

Beyond the Vulnerability Assessment: Moving from Sea Level Rise Adaptation Planning to Implementation in the San Francisco Bay Area

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I. Introduction

This guidance was born from the needs of San Francisco Bay Area local jurisdiction staff tackling the challenge of sea level rise. Several local jurisdictions have completed sea level rise vulnerability assessments, and are now faced with developing and/or implementing adaptive measures, potentially

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needing guidance on where to begin, or how to move forward from assessment to adaptation. This document is intended to help those unsure of how to take the next step in choosing and implementing sea level rise adaptation strategies. It includes a categorization and analysis of planning, regulatory, market-based, and engineering tools, with an emphasis on regulatory and market-based tools that jurisdictions can use as a first step to catalyze action on adaptation strategy implementation. These tools can help decision-makers achieve the goals of their sea level rise adaptation planning, whether to protect, accommodate, retreat and/or preserve¹⁰. Examples are also provided, along with various considerations and caveats. In addition, this guidance suggests guiding principles and important considerations, and offers lessons learned in climate adaptation implementation from around the U.S. This research will be presented as both a PDF document and as a Word document with an accompanying Excel spreadsheet to enable local governments to tailor the tools to their specific needs and circumstances. This guidance was completed as a part of the author's climate resilience fellowship with the California State Coastal Conservancy, funded by the Center for the Blue Economy at the Middlebury Institute of International Studies in Monterey, California.

How to use this document –

The purpose of this document is to provide general guidance for counties and cities, specifically in the San Francisco Bay Area, attempting to implement sea level rise adaptation policies and strategies. However, much of this guidance is applicable along the entire California coast. Not every tool will be applicable to every jurisdiction, nor is this an exhaustive list of tools that jurisdictions may wish to use. This guidance hopes to expose decision-makers to the various options for adaptation and encourage creative use of traditional regulatory and market-based tools. Section II expounds on the role local governments play in sea level rise adaptation including several common barriers they may face. Section III provides popular guiding principles for local governments to follow in order to overcome these barriers. Section IV explores some of the major determinants of selecting appropriate sea level rise adaptation tools. Section V explains how to use the tools provided in Appendix A and B. Section VI discusses the various laws and policies that local governments will need to consider when choosing how to adapt. Section VII exposes a few of the coordination considerations local governments should undertake in order to efficiently and effectively adapt to sea level rise. Section VIII urges local governments to consider equity and environmental justice in their process. Section IX provides local governments with various implementation strategies. Section X provides some of the major lessons learned on climate change adaptation from around the U.S. Appendix A is comprised of a classification of local sea level rise adaptation tools, descriptions, and caveats. Appendix B consists of an accompanying Excel spreadsheet, containing a matrix of the tools, various characteristics, definitions and caveats, and examples/resources. Although resources are referenced throughout this guidance, Appendix C provides a list of relevant resources with hyperlinks where applicable.

II. The Role of Local Governments

Climate change is happening, sea levels are rising, and California has committed itself to addressing it (Griggs et al 2017). Local governments, however, are on the front lines of this adaptation as they are responsible for public safety, land-use planning, infrastructure, emergency response, and public health

¹⁰ Protect: infrastructure used to defend people, property, and infrastructure in place from the impacts of sea level rise; Accommodate: allows development with modifications applied to reduce damage; Retreat: moving development inland to less-risky areas; Preserve: the preservation of open space.

protection, all which will be drastically impacted by sea level rise, (Hecht 2013). Furthermore, sea level rise will have nuanced local impacts requiring the specificity provided by local policies, (Center for Science in the Earth System (The Climate Impacts Group); Joint Institute for the Study of the Atmosphere and Ocean; University of Washington; King County, WA; ICLEI 2007). Thus far, progress has primarily been made on initial or “soft” adaptation activities like vulnerability assessments, planning, and capacity building. Moving to actionable “hard” activities that catalyze the implementation phase has proven to be harder due to several existing barriers, (Grannis et al 2014).

