological outcomes.

BOX 1:

Elements of social equity in nature-based coastal adaptation

Generally, social equity is “concerned with fairness and justice in how people are treated or public policies are formulated and implemented” (Bennett et al., 2021). While there are many definitions of equity, for the purposes of this report, we define equity as a process that leads to the intended outcome of justice, which necessitates the reckoning, remedying, and prevention of systemic injustices. This includes transforming the behaviors, institutions, and systems

that disproportionately harm frontline communities and tribes, increasing their access to power and resources, and eliminating barriers to opportunity (adapted from Mohnot, Bishop, and Sanchez, 2018). In the context of marine conservation, social equity has recently been expanded to encompass six primary elements: recognition, procedures, distribution, management, environment, and contextual/structural (Table 1) (Bennet et al., 2021).





Table 1. Definitions of the elements of social equity in the context of marine conservation (Bennett et al., 2021).

ELEMENTS OF SOCIAL EQUITY	DEFINITION IN THE CONTEXT OF CONSERVATION
Recognition	The acknowledgment and incorporation of the rights, tenure, cultural identities, practices, values, visions, knowledge systems and livelihoods of local groups into conservation governance, planning, and management.
Procedures	The inclusion and effective participation of all relevant actors and groups in rule and decision-making for conservation policies and programs, which requires good governance practices such as transparency and accountability.
Distribution	The level of fairness in the distribution of benefits and burdens between different groups, including current and future generations, of the outcomes of conservation actions.
Management	The extent to which local people are able to participate in, carry out the work of, or be responsible for and have a leadership role in management activities.
Environment	The quality of local environment and nature's contributions to people based on the effectiveness of actions taken to maintain ecological sustainability, health and productivity that people depend on for food security, livelihoods, cultural anchoring, health, and well-being.
Contextual or Structural	The surrounding social, economic, and political conditions that influence people's pre-existing status (in terms of wealth, social capital, assets/capabilities, and power), as well as the structures that enable or undermine people's ability to achieve recognition, procedural, distributional, managerial, and environmental equity in conservation initiatives.

BOX 1:

What are living shorelines in California?

For this report, living shorelines are defined as nature-based approaches to address shoreline change and vulnerabilities through the preservation, restoration, or enhancement of biodiversity, habitat, and other environmental and shoreline processes. This definition is intentionally broad, pulling from multiple definitions and interchangeable terms used and operationalized in different ways by agencies and practitioners (California Coastal Commission 2021; Judge et al., 2017; NOAA 2015; RAE 2015; Bridges et al., 2015). While some living shoreline definitions do not include non-sheltered shorelines facing the open ocean, this report takes a more expansive approach and includes living shorelines in bays, estuaries, and the outer coast. This term may also be used with other broader encompassing terms including natural “green” or “blue” infrastructure, nature-based solutions or features, or soft and hybrid approaches to shoreline management. Throughout this report, we

use the term interchangeably with nature-based coastal adaptation.

In California, examples of living shorelines include techniques to restore, enhance, create, stabilize, or revegetate coastal and estuarine habitats, including eelgrass beds and salt marshes, habitat reefs (including oyster reefs), horizontal or “habitat” levees, sandy beaches, bluffs, cliffs, and coastal dunes that simultaneously expand habitat and support biodiversity (see below). Living shorelines also include a range of hybrid techniques that combine ‘soft’ and ‘hard’ approaches, for example a salt marsh living shoreline may include coarse sediment augmentation as a means to protect the habitat from erosion. See Appendix B for a list of living shoreline projects in California.

EXAMPLES OF LIVING SHORELINES IN CALIFORNIA



COASTAL SALT MARSH
Elkhorn Slough



EELGRASS HABITAT REEF
San Francisco Bay



HORIZONTAL HABITAT LEVEE
Oro Loma Sanitary District








COASTAL DUNE
Cardiff Beach

Table 2. Evidence for Services Provided by Living Shorelines.

Living shorelines can provide a suite of ecological, physical, and societal benefits, documented here as a snapshot based on a non-exhaustive rapid assessment of scientific literature for the primary living shorelines in California. While evidence is growing as more living shoreline projects are implemented in California and beyond, many gaps still remain (denoted in gray), particularly related to economic, human health, and access. This rapid assessment did not include an evaluation of how benefits may vary

under different sea level rise or storm scenarios (living shorelines are not likely to be resilient to or continue to provide benefits across all scenarios or conditions), nor did it account for differences in project design and other physical conditions and geographies that may impact effectiveness at providing benefits. Potential equity impact associated with each benefit was determined by consulting with our science panel and additional external interviews (see Acknowledgements).

BENEFIT CATEGORY		HIGH POTENTIAL EQUITY IMPACTS					
			SEAGRASS BEDS	COASTAL MARCH	DUNE ECOSYSTEMS	HABITAT REEF (Including Oysters)	HORIZONTAL HABITAT LEVEE
Water Quality & Availability	WATER FILTRATION		●	●	●	● ▲	
	GROUNDWATER RECHARGE / PROTECTION		■	■	■	■	
Physical Protections	WAVE REDUCTION	■	●	●	●	●	
	COASTAL FLOOD REDUCTION	■	■	●	■	●	
	SEDIMENT CYCLE SUPPORT	■ ■	●	●	■	■	
	REDUCED EROSION	■	●	●	■	●	
Climate Regulation	CARBON SEQUESTRATION		●	●	■	■	
Ecological	INCREASED HABITAT (Incl. Nursery)		●	■	●	●	
	INCREASED BIODIVERSITY		●	●	●	●	
Access	INCREASED COASTAL ACCESS	■ ■	■	● ▲	● ▲	● ▲	

Strong evidence for benefit shown in literature
 Did not see support for benefit / benefit not likely to be associated with project type
 No scientific evidence available

●
 Evidence available from studies in California




















▲
 Project underway but no scientific data currently available

■ ■
 High potential equity impact, but only if anti-displacement policies are in place

Moderate or mixed evidence for benefit shown in literature
 Support based on personal communication with tribal members

■
 High potential equity impact or benefit

Table 2. Evidence for Services Provided by Living Shorelines (Continued).

BENEFIT CATEGORY		HIGH POTENTIAL EQUITY IMPACTS					
			SEAGRASS BEDS	COASTAL MARCH	DUNE ECOSYSTEMS	HABITAT REEF (Including Oysters)	HORIZONTAL HABITAT LEVEE
Health / Recreation	NON-CONSUMPTIVE RECREATION (Incl. Physical Health)			●			
	RECREATIONAL FISHING			●			● ▲
	IMPROVED MENTAL HEALTH						
Culture / Community	CULTURAL / SPIRITUAL SIGNIFICANCE		■	■	■	■	■
	CONNECTION / SENSE OF PLACE		■	■	■	■	■
	SUBSISTENCE FISHING						
Education	EDUCATIONAL OPPORTUNITIES						● ▲
Economic	INCREASED PROPERTY VALUES						
	AESTHETICS				●		
	REDUCED FLOOD INSURANCE PREMIUMS						
	WORKFORCE DEVELOPMENT AND JOB TRAINING		●	● ▲	●	● ▲	● ▲
	TOURISM						
	PROTECTION OF INFRASTRUCTURE AND HOMES				● ▲	●	
	RAW MATERIALS						
	IMPROVING COMMERCIAL FISHERIES OUTPUTS						










 Strong evidence for benefit shown in literature
  Did not see support for benefit / benefit not likely to be associated with project type
  Evidence available from studies in California
  Project underway but no scientific data currently available
 Moderate or mixed evidence for benefit shown in literature
  No scientific evidence available
  Support based on personal communication with tribal members
  High potential equity impact, but only if anti-displacement policies are in place
 High potential equity impact or benefit

Figure 1. Conceptual framework for simultaneously advancing social equity and living shoreline character.

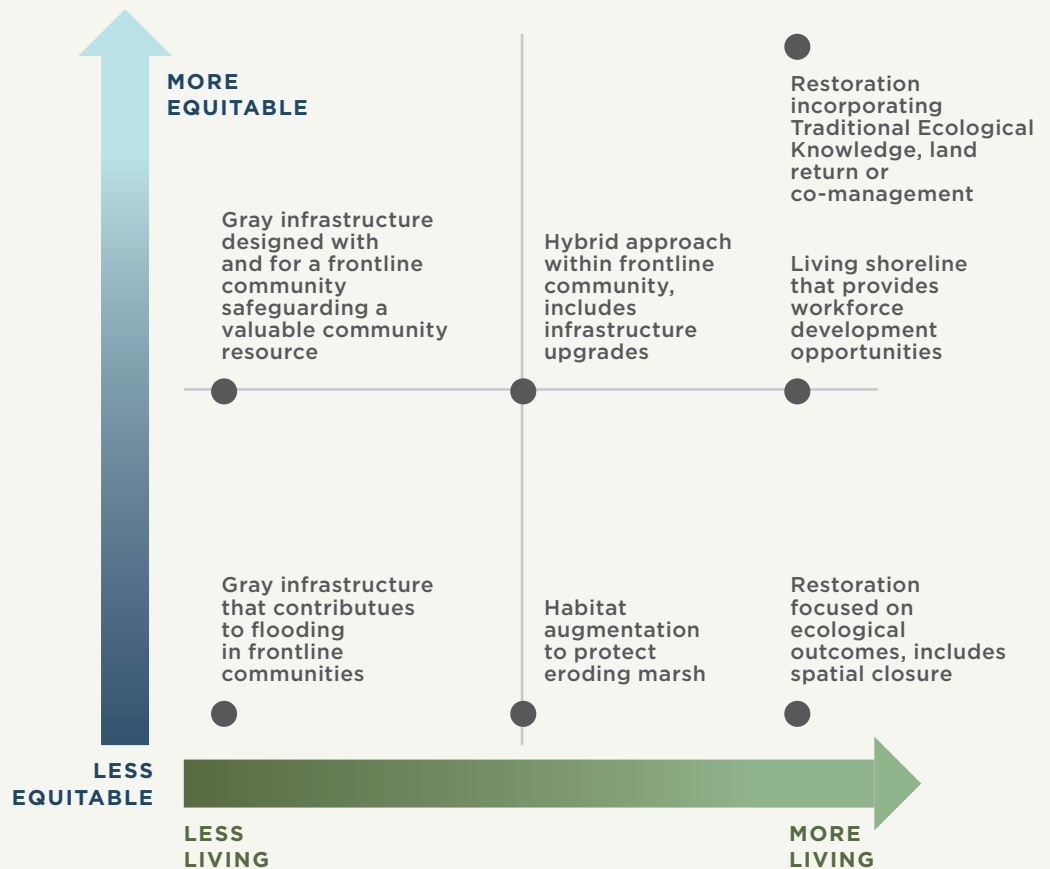
This example framework is designed to support conversations around moving towards shoreline management approaches in California that increase social equity as well as enhance ecological, physical and other environmental processes (living shoreline character). For the purposes of this example, we assume shoreline equity and living shoreline character are co-equal community goals, and include several simplified adaptation scenarios to explore where they may fall relative to one another. A.) Increased living shoreline character could include project components that increase habitat and biodiversity, provide natural flood capacity/mitigation, water quality benefits,

or protect sensitive species, habitats, and natural shoreline processes and ecosystems. B.) Potential components that may increase shoreline equity could include projects that elevate community values and priorities, provide direct and meaningful benefits to frontline communities or tribes (e.g., shoreline protections, workforce development, public health benefits, infrastructure upgrades, etc.), enhance or maintain public access, acknowledge and seek to rectify current and historic injustices (e.g., land return and co-management with tribes), and include monitoring of social equity metrics. See Table 2 in Bennett et al. 2021 for a more comprehensive list of potential social equity metrics in marine conservation that could also be applied to shoreline equity.

B. Shoreline Equity

Example project components that may increase shoreline equity include:

- Design/executed in partnership with local communities and tribes
- Participatory process and co-development with community benefit agreements; community needs prioritized and project adapted accordingly
- Maintains or enhances direct/meaningful benefits to frontline communities
- Acknowledges/seek to rectify historic injustices
- Gentrification risks assessed/mitigated
- Human dimensions metrics are monitored
- Includes local workforce development and training opportunities



A. Living Shoreline Character

Example project components that may increase living shoreline character include:

- Enhances ecological function, including increased habitat and biodiversity
- Provides physical protections, including reduced wave energy, erosion and coastal flooding
- Supports sediment cycle and other shoreline processes
- Enhances water quality and availability via water filtration, storm water retention, and groundwater recharge
- Supports carbon sequestration and storage



II. Evidence-based Policy Recommendations for Advancing Equitable Nature-based Coastal Adaptation in California

The recommendations below (summarized in Table 3, pg. 36) were developed for policymakers with guidance from a science panel and with input from community leaders, tribes, and government agencies in California. The recommendations span six elements of social equity (Box 1) and are not intended to be a comprehensive assessment of equity and coastal adaptation, but rather to provide framing and insights for advancing the State toward more equitable approaches to nature-based coastal adaptation and shoreline management in California.

1. **Prioritize appropriate coastal adaptation in frontline and tribal communities, and invest in approaches that elevate community values and needs while maximizing social and environmental outcomes.**

WHY: *Many frontline communities and tribes in California face disproportionate health and environmental burdens as a result of historic inequities and disinvestment, are often excluded from decision-making, have limited access to services, and will continue to experience more significant impacts due to climate change. While efforts to embed equity and environmental justice in coastal adaptation are growing, more is needed to ensure equitable access to shoreline management benefits, investments, and resources to promote resilience in communities who have experienced a legacy of discrimination in land use planning and development.*

HOW:

1.1. Embed social equity across all state coastal adaptation and shoreline resilience planning, policies, processes, and grant programs. Briefly, this includes greater recognition of tribal sovereignty and frontline community needs and lived experiences in decision-making and funding priorities, and working to ensure communities have access to funding and information related to coastal resilience and shoreline management. The State should continue to invest in coastal and near-coastal community environmental justice issues as part of California’s broader climate change resilience planning efforts and strategies. This includes continuing to expand social science and human dimensions issues within California’s Ocean and Coast Summary Report (Sievanen and Phillips et al., 2018), highlighting coastal case studies within the Climate Justice Summary Report (Roos 2018) and Summary Report from Tribal and Indigenous Communities within California (Goode et al., 2018), and prioritizing coastal community environmental justice issues as part of California’s Climate Adaptation Strategy⁵. See Greenlining’s Making Equity Real in Climate Adaptation and Planning⁶ for additional resources on operationalizing equity in climate and resilience policy and granting programs.

1.2. Allocate at least 50% of funding or create dedicated grant programs for projects that directly and meaningfully benefit frontline communities and tribes. Existing California legislation⁷ directs some state agencies and programs to allocate percentages of funds into frontline communities, ranging from 15-35%⁸, while some granting programs establish allocations on a voluntary basis. Given the decades of active disinvestment to frontline communities, equitable distribution of funds implies a significant percentage of funds be set aside - recommended here as a minimum of 50%⁹ - for frontline and Indigenous communities to undo historic inequities. Investments should prioritize projects that are community-led, align priorities with frontline communities, leverage local and traditional knowledge, incorporate community science and participatory research, and address frontline community and tribes’ needs, among others. Examples of coastal agency RFPs that designate funding for frontline communities include the Ocean Protection Council’s 2021 Prop 1 Solicitation, which funded 100% to “communities entitled to environmental justice”, and the State Coastal Conservancy’s 2022 Explore The Coast Grants designates 50% to “Priority Communities”, defined therein (OPC 2021; SCC 2022).

5. <https://www.climate-resilience.ca.gov/>

6. <https://greenlining.org/publications/2019/making-equity-real-in-climate-adaption-and-community-resilience-policies-and-programs-a-guidebook/>

7. Senate Bill 535, Assembly Bill 1550, Senate Bill 5, Assembly Bill 523

8. Although these are the statutory minimums, California regularly invests at a higher percentage in practice (closer to 50% toward priority populations)

9. Based on recommendations provided by community leaders during interviews conducted during the development of this report

1.3. Prioritize technical assistance in frontline communities and tribes, and increase access to training and communication resources on nature-based coastal adaptation approaches relative to other forms of coastal climate adaptation. Not all communities have equal access to resources and funding, particularly those without high percentages of community-based organizations, NGOs, and community organizers. Increased understanding and deployment of nature-based coastal adaptation approaches requires proactively assisting frontline communities who may benefit from a policy or grant program with accessing these opportunities, and providing structures for community networking and collaboration. The state may consider replicating Strategic Growth Council's Community and Technical Assistance¹⁰ and programs within coastal planning processes and grant programs. In addition, complex permitting combined with the need for specialized expertise can act as a significant deterrent for localities considering nature-based coastal adaptation measures, including living shorelines. Permitting assistance should be prioritized for frontline and tribal communities, and no-cost, open access technical resources, such as NOAA Office for Coastal Management's coastal resilience and living shoreline trainings¹¹ should be expanded and more widely advertised to improve the accessibility of living shorelines as an adaptation tool.

1.4. Support and expand collaborative networks and regional partnerships around nature-based coastal adaptation planning and implementation. In addition to increasing access to training and communication resources, coastal communities may also benefit from support in building relationships, knowledge sharing, and directing resources toward collective coastal planning goals. The North Coast Resource Partnership¹² and the Strategic Growth Council's Regional Climate Collaboratives¹³ are excellent examples of programs designed to advance collective community impact.

2. Plan for meaningful engagement with frontline communities and tribes and incorporate their values and needs before, during, and after project implementation.