Some of these barriers were identified by a sea level rise stakeholder group assembled by the Climate Readiness Institute in the San Francisco Bay Area. The primary barriers included: insufficient funding, lack of staff time and expertise, insufficient local data (or a perception of an insufficiency), and lack of formal structures for collaboration. Secondary barriers identified included: lack of clarity on the state public trust doctrine, lack of public demand for adaptation, pressure for development in vulnerable areas, and a lack of regional leaders, (“SF Bay Area Sea Level Rise Stakeholder Group Meeting” 2017). Although these barriers can be daunting, scholars and state agencies have identified principles to apply throughout the adaptation process that can help local governments overcome some of these barriers. Moreover, this report attempts to further address the barriers of lack of staff time and expertise, lack of formal structures for collaboration, and lack of clarity on the state public trust doctrine. To successfully adapt, it is important to empower local decision-makers with a clear path to addressing the impacts of sea level rise, (Grannis et al 2014).

III. Guiding Principles for Local Governments

Although there are many guidance documents available on climate change adaptation, these resources seemed particularly relevant to sea level rise adaptation for local governments in the San Francisco Bay Area.

Hecht identified a set of governing principles for local governments to successfully address the impacts of climate change. He recommends local governments should: 1) identify physical and social vulnerabilities and barriers to achieving resilience, 2) not wait for perfect information and understanding before taking action, 3) use evaluation tools that engage their communities (such as environmental impact assessments and scenario planning), 4) use currently available tools and responsibilities such as land-use planning and emergency response, 5) understand the state and federal legal context, 6) consider how other government programs can help or hinder climate change adaptation, and 7) pay special attention to addressing the potential vulnerability of those who are already the most vulnerable, (Hecht 2013). If these principles are followed, several of the barriers identified by the Climate Readiness Institute will be addressed, including: lack of staff time and expertise, insufficient local data (or a perception of an insufficiency), lack of clarity on the state public trust doctrine, and lack of public demand for adaptation. Specifically, lack of staff time and capacity appears to be a significant hurdle, but by integrating climate change and sea level rise into currently available tools and responsibilities, staff can reframe their work in a way that does not create insurmountable capacity and time burdens for staff. This report will further expound upon above principles: 4, 5, and 6.

In the report, *Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments*, the authors identified principles for achieving climate resilience. They recommend local governments: 1) increase public awareness, 2) increase technical capacity, 3) mainstream information on climate change vulnerability and risks into current planning, policy, and investments, 4) increase adaptive capacity, and

5) strengthen community partnerships to effectively reduce vulnerability, (Center for Science in the Earth System (The Climate Impacts Group); Joint Institute for the Study of the Atmosphere and Ocean; University of Washington; King County, WA; ICLEI 2007). If these principles are followed, several of the above barriers can be addressed, including: lack of staff time and expertise, insufficient local data (or a perception of an insufficiency), and lack of public demand for adaptation. Again, mainstreaming information on climate change vulnerability and risk into current practices, will help overcome staff capacity issues. This report will further expound upon principle 3.

Specific to coastal sea level rise, the California Coastal Commission (CCC) identified several principles in their 2015 sea level rise policy guidance, titled, *Sea Level Rise Policy Guidance: Interpretative Guidelines for Addressing Sea Level Rise in Local Coastal Programs and Coastal Development Permits*. The recommended principles can help streamline adaptation for those in the California coastal zone. The principles are divided into four broader categories, including: 1) using science to guide decisions; 2) minimizing coastal hazards through planning and development standards; 3) maximizing protection of public access, recreation, and sensitive coastal resources; and 4) maximizing agency coordination and public participation, (California Coastal Commission 2015). For the more detailed principles, see the CCC's 2015 sea level rise policy guidance in Appendix C. If these principles are followed, several of the identified barriers will be addressed, including: insufficient local data (or a perception of an insufficiency), lack of formal structures for collaboration, and pressure for development in vulnerable areas. This report will further expound upon principle categories: 2 and 4.