WHY: *Community engagement is difficult to obtain funding for and is often pursued when a living shoreline project design is 60-80% complete, or is excluded entirely (San Francisco Estuary Partnership and City of Santa Cruz, personal communication). Listening to and meaningfully incorporating frontline community and tribal needs and feedback at the outset and throughout implementation of a project can help ensure a project is useful, meaningful, and relevant for a particular community and is culturally sensitive, which can lead to greater long-term stewardship. Where applicable, the community should be given the opportunity to be trained on, and lead (or co-manage, for tribes) where they opt to do so. This recommendation also requires addressing capacity limitations of communities and local community groups to increase their ability to participate in shoreline planning and implementation processes.*

HOW:

2.1. Support establishment and long-term capacity building at community-based and tribal-led organizations to increase their ability to engage in shoreline planning processes.

Community-based and tribal-led organizations working at the local level face extensive capacity issues, with limited staff able to engage and advocate for communities in a growing number of coastal and climate adaptation planning processes. Granting programs may expand eligibility requirements to allow directed funding for community-based organizations, resources for community organizing and engagement, as

10. <https://sgc.ca.gov/programs/cace/resources/>

11. <https://coast.noaa.gov/digitalcoast/training/home.html>

12. <https://northcoastresourcepartnership.org/>

13. https://sgc.ca.gov/programs/cace/docs/20211011-Fact_Sheet-RCC.pdf

well as relaxing caps for overhead to help build program sustainability and establish long-term staff positions. To the extent feasible, grant programs should allow for advanced payment rather than a reimbursement model which presents a barrier for organizations that don't have adequate funding to get projects off the ground. Granting programs can also support community-based and tribal-led organizations in efforts to start land trusts¹⁴ and establish voluntary land taxes by offering stepwise workshops and webinars (Alisa White, 2021).

2.2. Encourage projects to include community benefit agreements and require community engagement or needs assessments to help ensure projects reflect community values and needs. Ideally, engagement should occur at all phases of adaptation planning, from initial scoping, design, construction, and long-term monitoring. Projects should leverage local knowledge and partnerships with organizations who have ongoing relationships within tribes and communities. Some small, rural, or under-resourced communities may not have established nonprofit infrastructure or advocates specializing in coastal issues. In these cases, agencies and practitioners may need to be creative in seeking community input from groups that are not seen as traditional environmental justice or climate-focused organizations but work closely with communities impacted by climate change, which can include youth, immigration, racial justice, housing, or worker rights groups, faith-based organizations, schools, and other community hubs. Many resources on best practices for community engagement are available (Box 3). An environmental justice or social vulnerability assessment can help with the design of a frontline community engagement plan that is appropriate for a given community to increase participation. The State may consider developing a community engagement template for coastal adaptation projects that allows for

BOX 3:

Best practices for Community Engagement

Many resources on best practices for community engagement are available (e.g., SB 100 Toolkit: Planning for Healthy Communities¹⁵; California Environmental Justice Alliance, 2017). Several best practices across resources include:

- Meeting communities where they are
- “It’s never too early” - engage communities at every stage of the process
- Developing community agreements at the outset of a planning process
- Ensuring engagement is a two-way dialogue (reciprocal), with the goal of empowering communities and increasing their agency in the decision-making process and not just to keep them informed
- Consistent engagement and “moving at the speed of trust”
- Listening to community concerns and adapting project design accordingly
- Planning budgets to provide fair compensation for project participation at consultant rates
- Designating and supporting a project liaison from the community
- Planning for maximally accessible meetings
- Recognizing survey fatigue or being mindful of capacity to engage; work with local needs and priorities that have already been articulated

14. <https://storymaps.arcgis.com/stories/ca3f7eb701784ffeb1297567495f991a>

15. <https://caleja.org/2017/09/sb-1000-toolkit-release/#form>



place-based flexibility. Downscaled assessments of climate risk and social vulnerability can also be used to identify frontline communities and help target outreach efforts, a process which has been undertaken by the City of Santa Cruz (Climate Adaptation Update Team, 2018).

2.3. Broaden grant eligibility to include funding for community engagement, needs assessment, and outreach activities. This includes expanded funding and granting flexibility to allow for community engagement at earlier stages of a project, adequate translation and interpretation of materials and meeting discussions into the most commonly spoken languages in each planning region, compensating individuals for their time and contributions, and for hiring community-based organizations to co-develop and implement engagement strategies, convene community discussions and listening sessions, and develop and deploy surveys and communication materials.

2.4. Create a shared database of community plans and needs assessments related to climate adaptation and shoreline management to reduce the burden on communities. Many community-based organizations (CBOs) and tribes are managing an influx of groups trying to engage, interview, and understand needs. In addition to investing in CBO and tribal capacity building (per recommendation 2.1 above) a shared database could help reduce survey and engagement fatigue, while also allowing for sharing of local and regional priorities and needs across agencies and practitioners.

3. Address broader structural inequities in California that impact frontline coastal communities and effective ocean and coastal policy and management.

WHY: *Improving equitable outcomes for tribes and frontline communities cannot be limited to shoreline management and adaptation, and*

requires addressing broader structural and systemic inequities within society first or simultaneously. For example, as seas rise in California, flooding of hazardous sites is five times more likely to occur in disadvantaged communities¹⁶, exposing those nearby to pollutants from facilities such as power plants or waste sites. The State should coordinate with local and federal government to address priority social and environmental justice issues like reducing pollution in frontline communities, investing in projects with public health, economic, and environmental outcomes that span the land-sea interface, and expanding active and diverse representation and inclusion across coastal science and management.

HOW:

3.1. Increase interagency, cross-jurisdictional coordination to address high priority environmental justice issues and other community-identified needs in parallel with advancing nature-based climate adaptation.

Living shorelines may not be an immediate priority for frontline communities facing disproportionate exposure to environmental hazards due to industrial uses in urban areas and economic issues such as access to affordable housing and jobs. Climate adaptation and coastal access provided by living shorelines adjacent to areas with high industrial toxins may actually expose communities to greater public health hazards (West Oakland Environmental Indicators Project, 2022). Clean-up of legacy toxic sites and developing guidelines for hazardous facilities at risk of flooding due to sea level rise should be a high priority statewide (Toxic Tides Project, 2022). This will also reduce the potential for incompatible land uses with nature-based solutions like living shorelines. Public health, water quality, land use, local and coastal government agencies can improve coordination, for example by pairing funding to address multiple environmental justice issues simultaneously, and prioritizing projects with both public health and environmental outcomes. The Transformative Climate Communities¹⁷ program is an example of this multi-sectoral approach toward advancing community and climate resilience.

3.2. Expand active and diverse representation and inclusion across coastal science and management:

such as, (a) supporting diversity in hiring within state coastal agencies by emphasizing the need for expertise in Native American Studies and community practices; (b) positioning equity leads and tribal liaisons within agencies as full time employees with decision making power and without extra duties (e.g., the Department of Water Resources Tribal Policy Advisor¹⁸, California Natural Resources Agency Assistant Secretary for Equity and Environmental Justice¹⁹); (c) requiring staff training and/or incentivizing certificate programs in Indigenous natural resource management and community engagement; and (d) linking grant eligibility to board representation to incentivize representation at the leadership level. Lack of representation at state agencies creates barriers for building trust and meaningful engagement with communities (per recommendation 7), in addition to creating confusion about who to contact. Supporting diversity and equity in hiring and training can help ensure that diverse perspectives are considered in permitting and grantmaking processes.

3.3. Include environmental justice practitioners and community representatives on agency advisory committees and boards, grant proposal review panels, and other decision-making bodies to help ensure equity is incorporated across all aspects of the climate adaptation process.

16. See the Toxic tides project: <https://sites.google.com/berkeley.edu/toxicitides/home>; Disadvantaged communities are defined in this context as communities with CalEnviroScreen 4.0 scores in the top 25th percentile as designated by the CalEPA

17. <https://greenlining.org/our-work/environmental-equity/transformative-climate-communities-2/>

18. <https://water.ca.gov/about/tribal-policy>

19. <https://resources.ca.gov/About-Us/Who-We-Are/Assistant-Secretary-for-Equity-and-Environmental-Justice>

4. Define context-specific social equity goals early in the process and establish clear equity metrics to evaluate project outcomes.

WHY: *Equitable shoreline management, including implementation of living shorelines, is context-dependent and will require attention to pre-existing historical, social, and economic conditions and inequities in the specific place in which a project is occurring or planned. Living shoreline project types are diverse, as are California's coastlines, climate vulnerabilities, and communities, and therefore the potential social equity considerations of individual projects can vary significantly. The State should be flexible and adaptive in defining social equity goals so that they can be driven by frontline communities and tribes on local scales. While existing environmental justice and other social vulnerability screening tools are available (Box 4), they should be paired with local community engagement and a requirement to include social scientists and community leaders on the project planning team to help ensure projects contribute to social equity within local communities.*

HOW:

4.1. Develop social equity metrics to inform design, monitoring, and evaluation of coastal adaptation projects. While there is increasing attention and interest on equity and coastal adaptation, currently, there is not a shared understanding of how to integrate or assess social equity within coastal adaptation projects, including living shorelines. The State could consider developing equity metrics, building on available best practices, to be used as weighted scoring criteria or included within grant or permitting requirements as a transparent means for evaluating equity across all State grants. Such a tool may also be useful for practitioners to inform equitable project design, process, monitoring, and evaluation.