For the San Francisco Bay Area, the San Francisco Bay Conservation and Development Commission (BCDC)'s Adapting to Rising Tides (ART) program developed an approach for sea level rise planning. This approach includes three factors for success: collaboration, transparency, and sustainability. In defining sustainability, ART uses four frameworks: society and equity, economy, environment, and governance, (BCDC ART Program 2017). The ART approach was utilized to conduct vulnerability assessments around the Bay Area, where it began to address some of the identified barriers, including: lack of staff time and expertise and lack of formal structures for collaboration. This report will further expound upon aspects of the ART approach, including collaboration and sustainability.

Although following these principles will not guarantee local governments will overcome all the barriers described above, they provide a solid foundation for implementing successful climate change adaptation at the local level. Once barriers are overcome and counties and cities are ready to start taking action, an understanding of what determines strategies is paramount.

IV. Determinants of Strategies

Although an innumerable amount of conditions can affect the choice of adaptation strategies, the ones identified below appear to be the best suited to the focus of this guidance.

In Reiblich, Wedding, and Hartge's¹¹ *Enabling and Limiting Conditions of Coastal Adaptation: Local Governments, Land Uses, and Legal Challenges*, the authors identified several spatial and non-spatial factors that aid local governments in determining which sea level rise adaptation tools to utilize. The

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spatial conditions include: geomorphic features, current zoning, current land uses and population densities, existing habitats, other legal restrictions with a spatial element (such as coastal development permits), and political boundaries and jurisdictional overlaps. Non-spatial factors include: cultural attachment and values, the “not in my backyard” mindset, “takings” issues, cost, and political will, (Reiblich, Wedding, Hartge 2017). Similarly, in the *Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments* report, the authors developed a set of questions for local governments to be used as criteria for determining actions. These questions include: “1) Will the actions meet your preparedness goal? 2) Do the benefits outweigh the costs? 3) Is the action robust under a range of climate change scenarios? 4) Is the action flexible and does it increase flexibility in how a planning area is managed or functions? 5) Can the action be implemented, and in what time frame? 6) Are there unique ‘windows of opportunity’ for implementing a particular action? 7) Is the action equitable? 8) Will the action decrease the risk of losing unique environmental or cultural resources? [and] 9) Will the action address a risk for which there is greater scientific confidence?” (Center for Science in the Earth System (The Climate Impacts Group); Joint Institute for the Study of the Atmosphere and Ocean; University of Washington; King County, WA; ICLEI 2007). It is also important to note that community values, priorities, and visions can also play a significant role in determining adaptation strategies. Once these considerations and criteria have been internalized, governments can move to the comparison and selection of sea level rise adaptation tools to implement chosen strategies.

V. Choosing Tools

There are many potential sea level rise adaptation options that county and city governments can deploy. Appendix A and B contain many of these available tools. The author categorizes tools by type: planning, regulatory, market-based, and engineering, and further breaks them into strategies and into the individual tools themselves. A deeper dive was taken into the regulatory and market-based tools as most are intimately familiar with planning and engineering tools. Moreover, there appears to be a lack of information for regulatory and market-based tools compared to planning and engineering tools. In Appendix A, tools are presented with descriptions and various notes and caveats. In Appendix B (the accompanying Excel spreadsheet), the purpose of each tool is categorized as either protect, accommodate, retreat, and/or preserve, and by current development state (pre-development, existing development, and redevelopment). Also in Appendix B, examples and resources for each tool are provided where applicable. Where possible, definitions and caveats from Appendix A have also been included in Appendix B. Note: the tools in Appendix A and B contain an amount of fluidity. Many of them overlap, go by various names, can be used to achieve various goals, and can be implemented in various spaces. Tools can be bundled with others or used alone. Some tools can achieve more broad goals where others are for more specific outcomes. The identified purposes of each tools can also vary depending on the priorities and values of a specific jurisdiction. Not all tools will be applicable for all local governments and tools should be tailored to the specific needs of each county or city. These tools are meant to guide decision-makers in thinking creatively about options and are not intended to provide a prescriptive formula.