4.2. Invest in projects that include community-based participatory research and multidisciplinary project teams that bring together natural and social sciences, and the voices and perspectives of tribes and frontline communities. Permitters and funders can encourage diverse expertise and the need to honor lived experience and expertise of community members early in the project planning process by bringing social science and community perspectives into project development and through implementation. This includes expertise in environmental justice, equity, the humanities, anthropology, and methods of participatory research to encourage projects that are culturally competent and focused on societal benefits.

4.3. Continue to improve environmental justice community screening tools such as integrating context-specific vulnerability assessments, exploring opportunities to update social and physical indicators specific to coastal communities, expanding integration with other mapping and screening tools, and working with tribes to explore appropriate measures for representing interests or ancestral lands (*see also research recommendation 2.1*).

BOX 4:**Resources for identifying frontline communities in California.**

Below are a set of resources and tools currently in use by state and federal agencies to identify frontline communities. These tools utilize a range of metrics including demographic and census tract information, pollution burdens, risk to sea level rise, flooding and erosion, and proximity to toxic sites.

While these are a good starting point as initial screening tools, their uses and outputs vary, they do not capture all facets of equity (e.g., CalEnviroScreen does not factor in projected climate impacts, nor does it consider impacts to tribal communities or resources), and often miss finer-scale (e.g., smaller than census tracts) frontline communities given regional differences in the cost of living, particularly for largely affluent coastal communities. Use of existing tools should thus be paired with proactive outreach and community engagement. There is also a need for better integration across tools (see Research Recommendation 2.1).

- **BCDC Community Vulnerability Mapping Tool**
<https://bcdc.maps.arcgis.com/apps/webappviewer/index.html?id=526ca82e85e403489de768498f605f3>
- **CalEnviroScreen 4.0**
<https://calenviroscreen-oehha.hub.arcgis.com/#CalEnviroScreen>
- **Department of Water Resources disadvantaged community mapping**
<https://gis.water.ca.gov/app/dacs/>
- **DTSC EnviroStor**
<https://www.envirostor.dtsc.ca.gov/public/>
- **Federal**
<https://screeningtool.geoplatform.gov/en/>

- **Federal - Climate and Economic Justice Screening Tool (coming):** <https://screeningtool.geoplatform.gov/en/#3/33.47/-97.5>
- **GeoTracker**
<https://geotracker.waterboards.ca.gov>
- **Governor's Office of Planning and Research Vulnerable Communities platform (coming soon)**
- **Surging Seas Risk Zone Map (Climate Central)**
https://ss2.climatecentral.org/#12/40.7298/-74.0070?show=satellite&projections=0-K14_RCP85-SLR&level=5&unit=feet&pois=hide
- **Toxic Tides Initiative**
<https://sites.google.com/berkeley.edu/toxictides/home>
- **US EPA EJScreen**
<https://ejscreen.epa.gov/mapper/>

Below are several resources for identifying tribes and Indigenous communities who may be impacted

- **Bureau of Indian Affairs Pacific Region**
<https://www.bia.gov/regional-offices/pacific>
- **California Native American Heritage Commission (NAHC)**
<https://nahc.ca.gov/>
- **California Truth and Healing Council**
<https://tribalaffairs.ca.gov/cthc/>
- **The Governor's Office of the Tribal Advisor's**
<https://tribalaffairs.ca.gov/>

5. Prioritize projects that improve access and stewardship by historically excluded frontline communities and tribes in California.

WHY: *California's history of coastal development and land use includes significant displacement and disenfranchisement of frontline communities. Access to the public coastline was and continues to be disproportionately distributed along racial and economic lines (Garcia and Baltodano, 2005; Reineman et al., 2016). Divestment of tribal rights has limited the ability of Indigenous communities to freely access ancestral territory, prohibiting their ability to steward the land and gather for cultural practices (Baldy, 2013). In addition, government land seizure forcibly removed Black landowners and beachgoers from coastal southern California (Rosanna Xia, 2020). Incorporating access and ownership elements into living shorelines, where possible, may provide the most direct benefits to communities and aligns with the State's designation of the coast as a public trust resource. However, public access considerations are highly site-specific; for example, some living shorelines, like eelgrass beds or oyster reefs, occur in tidal/subtidal areas that substantially limit public access due to safety hazards or environmental protection, or may be closed to limit impacts to protected species like breeding seabirds.*

HOW:

5.1. Prioritize projects that improve public access for all Californian's in policy, funding and permitting, while balancing safety and environmental protection considerations. Funders and permitters can emphasize the need for projects that improve or maintain coastal access (per the California Coastal Act), for recreation, mental and physical health, subsistence fishing, and cooling, among many other uses. This may include pairing living shoreline investments with culturally competent, climate-smart, and accessible infrastructure improvements; for example, trails and walkways, parking, crosswalks, and lighting (for safety

and accessibility), staffing (e.g., tour guides and docents), visitor services, and educational programming. Infrastructure should facilitate intergenerational and multi-cultural use (e.g., play facilities, multilingual signage, murals, picnic tables and shade, restrooms). Alongside improvements, monitor potential changes in access (to assess potential displacement - see *recommendation 8*). This recommendation may require diverse (and new) collaborations between coastal agencies, local government, nonprofits, academia, and community groups.

5.2. Assess barriers to tribal use and access of coastal spaces for ceremony, gathering, and subsistence, among both federally recognized and unrecognized tribes.

This includes addressing policy, permitting, and financial barriers to tribal access and use of the coast, for example by removing permit fees for tribal take and for access to state and federal parks (e.g., via legislative changes and updates to California Fish and Game Code). This may also include expanding MOUs²⁰ between California Native American Tribes and California State Parks to address cultural and natural resources of concern or interest to the tribes within State Parks (currently undertaken on an individual park basis), for example via co-management of tribal special events and the California Native American Gathering Permit process, and re-naming sites to remove residual derogatory place names (see Sue-meg State Park²¹).

5.3. Support opportunities to expand coastal resource co-management and land return to restore Indigenous knowledge, stewardship, and practices. California's Native Ancestral Lands Policy²² encourages every State agency, department, board and commission to "to work cooperatively with California tribes that

20. https://www.parks.ca.gov/?page_id=30608

21. California State Parks renamed Patrick's Point State Park to Sue-meg State Park to honor the place name used by the Yurok people since time immemorial <https://www.parks.ca.gov/NewsRelease/1040>; See also Truth and Healing Council recommendations on renaming

22. Native American Ancestral Lands policy, Office of the Governor 2020 <https://www.gov.ca.gov/wp-content/uploads/2020/09/9.25.20-Native-Ancestral-Lands-Policy.pdf>

are interested in acquiring natural lands in excess of State needs.” Within the coastal space, funders and permittees can encourage and prioritize living shoreline projects that plan for co-management and land return. For example, the State should examine California’s Surplus Lands along the coast for both living shoreline restoration potential and opportunities to return Indigenous homelands. In addition, funders can expand grant eligibility to include funding for all aspects of the land return process (e.g., for surveyors, legal fees, permits, land purchase, etc.), and increase investments in Tribal-led coastal climate adaptation projects. The State should continue to explore public-private partnerships for example with conservation organizations that hold coastal property or champion living shoreline projects (Box 5).

BOX 5:

Examples of Land Return in California

The landback or land return movement, which involves the return of private and public lands to Indigenous peoples, is growing in California. In March 2022, Governor Gavin Newsom announced a \$100 million funding opportunity for tribal-led efforts to buy back land and pursue climate adaptation and conservation goals²³.

- **2022:** The Save the Redwoods League returned 523 acres in Mendocino county to the Intertribal Sinkyone Wilderness Council, a consortium of 10 federally recognized tribes: the Cahto Tribe of Laytonville Rancheria, Coyote Valley Band of Pomo Indians, Hopland Band of Pomo Indians, Pinoleville Pomo Nation, Potter Valley Tribe, Redwood Valley Little River Band of Pomo Indians, Robinson Rancheria of Pomo Indians, Round Valley Indian Tribes, Scotts Valley Band of Pomo Indians, and the Sherwood Valley Rancheria of Pomo Indians.