See Appendix A for local sea level rise adaptation tools, descriptions, and caveats. See Appendix B (accompanying Excel spreadsheet) for a matrix containing tool purpose, strategy, current land use, examples, and resources.

While choosing suitable tools, there are also several legal, coordination, and equity considerations for local governments to take into account. Both gaps in legal clarity and coordination were identified as potential barriers to successful sea level rise adaptation, so it is essential that counties and cities consider the following issues. Equity must also be considered to achieve holistic and successful sea level rise adaptation.

VI. Legal Considerations

Many detailed legal resources on property and coastal law exist but this section attempts to summarize the best available information on the relevant legal and policy implications of sea level rise adaptation for local jurisdictions in California.

There are several laws and policies that can be implicated in sea level rise adaptation which deserve special attention for their ability to derail or enhance a strategy. These laws and policies include: the California Coastal Act, the San Francisco Bay Plan and the McAtteer-Petris Act, the California public trust doctrine, takings and background principles, the California Environmental Quality Act (CEQA), and the National Flood Insurance Program (NFIP) and accompanying Community Rating System (CRS).

The California Coastal Act and the San Francisco Bay Plan, through the McAtteer-Petris Act, govern development along California's coast line and the San Francisco Bay. Both the California Coastal Act and the San Francisco Bay Plan strive to protect, conserve, and enhance the quality of the coast and maximize public access. These policies also reinforce the public trust doctrine, (Herzog and Hecht 2013). Under the California Coastal Act's policies on hazard avoidance and resource protection, the CCC has the legal authority to consider the impacts of sea level rise in permitting, Local Coastal Programs (LCPs), staff recommendations, and CCC decisions (California Coastal Commission 2017). The CCC adopted a sea level rise guidance document in 2015 and is currently working on an adaptation guidance for residential development. For the San Francisco Bay Area (the nine counties that surround and drain into the San Francisco Bay), the McAtteer-Petris Act was amended to authorize BCDC to develop regional strategies for addressing sea level rise in coordination with local governments and agencies. In 2011, BCDC updated the San Francisco Bay Plan to cope with the impacts of climate change in the Bay Area. In October of 2016, BCDC adopted sea level rise recommendations from a series of stakeholder workshops (BCDC 2016). These recommendations can be found in Appendix C. As a result of these workshops, BCDC will consider an amendment to the San Francisco Bay Plan addressing bay fill for habitat projects which could have implications for furthering sea level rise adaptation efforts. This process is expected to last until fall 2018, (BCDC July 2017). In practice, these policies are enforced through local planning and permitting efforts including the LCP and General Plans.

The public trust doctrine dates back to English common law, where navigable waterways and submerged tidelands were held in trust by the state for public use. "In California, the public trust doctrine places a duty upon the state to manage coastal resources, including tidelands and surface waters, up to the mean high tideline for the benefit of the state's citizens," (Herzog and Hecht 2013). Today, these uses include fishing, navigation, commerce, water-oriented recreation, scientific study, open space, and environmental protection, (Herzog and Hecht 2013). In July 2017, a report compiled by the Center for Ocean Solutions clarified California's duty to protect and sustain the public trust.

Members of this working group on California’s public trust doctrine and coastal land management¹² explained that the state will find strong legal support in considering the effects of sea level rise on public trust resources and interests. In a consensus statement, this working group exposed how the state public trust doctrine will not hamper sea level rise adaptation strategies but could potentially enhance them by creating an obligation to act, (Center for Ocean Solutions, Stanford University 2017).