- **2020:** Western Rivers Conservancy and California Natural Resources Agency returned 1,199-acres of coastal land 20 miles south of Monterey and transferred title to the Esselen Tribe of Monterey County.
- **2016:** Planting Justice, an Oakland-based non-profit dedicated to food justice and community healing, returned two acres in East Oakland to the Sogorea Te’ Land Trust, an urban Indigenous women-led land trust.
- **2016:** Private landowner/farmer Bill Richardson returned 688 acres of coastal lands in Northern Sonoma County to Kashia Band of Pomo Indians of the Stewarts Point Rancheria

Additional Land Return resources can be found here: <https://storymaps.arcgis.com/stories/ca3f7eb701784ffeb1297567495f991a>

23. <https://www.gov.ca.gov/2022/03/18/governor-newsom-proposes-100-million-to-support-tribal-led-initiatives-that-advance-shared-climate-and-conservation-goals/>

6. Incorporate traditional knowledge systems in coastal restoration policies and climate initiatives.

WHY: *All California lands, including the coastal landscape, are tribal lands that Indigenous communities have stewarded and managed since time immemorial. As seas rise, so do threats to coastal tribal subsistence and heritage sites such as archeology sites in Southern California (Reeder-Myers, 2015). Nature-based solutions, including living shorelines, have a potential role to play in mitigating that threat. Tribes have a long history of coastal management and relationships with marine species in California (e.g., abalone, salmon, smelt, mussels, clams, seaweed) for subsistence and other cultural practices and thus they should be integral to decisions about how to safeguard and restore the coastline. Traditional knowledge (TK) systems related to habitat and species restoration and recovery vary significantly in definition and approach across California's many tribes and coastal habitats, highlighting the importance of local approaches to considering TK and intentional partnerships with California Native American tribal governments, organizations, and communities.*

HOW:

6.1. Increase funding for tribal-led coastal restoration and adaptation efforts. Granting programs should seek to put tribal interests at the forefront by funding tribes to lead this work and by establishing flexibility in funding that allows for subgranting. This would enable tribes to select and fund projects that include substantive partnerships and directly reflect their priorities and other interests. The Humboldt Area Foundation Native Cultures Fund²⁴ is an example model for this kind of community grant making supporting the “transmission of knowledge

between generations through the renaissance of California Native art culture, sacred sites, and language development” (Humboldt Area Foundation, 2022) (see Box 6 for additional examples of community-focused grant-making). Managers can also incentivize tribal partnerships and TK systems within permitting processes and grant guidelines.

6.2. Convene collaborative discussions and establish co-management guidelines, partnership and/or policy agreements with tribes and tribal-led organizations around restoration baselines, Indigenous management practices, and opportunities to elevate TK systems within coastal restoration policies and climate initiatives. Elevating TK systems in natural resource management and policy should intentionally support biocultural sovereignty and be careful to avoid exploitation of tribes or their knowledge (see *Guidelines for Considering Traditional Knowledges in Climate Change Initiatives*²⁵). Instead, these efforts should seek to benefit tribes directly either via formal tribal government consultation (where appropriate), or by including tribal peoples, Native American Studies scholars, elders, culture holders, and tribal organizations/non-profits in project planning and implementation. Given the many tribes across the state and the diversity of traditional knowledges, local engagement is needed to identify relevant Indigenous management practices and the potential for elevating TK systems within each project. Examples of planning efforts that incorporate tribal communities include the West Hollywood Climate Action Plan²⁶ and the tribal-led Karuk Climate Vulnerability Assessment and Climate Action Plan²⁷.

24. <https://www.hafoundation.org/Native-Cultures-Fund>

25. Climate and Traditional Knowledges Workgroup (CTKW). 2014. Guidelines for Considering Traditional Knowledges in Climate Change Initiatives. <https://climatetkw.wordpress.com>

26. <https://www.weho.org/city-government/city-departments/planning-and-development-services/long-range-planning/sustainability/climate-action-plan/climate-action-and-adaptation-plan>

27. <https://karuktribeclimatechangeprojects.com/climate-adaptation-plan/>

6.3. Support efforts to further understanding of when and where nature-based coastal adaptation approaches may reduce risk of sea level rise and other threats to cultural resources, ceremonial spaces, and archeological heritage sites within the marine landscape. This could involve directly supporting or partnering with tribes to conduct a comprehensive risk assessment of sea level rise, flooding, erosion, and other threats to tribal resources and infrastructure. An example of this includes recent funding to the Wiyot Tribe²⁸ to begin identifying and prioritizing cultural and natural resources within their ancestral lands and waters that are vulnerable to sea-level rise (California Natural Resources Agency, 2021). Concurrently, agencies should seek out and update policies that address cultural and ceremonial uses to give tribes greater decision-making authority in these processes.

28. <https://resources.ca.gov/Newsroom/Page-Content/News-List/8-Million-in-Grants-to-Improve-Resilience-to-Sea-Level-Rise-Along-the-Coast>

BOX 6:

Case Study: Community-Focused Grant-making

Measure AA, or the San Francisco Bay Clean Water, Pollution Prevention and Habitat Restoration Measure, was a revenue generating measure passed in 2016 by voters in the San Francisco Bay Area to raise approximately \$25 million annually, or \$500 million over twenty years, to fund restoration projects in the Bay. To improve equity in the grant-making process, the Restoration Authority Board created a separate Community Grants Program for community-based organizations in economically disadvantaged communities. The grant process involves a shorter application form, year-round application window, and additional technical support from staff.

This program track seeks proposals that:

- Support community visioning aimed at developing conceptual plans for shoreline habitat projects (e.g., Marin City Urban Wetland Community Visioning Project)
- Implement small shoreline habitat projects

with strong community benefits, for example, community engagement, education, workforce development, career development, leadership development, and community celebrations (e.g., Candlestick Point Stewardship Project)

- Train community leaders to develop proposals, apply for funds, and implement small shoreline habitat projects in partnership with shoreline landowners, such as planting native plants, removing invasive plants, and cleaning up trash (e.g., Bay Restoration: Youth Engagement and Service Learning in East Oakland)
- Empower communities to have a voice in the design and implementation of large shoreline restoration projects by helping them gain knowledge of shoreline issues and build relationships with restoration-focused organizations and agencies (e.g., San Francisco Bay Restoration Authority, 2022).



7. Evaluate potential gentrification outcomes of projects and incorporate displacement avoidance strategies where appropriate.

WHY: *Gentrification is “a process of neighborhood change that includes economic change in a historically disinvested neighborhood –by means of real estate investment and new higher-income residents moving in – as well as demographic change – not only in terms of income level, but also in terms of changes in the education level or racial make-up of residents” (Urban Displacement Project, 2022). Research has demonstrated that public investment via green space provisioning and shoreline improvement can exacerbate gentrification processes by increasing surrounding property values (Anguelovski et al., 2019; Black and Richards, 2020). As such, increases in green investments such as living shorelines - as well as broader efforts to safeguard the coast - may likewise result in increased gentrification threats to California’s frontline communities (though empirical data is currently lacking). Pairing nature-based coastal adaptation investments with displacement avoidance strategies (Box 7) can help ensure that the investments benefit those they were intended to.*

HOW:

7.1. Analyze potential gentrification risk and outcomes from coastal adaptation planning projects and incentivize inclusion of displacement avoidance strategies. Differences in the benefit profile and socio-economic context of a specific project will carry different displacement risks; for example, a project that improves public access and green space in a gentrifying area may be associated with higher risk for displacement than a project designed solely for offshore shoreline protection. Currently, empirical data is lacking in California on the effect of nature-based coastal adaptation investments. An approach to evaluate gentrification risk should include both community-centered and data-centered approaches. In the absence of data, the State may consider incentivizing inclusion of displacement avoidance strategies as a precautionary measure by scoring projects higher when they include such strategies.

7.2. Explore opportunities to pair nature-based coastal adaptation funding with broader climate and equity initiatives that support local communities and businesses. This can include funding for facilitated convenings with housing authorities, city officials, and community groups to explore what anti-displacement measures are available and feasible early in the coastal adaptation planning process. The State may also seek to expand collaborative interagency grant programs that pair coastal climate adaptation funding with broader climate and equity initiatives, for example exploring partnerships with programs seeking to expand affordable housing and tenant protections, workforce development, and access to reliable public transit.

7.3. Promote avenues for frontline community ownership and management of living shoreline project sites and initiatives. Histories of land dispossession and systemic exclusion from ownership still have present-day ramifications that negatively impact frontline and Indigenous communities. Building community organizing capacity and increasing community ownership, management, and tenure of land significantly promotes community resilience to displacement. Promoting opportunities for community ownership can involve funding workshops to offer information to communities about community and conservation land trusts and prioritizing technical assistance and resources to existing frontline and Indigenous community land trusts pursuing shoreline adaptation projects.

BOX 7:

Potential Displacement Avoidance Strategies to Consider Pairing with Coastal Adaptation Projects

Displacement avoidance strategies are increasingly recognized as necessary components to include in greening and climate adaptation projects. Nature-

based coastal adaptation projects may seek to incorporate some of the following example policies as part of community and grant agreements.