As mentioned above, the fear of takings challenges can slow or even prevent sea level rise adaptation from moving forward. The Takings Clause, found in the Fifth Amendment to the U.S. Constitution reads, “nor shall private property be taken for public use, without just compensation,” (Wolf 2013). In 1960, Justice Hugo Black gave an interpretation of the clause to clarify future cases. He said, “The Fifth Amendments’ guarantee that private property shall not be taken for a public use without just compensation was designated to bar Government from forcing some people alone to bear public burdens which, in all fairness and justice, should be borne by the public as a whole,” (Wolf 2013). There is a legitimate concern that several sea level rise adaptation tools could be subject to a takings challenge, especially those where government actions lead to the loss of the economically beneficial use of private property as was determined to be a per se taking in *Lucas v. South Carolina Coastal Council*. However, as Hecht points out in his paper, *Taking Background Principles Seriously in the Context of Sea Level Rise*, there is a more important legacy that resulted from the *Lucas* case: if a regulation is consistent with background principles, no takings can occur. Although the Supreme Court upheld this decision in *Stop the Beach Renourishment v. Florida Department of Environmental Protection*, the implications of background principles are not always taken seriously. Furthermore, takings challenges can be expensive and time-consuming, delaying adaptation strategies. Thus, in order to avoid a takings claim, cities and counties should have a strong understanding of how background principles operate when employing regulatory tools for adapting to sea level rise. Without this understanding, takings risks can be overstated and regulatory tools unnecessarily limited. Background principles are underlying limitations on private property interests derived from a state’s legal tradition, (Hecht 2015). As Hecht describes, “...a state action that simply recognizes or enforces background principles cannot affect a taking, because the government cannot take a property interest that an owner never legitimately possessed in the first place,” (Hecht 2015). Pertinent to sea level rise adaptation, background principles found in common law nuisance, the public necessity doctrine, and the public trust doctrine can prevent a takings claim. Common law nuisance prevents a private landowner from using their property in a harmful or offensive manner, the public necessity doctrine allows trespassing if harm to an individual or the public is greater than harm to the property, and the public trust doctrine holds coastal resources below the mean high tide line for the public’s benefit, (Hecht 2015). Sometimes, however, background principles may not be applicable depending on the circumstance and the type of takings. Wolf¹³ analyzes various ways takings challenges can be made in the face of sea level rise adaptation. He provides a guide to making seemingly risky sea level rise adaptation tools “takings-proof.” Depending on the type of takings, his strategies include: articulating essential nexus and rough proportionality, clarifying the difference between takings by the government and takings by the force of nature, and marshaling relevant precedent (Wolf 2013). This resource can be found in Appendix C.

¹² The consensus statement was jointly authored by Don Gourlie, Ashley Erickson, Deborah Sivas, Meg Caldwell, Tim Eichenberg, Ralph Faust, Curtis Fossum, Charles Lester, Steve Roady, Jan Stevens, and William White.

¹³ Michael Allen Wolf is the Richard E. Nelson Chair in Local Government Law at the University of Florida Levin College of Law.

CEQA requires state and local agencies to evaluate and identify the environmental impact of their actions. Regarding local sea level rise adaptation, CEQA will require governments to understand the environmental impacts of their projects as well as the future interactions between proposed development and the future coastline. CEQA can help decision-makers take into account the environmental impacts and consequences of development, enabling them to reduce negative impacts. However, in *Ballona Wetlands Land Trust v. City of Los Angeles*, the California Court of Appeals for the Second District held that an environmental impact report would not need to consider the impact of the environment (in this case, sea level rise) on a project since the purpose of an environmental impact report is to assess the impact of a project on the environment. Despite this decision, scholars still believe CEQA can play an integral role in considering sea level rise impacts in most circumstances. Although it cannot be cited as legal authority because of its state trial court opinion status, the decision by the Ventura County Superior Court in *Sierra Club v. City of Oxnard* demonstrated that local jurisdictions should still undertake CEQA in terms of sea level rise impacts by explaining that land use compatibility is an integral part of CEQA, (Herzog and Hecht 2013).