CATEGORY	POLICIES AND STRATEGIES
Production and preservation of affordable housing	<ul style="list-style-type: none"> • Community land trusts • Land banking programs • Inclusionary zoning • Affordable housing production incentives (e.g. density bonus ordinance) • Community benefits agreement • Acquisition and rehabilitation to preserve affordable housing
Tenant protections and support	<ul style="list-style-type: none"> • Culturally appropriate tenant rights education • Just cause eviction ordinance • Rent control • Rent review board • Funding for tenant organizing • Tenant legal services and right to counsel in eviction proceedings • Tenant opportunity to purchase policies
Neighborhood stabilization and wealth building	<ul style="list-style-type: none"> • Job creation for long-time, low-income residents (e.g. first source hiring) • Targeted percentages of work-hours for communities (eg. disadvantaged zip codes, formerly incarcerated re-entry) • Job training and workforce development programs • Development and promotion of micro-lending opportunities • Development of worker cooperatives • Non-speculative homeownership opportunities
Small business protection, stabilization, and wealth building	<ul style="list-style-type: none"> • Contract with local/small/diversely owned businesses • Creation of small business disruption fund and layoff aversion programs during construction or other business interruption events • Formal programs to ensure that some fraction of a jurisdiction's good and services come from local, small, and minority-owned businesses • Development of no-cost and low-cost business development and retention programs with established local, state and federal partners such as the California Small Business Development Center Network, Women's Business Centers, Procurement Technical Assistance Centers and others

References:

- California Strategic Growth Council Transformative Climate Communities Grant Program (Appendix C) https://sgc.ca.gov/meetings/council/2022/docs/20220224-Item5_TCC_Guidelines_Round_4.pdf#page=119&zoom=100,73,96
- Greening without Gentrification Project (UCLA Institute of Environment and Sustainability) <https://www.ioes.ucla.edu/wp-content/uploads/Greening-without-Gentrification-report-2019.pdf>
- Transit oriented development without displacement (UCLA Institute of Transportation Studies) <https://www.its.ucla.edu/project/transit-oriented-development-without-displacement-strategies-to-help-pacoima-businesses-thrive/>
- Urban Displacement Project (UC Berkeley) California <https://www.urbandisplacement.org/maps/los-angeles-gentrification-and-displacement/>

8. Incorporate inclusive education and workforce development opportunities into project implementation.

WHY: *Research based on coastal habitat restoration efforts in California (and the broader U.S.) has shown that restoration can contribute to job creation and provide long term economic gains (e.g., via rebuilt sustainable fisheries and tourism), in addition to the rehabilitation of ecological services (Edwards et al., 2013). Between 16.9 and 19 jobs were created for every million USD invested in oyster reef and living shoreline restoration projects, respectively, which is much higher than other sectors like coal, gas, and nuclear energy generation (Edwards et al., 2013). Building workforce development and educational opportunities into nature-based solutions can help ensure economic benefits stay in the local community, thus reducing risk of displacement and building place-based stewardship. Furthermore, training in science and engineering techniques could meet a statewide need for technical expertise in living shorelines. Supporting workforce development transitions, such as from climate-vulnerable agricultural and fossil fuel-based work to renewable energy, conservation, or blue economy projects, can also create economic resilience to climate-forced shifts in labor on California's coast (such as decommissioning of power plants or shifts in agriculture activities due to extreme heat and other climate impacts).*

HOW:

8.1. Leverage increasing federal and state investments in coastal resilience and nature-based solutions to support new green job pathways in coastal restoration and living shorelines. Funding streams for coastal resilience are ramping up, driven by federal infrastructure investments and state budget surpluses (Becky Smyth et al., 2022; Mark Gold et al., 2022). These new investments can build support for new green job pathways, add capacity to existing workforce development

programs, and expand experiential education initiatives for communities currently underrepresented in the environmental field.

8.2. Ensure socioeconomic benefits of living shoreline projects remain in nearby frontline and tribal communities. Projects should aim to hire diverse candidates with local expertise and prioritize contracts with local, minority-owned, or community-based businesses and organizations. Additionally, practitioners should be encouraged to incorporate paid educational internship opportunities into work plans, partnering with local community college and universities' career centers to recruit for these positions. Project implementers should be encouraged to intentionally collaborate with federally-recognized tribes' natural resource departments, as well as hire non-federally recognized tribal members and support program development of non-federally recognized tribes. Projects can also partner with existing workforce development programs to develop restoration job training programs for individuals with transferable skills from other sectors (including agricultural and construction workers).

8.3. Support programs for youth that increase opportunities for all levels of education and promote community stewardship around living shorelines. Youth engagement often translates to increased engagement for adults and the broader community. Place-based environmental stewardship education can result in stronger place attachment, improved mental health, and increased interest in environmentalism in youth (Ardoin et al., 2020; Kudryavtsev et al., 2011; Szczytko et al., 2018). Approaches may include incorporating living shoreline maintenance and monitoring into all levels of educational curriculum or school programs, including K-12, community college, universities, non-profits, and conservation corps. These curriculums should emphasize historic and present-day Indigenous coastal management practices and stewardship. Participatory research projects (West Oakland Environmental Indicators Project, 2022) especially can provide opportunities for learning both

science and developing technical skills. This could also include providing scholarships or funding for early career training opportunities for students from frontline communities to encourage pursuit of marine and coastal science career pathways.

8.4. Create pipeline training programs that lead to meaningful, living wage employment opportunities for participants. Living shoreline and restoration projects create jobs for boat operators, scientists, construction workers, surveyors, equipment operators, nursery workers, and more. Funders can invest in living shoreline training certification programs serving underrepresented students and embedded in

community college and university curriculum to promote diversity in the nature-based climate adaptation planning field, retention of hires from groups currently underrepresented in STEM or the conservation field, and accessibility of novel technical skills to a broader workforce. Organizations should also think beyond temporary positions for undergraduates and develop second/third step early-career positions to ensure that individuals can continue advancing professionally. For instance, the California Conservation Corps' promotional pathways offer Specialist and Crew Leader roles that provide higher compensation, leadership training, and eligibility to sit for the Conservationist I exam.

BOX 8:

Environmental Workforce and Education Initiatives in California.

The following resources are examples of organizations working to embed inclusive education and workforce development into environmental restoration and coastal adaptation projects.

Workforce

- **California Ecological Restoration Business Association**
<https://caecologicalrestoration.org/>
- **California Conservation Corps**
<https://ccc.ca.gov/life-in-the-corps/training-and-career-pathways/>
- **Ecological workforce**
<https://www.ecologicalworkforce.org/>
- **HanfordFUND**
<https://www.hanfordarcfund.org/restoration-workforce-overview>
- **High Road Training Partnerships (H RTP) initiative**
<https://cwdb.ca.gov/initiatives/high-road-training-partnerships/>
- **Roger Arliner Young (RAY) Fellowship**
<https://rayfellowship.org/program-overview>

Education

- **Amah Mutsun Land Trust Native Stewardship Corps**
<https://www.amahmutsunlandtrust.org/native-stewardship-corps>
- **Doris Duke Conservation Scholars Program at University of California, Santa Cruz**
<https://conservationscholars.ucsc.edu/>
- **Literacy for Environmental Justice Eco-Apprentices program**
<https://www.lejyouth.org/index.php/eco-apprentices/>
- **Sierra Institute P-Crew Program**
<https://pcrew.sierrainstitute.us/>
- **West Oakland Environmental Indicators Project's The Oakland Shoreline Leadership Academy**
<https://woeip.org/featured-work/oakland-shoreline-leadership-academy/>

9. Scale up investment in a strategic suite of living shoreline pilot projects and explore opportunities to reduce programmatic barriers to increasing living shorelines as a coastal adaptation tool.

WHY: *Living shoreline science is in its infancy in California. Existing projects are operating at small geographic scales, many of which do not have a physical nexus with human communities, and primarily assess physical and ecological performance, with minimal emphasis on social outcomes. Without scaled-up investment in these learning opportunities, the State will continue to lack basic information on the conditions in which the many living shoreline types are able to improve coastal resilience or provide optimal socio-ecological benefits for coastal adaptation. A strategic investment in a diverse range of pilot projects - in alignment with recommendation 1 - would rapidly expand understanding of living shorelines and their potential as a solution to sea level rise and other climate impacts. In addition, and as climate threats loom, expanding living shoreline efforts statewide will require exploring opportunities to improve efficiencies in granting and permitting. Some restoration efforts have taken a decade or more to begin construction (Grenier et al., 2021). In contrast, some experts suggest that gray infrastructure, like seawalls, have fewer barriers compared with more living approaches that require extensive monitoring and maintenance. Scaling up nature-based coastal adaptation approaches in California will thus require advancements in both scientific learning and streamlining of government processes.*

HOW:

9.1. Identify and invest in a priority set of coastal restoration pilot projects across diverse habitat types and performance measures, including ecological, physical and social considerations. In alignment with recommendation 1, pilot projects should take place in frontline communities with high social vulnerability to the impacts of sea level rise and other climate stressors. Projects should be designed with communities, tribes, agencies, and scientists to improve understanding of the ability of living shorelines to address shoreline change and vulnerability as well as inform understanding of community impacts like risk of gentrification and changes in use or access. Pilot projects should represent both estuarine and outer coastal environments and should test performance in different sea level rise and storm scenarios. Results of investments in the above should be synthesized into best practices and lessons learned to support the development of living shoreline design and engineering standards.

9.2. Develop and require monitoring and evaluation of human dimensions and social equity outcomes of coastal adaptation projects. Permittees and funders can encourage monitoring and evaluation of human dimensions

metrics (e.g., changes in public access and use) as well as social equity metrics to help assess a project’s ability to advance a more equitable distribution of resources or decision-making power (among other factors) and help inform understanding of gentrification risk. Monitoring should seek to capture both baseline and performance after completion for a minimum of 5 years.

9.3. Explore opportunities to reduce wait times and improve efficiency within California’s coastal adaptation and restoration granting and permitting agencies. California’s recent “cutting green tape” efforts are attempting to streamline ecological restoration and stewardship permitting and granting processes (Wade Crowfoot, 2022). Reducing permitting wait times can be addressed by expanding staff capacity at permitting and granting agencies. Smarter permitting can also include: coordinating across similar projects, coordinating within and among agencies, and permitting to achieve ecosystems that deliver higher levels of desired functions (Grenier et al., 2021). However, these efforts should be mindful not to cut out public processes, as reducing regulation can lead to inequitable outcomes, for example from abuse of the emergency permitting process (e.g., Santa Barbara in response to debris flow after wildfires; Goto et al., 2020).



Table 3. Recommendations for advancing equitable approaches to nature-based coastal adaptation and shoreline management in California.

RECOMMENDATION	HOW
<p>1. Prioritize appropriate coastal adaptation in frontline and tribal communities, and invest in approaches that elevate community values and needs while maximizing social and environmental outcomes.</p>	<ul style="list-style-type: none"> 1.1. Embed social equity across all state coastal adaptation and shoreline resilience planning, policies, processes, and grant programs. 1.2. Allocate at least 50% of funding or create dedicated grant programs for projects that directly and meaningfully benefit frontline communities and tribes. 1.3. Prioritize providing technical assistance in frontline communities and tribes, and increase access to training and communication resources on nature-based coastal adaptation approaches. 1.4. Support and expand collaborative networks and regional partnership around nature-based coastal adaptation planning and implementation.
<p>2. Plan for meaningful engagement with frontline communities and tribes and incorporate their values and needs before, during, and after project implementation.</p>	<ul style="list-style-type: none"> 2.1. Support establishment and long-term capacity building at community-based and tribal-led organizations to increase their ability to engage in shoreline planning processes. 2.2. Encourage projects to include community benefits agreements and require community engagement or needs assessments to help ensure projects reflect community values and needs. 2.3. Broaden grant eligibility to include funding for community engagement, needs assessment, and outreach activities. 2.4. Create a shared database of community plans and needs assessments related to climate adaptation and shoreline management to reduce the burden on communities.
<p>3. Work to address broader structural inequities in California that impact frontline coastal communities and effective ocean and coastal policy and management.</p>	<ul style="list-style-type: none"> 3.1. Increase interagency, cross-jurisdictional coordination to address high priority environmental justice issues and other community-identified needs in parallel with advancing nature-based climate adaptation. 3.2. Expand active and diverse representation and inclusion across coastal science and management. 3.3. Include environmental justice practitioners and community representatives on agency advisory committees and boards, grant proposal review panels, and other decision-making bodies.
<p>4. Define context-specific social equity goals early in the process and establish clear equity metrics to evaluate project outcomes.</p>	<ul style="list-style-type: none"> 4.1. Develop social equity metrics to inform design, monitoring, and evaluation of coastal adaptation projects. 4.2. Invest in projects that include community-based participatory research and multidisciplinary project teams that bring together natural and social sciences, and the voices and perspectives of tribes and frontline communities. 4.3. Continue to improve environmental justice community screening tools.

Table 3. Recommendations for advancing equitable approaches to nature-based coastal adaptation and shoreline management in California. (Continued).

RECOMMENDATION	HOW
<p>5. Prioritize projects that improve access and stewardship by historically excluded frontline communities and tribes in California.</p>	<p>5.1. Prioritize projects that improve public access for all Californian’s in policy, funding and permitting.</p> <p>5.2. Assess barriers to tribal use and access of coastal spaces for ceremony, gathering, and subsistence, among both federally recognized and unrecognized tribes.</p> <p>5.3. Support opportunities to expand coastal resource co-management and land return to restore Indigenous knowledge, stewardship, and practices.</p>
<p>6. Incorporate traditional knowledge systems in coastal restoration policies and climate initiatives.</p>	<p>6.1. Increase funding for tribal-led coastal restoration and adaptation efforts.</p> <p>6.2. Convene collaborative discussions and establish co-management guidelines, partnership and/or policy agreements with tribes and tribal-led organizations around restoration baselines, Indigenous management practices, and opportunities to elevate TK systems within coastal restoration policies and climate initiatives.</p> <p>6.3. Support efforts to further understanding of when and where nature-based coastal adaptation approaches may reduce risk of sea level rise and other threats to cultural resources, ceremonial spaces, and archeological heritage sites within the marine landscape.</p>
<p>7. Evaluate potential gentrification outcomes of projects and incorporate displacement avoidance strategies where appropriate.</p>	<p>7.1. Analyze potential gentrification risk and outcomes from coastal adaptation planning projects and incentivize inclusion of displacement avoidance strategies.</p> <p>7.2. Explore opportunities to pair nature-based coastal adaptation funding with broader climate and equity initiatives that support local communities and businesses.</p> <p>7.3. Promote avenues for frontline community ownership and management of living shoreline project sites and initiatives.</p>
<p>8. Incorporate inclusive education and workforce development opportunities into project implementation.</p>	<p>8.1. Leverage increasing federal and state investments in coastal resilience and nature-based solutions to support new green job pathways in coastal restoration and living shorelines.</p> <p>8.2. Ensure socioeconomic benefits of living shoreline projects remain in nearby frontline and tribal communities.</p> <p>8.3. Support programs for youth that increase opportunities for all levels of education and promote community stewardship around living shorelines.</p> <p>8.4. Create pipeline training programs that lead to meaningful, living wage employment opportunities for participants.</p>
<p>9. Scale up investment in a strategic suite of living shoreline pilot projects and explore opportunities to reduce programmatic barriers to increasing living shorelines as a coastal adaptation tool.</p>	<p>9.1. Identify and invest in a priority set of coastal restoration pilot projects across diverse habitat types and performance measures.</p> <p>9.2. Develop and require monitoring and evaluation of human dimensions and social equity outcomes of coastal adaptation projects.</p> <p>9.3. Explore opportunities to reduce wait times and improve efficiency within California’s coastal adaptation and restoration granting and permitting agencies.</p>



III. Priority Research Needs for California

ASSESSMENT OF THE SOCIAL EQUITY outcomes associated with the spectrum of coastal adaptation responses in California is still in its infancy. As such, we need coordinated efforts to advance scientific learning across disciplines in these novel systems. Understanding both the social and biophysical outcomes of existing projects will offer invaluable lessons-learned for future projects and the development of the field. As the recommendations outlined in this report suggest, the human and equity dimensions of living coastal adaptation measures are complex and have not been thoroughly studied.

The research questions and suggested methods presented in Table 4 emerged from discussions with a science panel, and were further vetted in expert interviews. Research questions are paired with suggested analyses or projects that can be completed within three to five years, ranging from expert convenings, qualitative and quantitative social science studies, mapping needs, community surveys, and decision-maker tool development. Research questions and methods are not in prioritized order; the State should, where possible, seek to concurrently integrate and/or advance as many of the needs below, for example in a broad funding call.

Table 4. Equity and nature-based coastal adaptation research needs and suggested methods for California.