The NFIP, administered through the Federal Emergency Management Agency (FEMA), is a voluntary program based on an agreement between the local and federal governments. In order to participate in the program, and ensure the availability of federal flood insurance to local landowners, local governments must regulate floodplain development. However, local governments can go above and beyond the base requirements in the NFIP by participating in the CRS program with stronger floodplain regulations. In exchange, local landowners can receive discounted flood insurance. This creates a political incentive to participate in the CRS program, (Grannis 2011). Emily Maus and Jessica Grannis¹⁴ draft paper, *Bonus Points: CRS Potential in the GCC Model Sea-Level Rise Ordinance*, as well as Wetlands Watch's online Sea Level Rise Adaptation Guide have identified options for receiving potential points in the CRS program, leading to lower insurance rates. In addition, Sean Hecht and Megan Herzog¹⁵ at the Frankel Environmental Law Program at the UCLA School of Law have been developing a model ordinance for California, which is intended to help local governments adapt to sea level rise and incorporate the requirements and incentives of the NFIP and CRS. See Appendix C for these resources.

VII. Coordination Considerations

In addition to pertinent laws and policies, cities and counties should also take into consideration both vertical and horizontal coordination to reduce redundancy, increase efficiency, and streamline processes. Sea level rise adaptation cannot successfully occur if only addressed by one level of government. Although local governments are on the front lines, federal and state actions can be integral. Federal and state agencies have a greater ability to provide technical assistance and guidance, funding, and scientific data to aid local governments. State mandates and investments can also spur action on the local level, (Grannis et al 2014). Currently, several federal agencies have produced frameworks for adapting to coastal climate change impacts, including the National Oceanographic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency (EPA), and the

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Department of the Interior. At the state level, California has also produced various guidance on coastal climate change adaptation, including *Safeguarding California's* Ocean and Coastal chapter, the CCC's 2015 sea level rise policy guidance document mentioned above, and CalTrans' *Guidance on Incorporating Sea Level Rise*. Despite these publications, detailed guidance on how to determine and implement specific tools on the local level remains largely unseen, (Reiblich, Wedding, Hartge 2017). However, the CCC recently released a draft document of this specificity for residential development along the coast, titled, *Residential Adaptation Guide: Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs*. The California Governor's Office of Planning and Research (OPR) will also administer the Integrated Climate Adaptation and Resiliency Program (ICARP), in hopes to improve vertical coordination of climate change adaptation. See Appendix C for these resources.

Equally as important is horizontal coordination within regions, counties, and cities. Mark Lubell¹⁶ identified seven governance challenges to sea level rise adaptation in the San Francisco Bay Area. The first two challenges identified are directly related to coordination: a need to have institutions for multi-level cooperation and a need for regional adaptation planning for sea level rise. It is important for cities and counties in the Bay Area to strive for multi-level cooperation and regional adaptation as various local governments, private companies, regional infrastructure operators, and others are creating their own processes leading to fragmented decision-making, redundancy, and a failure to account for interdependence. To address these governance challenges, Lubell offers seven solutions, each with various action items, (Lubell 2017). This resource can be found in Appendix C.

Within a local jurisdiction, it is imperative to not only know what other departments and agencies are working on sea level rise adaptation, but also to coordinate in order to reduce redundancy, share resources, and streamline policies. There can be significant overlap between sea level rise adaptation strategies and tools in Local Coastal Programs, General Plans, Local Hazard Mitigation Plans, floodplain management and ordinances, Capital Improvement Programs, transportation plans, zoning laws, and more, (California Coastal Commission 2015). One effort to streamline these overlapping planning efforts is the Regional Resilience Framework currently being developed by FEMA, the U.S. EPA, and the Association of Bay Area Governments (ABAG). This framework attempts to incorporate planning processes into a single action plan to build resilience across silos. Moreover, FEMA is conducting a series of coastal resilience workshops as a part of their RiskMAP program with the CCC and local jurisdictions to coordinate guidance and address fragmented adaptation efforts along the California coast. See Appendix C for more information on FEMA's RiskMAP program.