RESEARCH QUESTIONS	SUGGESTED METHODS
<p>1. What are the social equity outcomes associated with the spectrum of coastal adaptation responses?</p>	<ol style="list-style-type: none"> 1.1. Evaluate potential gentrification outcomes across the suite of coastal adaptation and shoreline management approaches using both community-centered and data-centered methods. 1.2. Synthesize and develop human dimensions and social equity monitoring metrics for coastal adaptation and restoration projects. 1.3. Develop a conceptual framework to assess tradeoffs in social equity and ecological outcomes across the suite of coastal adaptation responses. Apply the tool using place-based examples to understand trade-offs within the local context. 1.4. Analyze social equity outcomes and trade-offs across the range of adaptation strategies and/or phased adaptation pathways in California to inform equitable responses to sea level rise in different contexts for frontline communities. 1.5. Case study analysis of living shoreline’s impact over time to better understand community sense of place across various shorelines, including how coastal spaces are used and changed, including qualitative analysis (see LA River Digital Humanities Project) 1.6. Expand human use and recreational data collection and modeling to better understand potential access and use of living shoreline habitats and how those may change over time
<p>2. What are the frontline communities along or near California’s shoreline and the nature of shoreline management challenges in them? What would increase the capacity of frontline communities to pursue and implement nature-based strategies?</p>	<ol style="list-style-type: none"> 2.1. Improve existing tools for identifying frontline communities, including (a) exploring appropriate measures for representing interests or ancestral lands to identify risk to tribal communities, (b) context-specific vulnerability assessments, and (c) integration of existing mapping tools to better identify intersecting issues, for example pollution exposure and climate risk. 2.2. Apply qualitative social science research and evaluation of existing projects to ground-truth learning from community screening tools and other community vulnerability assessments. 2.3. Qualitative (e.g., community circles, conversations, storytelling, visioning) and/or quantitative public surveys of frontline communities along or near California’s shoreline to assess the nature of the shoreline management challenges, perceptions, and barriers to advancing nature based adaptation strategies; this process and information can be used as an entry point for adaptation planners to engage communities (see Mayatt-Bell et al., 2002).
<p>3. What are the conditions under which living shoreline projects are ecologically and physically feasible as shoreline management approaches to plan for sea level rise and other climate impacts in California? Where do viable site locations intersect with frontline communities and vulnerable tribal heritage sites?</p>	<ol style="list-style-type: none"> 3.1. Develop an inventory of current living shoreline project types (including geographic coverage) to track progress and document learning across habitat types. This could leverage the EcoAtlas Wetlands, Beaches and Watersheds inventory. 3.2. Analyze geographic placement and efficacy of existing and potential living shorelines relative to frontline communities to better understand distribution of benefits. 3.3. Identify and design priority pilot projects for California related to living shoreline performance and benefits. 3.4. Integrate frontline community vulnerability assessments and environmental justice screening tools with living shoreline habitat mapping and suitability models to inform citing of living shoreline projects and direct community outreach efforts. 3.5. Pair spatial analyses with pilot projects to ground truth ecological and physical performance. 3.6. Integrate learning from existing living shoreline projects and future pilot projects to develop consistent engineering methodologies and performance standards or practices for the range of living shoreline types in California. 3.7. Evaluate state and local laws and regulations serving as barriers to implementing community based projects.

Table 4. Equity and nature-based coastal adaptation research needs and suggested methods for California. (Continued).

RESEARCH QUESTIONS	SUGGESTED METHODS
<p>4. What is the distribution of current and historic coastal adaptation funding, including living shorelines, relative to frontline communities?</p>	<p>4.1. Analyze historic and current distribution of state, federal, local, and private coastal adaptation funding within/ adjacent to frontline communities and tribes in California to inform more equitable resource distribution.</p> <p>4.2. Analyze and understand equitable distribution of local, state and federal funds to underserved communities and tribes.</p> <p>4.3. Evaluate state and local laws and regulations serving as barriers to implementing community-based projects.</p> <p>4.4. Evaluate impact of past policy interventions to improve equity in coastal planning or restoration.</p>
<p>5. What are the opportunities to assess and/or incorporate knowledge of historic tribal uses/ habitats and project future restoration potential? How do histories of land usages and historical conditions shape future-oriented coastal adaptation efforts?</p>	<p>5.1. Expand research efforts that center traditional ecological knowledge and tribes within living shoreline and coastal adaptation projects.</p> <p>5.2. Community-led research initiatives documenting environmental history and community visioning.</p> <p>5.3. Partner with tribes seeking to develop or expand habitat and tribal resource maps to inform climate adaptation risk assessments and Include traditional uses prior to colonization.</p>
<p>6. What are the regulatory barriers and inequities that could be streamlined or amended within California’s permitting process for living shorelines?</p>	<p>6.1. Identify regulatory barriers to living shoreline adoption by surveying communities and agencies who interact with the regulatory process, building on recent analyses by Grenier et al, 2021.</p> <p>6.2. Analyze of inequities associated with existing regulatory frameworks and permitting structures.</p>
<p>7. What is the potential for workforce development within coastal adaptation and resilience planning efforts in California (including living shorelines)?</p>	<p>7.1. Analyze economics/costs associated with expected workforce transition (from climate-vulnerable careers) and job creations needed to achieve California’s climate change goals.</p> <p>7.2. Analyze socio-economic impacts, including job creation, from existing and future nature-based coastal adaptation projects.</p> <p>7.3. Evaluate existing career pipeline and educational training program outcomes within living shorelines and other nature-based coastal adaptation and resilience planning efforts.</p> <p>7.4. Evaluate opportunities to scale and support small and DBEs who are focused on expanding the opportunities for a more diverse and inclusive workforce.</p> <p>7.5. Research on just workforce transition of decommissioned coastal enterprises (e.g., agricultural operations, power plants).</p>

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Appendix A: Summary of Living Shoreline Habitats and Example Projects in California

Table 5. Examples of living shoreline approaches in California.






HABITAT TYPE	DESCRIPTION	LIVING SHORELINE APPLICATIONS/METHODS	EXAMPLES IN CALIFORNIA*	GEOGRAPHIC LOCATION
Coastal Dunes 	<p>Coastal dunes are dynamic systems characterized by sand accumulation in various morphologies and can be vegetated or unvegetated (Albert 2016).</p>	<ul style="list-style-type: none"> • Conservation of existing dune habitat and enhancement • Restoration of degraded dune habitat • Artificial dune creation in suitable areas • Adding dune restoration component to existing or future gray infrastructure project 	<p>Cardiff Living Shorelines Project, Border Field State Park Dune Enhancement, Humboldt Coastal Resilience Project, Marina Dune Preserve Restoration, Morro Bay State Beach Restoration, Pillar Point Harbor West Trail Living Shoreline, Seabright Beach Coastal Enhancement Project, Surfer’s Point Managed Shoreline Retreat Project</p>	<p>outer coast</p>
Salt Marsh 	<p>Salt marshes are coastal wetlands that are flooded and drained by salt water brought in by the tides. Salt marshes include a mix of salt-water tolerant and freshwater wetland plant species (Cloern et al. 2016; Duffy et al. 2016).</p>	<ul style="list-style-type: none"> • Conservation of remnant salt marsh • Restoration of tidal flow to degraded or diked salt marshes • Coarse sediment augmentation initiatives (placing sand, gravel, shell, or cobble in places that currently have fine sediment) to promote existing salt marsh resilience • Novel site construction and restoration for future sea-level rise projections • Adding salt marsh restoration component to existing or future gray infrastructure project 	<p>Hester Marsh Tidal Marsh Restoration, Napa River Salt Marsh Restoration Project, South Bay Salt Pond Restoration Project, South San Diego Bay Wetland Restoration Project, Sonoma Creek Enhancement Project, Greenwood Gravel Beach Design Project, Hayward Marsh Restoration Project</p>	<p>inner and outer coast</p>
Habitat Reef (e.g., oyster reef) 	<p>Habitat reefs are solid structures found in embayments, constructed by providing hard structure to attract encrusting species such as oysters and mussels (Cloern et al. 2016)</p>	<ul style="list-style-type: none"> • Construction and placement of artificial oyster substrate units for natural recruitment in novel or degraded areas • Oyster restoration in low reproduction areas using aquaculture • Conservation of existing reef structures • Altering gray armoring structures to mimic natural substrate and encourage encrusting species recruitment • Adding reef-forming restoration component to existing or future gray infrastructure projects 	<p>San Francisco Bay Living Shorelines Project (San Rafael, Point Pinole, Point San Pablo), San Diego Bay Native Oyster Living Shoreline Project</p>	<p>inner</p>

Table 5. Examples of living shoreline approaches in California. (Continued).

HABITAT TYPE	DESCRIPTION	LIVING SHORELINE APPLICATIONS/METHODS	EXAMPLES IN CALIFORNIA*	GEOGRAPHIC LOCATION
<p>Seagrass Bed</p> 	<p>Seagrass beds are underwater meadows characterized by the foundational presence of seagrass species. These plants grow primarily in estuarine waters and less commonly on the open coast (Cloern et al. 2016).</p>	<ul style="list-style-type: none"> • Seagrass bed restoration targeting locations where natural recruitment is unlikely • Adding seagrass restoration planting component to existing or future gray infrastructure project such as oyster/habitat reefs 	<p>San Francisco Bay Living Shorelines Project (San Rafael, Point Pinole, Point San Pablo), Seagrass restoration at Elkhorn Slough, Eelgrass restoration in Upper Newport Bay</p>	<p>inner and outer</p>
<p>Horizontal Habitat Levee</p> 	<p>Naturally-occurring levees are sediment embankments formed as sediments deposit when flooding water recedes. Habitat levees are broad constructed features that include natural habitats and transitions, unlike levees built to simply cut off water flow (Cecchetti et al. 2020).</p>	<ul style="list-style-type: none"> • Construction of habitat levee for biofiltration of wastewater • Restoration of habitat on existing artificial levees • Partnering with sediment dredging efforts to enhance natural levee resilience to sea-level rise 	<p>Oro Loma Horizontal Levee, Palo Alto Horizontal Levee Pilot Project (planning phase), North Richmond Shoreline Living Levee Project (planning phase)</p>	<p>inner and outer</p>