VIII. Equity Considerations

Another vital aspect for local governments to take into consideration when adapting to sea level rise is equity. If equity and justice are not addressed, vulnerable populations are at risk of being disproportionately burdened by the impacts of climate change due to historical injustices and disinvestments (Climate Justice Working Group 2017). The Climate Justice Working Group was convened to develop recommendations for the 2017 *Safeguarding California* update, ensuring the state successfully addresses environmental justice and climate equity in its adaptation to climate change. This working group developed a vision and guiding principles for California in addition to providing sectoral

¹⁶ Mark Lubell is a professor in the Department of Environmental Science and Policy and the director of the Center for Environmental Policy and Behavior at the University of California, Davis.

recommendations. Their vision states, “By 2030, we envision a resilient California where our most vulnerable communities are ready to respond to the physical, environmental, economic and health impacts brought on by climate change, and thrive after climate events. California must proactively bring public and private investments into vulnerable communities to foster robust and thriving communities that are engaged, healthy, just, economically viable, and safe from environmental threats,” (Climate Justice Working Group 2017). To achieve this vision, the working group advises adaptation efforts to be guided by ten principles. These include:

- 1) “Actively engage frontline communities in research, planning, implementation, education, and decision making about potential climate change impacts and about the development, funding, implementation, and evaluation of adaptation and resilience policies. Create enabling conditions for frontline communities’ early, continuous, and meaningful participation in the development of adaptation policy and funding decisions. Partner with local leaders and community-based organizations to enhance the effectiveness of adaptation research and innovation, education, decision making, and policy implementation. This overarching principle applies to all of the subsequent climate justice principles and recommendations;
- 2) Identify and reduce frontline communities’ vulnerabilities to climate change, with a focus on physical, economic, and quality-of-life factors;
- 3) When planning for infrastructure investments, prioritize actions that increase the resilience of essential facilities and associated services that provide health care, food, drinking water, evacuation routes, and emergency shelter for frontline communities. Reduce community health and safety risks from potential damage to sensitive facilities such as water treatment plants, hazardous waste facilities, and power plants and transmission lines;
- 4) Promote adaptation policies, funding decisions, and implementation actions that increase training, employment and economic development opportunities among frontline communities. Where applicable, prioritize opportunities that advance a ‘just transition’ from dependence on fossil fuels and further enhance community resilience to the impacts of climate change;
- 5) Promote and support regional and local adaptation efforts that generate multiple benefits across sectors;
- 6) During planning and implementation of land use and community development decisions, consider and avoid negative consequences of actions, including displacement, that could inadvertently increase frontline communities’ and individuals’ climate vulnerability;
- 7) Promote adaptation co-benefits of toxic chemical and greenhouse gas reduction policies by supporting those that also reduce frontline communities’ climate vulnerability and enhance their resilience;
- 8) Ensure that adaptation policies, funding decisions, and implementation actions comply with relevant laws and policies that are designed to protect and advance civil rights and environmental justice;
- 9) Promote local, regional, and state agency transparency, accountability, and adaptive management by developing and applying easy-to-understand climate justice metrics, data and information resources, and annual reporting protocols; [and]

10) Identify needed funding, establish needed funding mechanisms, and allocate adequate funding to support adaptation policy development, implementation, and evaluation in frontline communities,” (Climate Justice Working Group 2017). It is imperative that cities and counties follow these principles when implementing climate adaptation strategies to ensure the inclusive resilience of their jurisdictions.

Specific to the ocean and coastal resources sector, the Climate Justice Working Group identified what issues and programs address the needs of vulnerable communities and the implementation challenges to such issues and programs. The group also identified what issues and programs are missing from this section of California’s adaptation guidance as well as their implementation challenges. Lastly, for the ocean and coastal resources sector, the working group provided several recommendations for listening to and integrating the needs of vulnerable communities (Climate Justice Working Group 2017). Find the details of this analysis and recommendation in Appendix C.

Several efforts are underway in the San Francisco Bay Area to successfully involve equity in sea level rise adaptation. In Measure AA, one of the prioritization criteria for the selection of restoration projects is whether the project benefits economically disadvantaged communities. The San Francisco Bay Restoration Authority’s *Grant Program Guidelines* further expounds upon this, defining economically disadvantaged communities as, “... a community with a median household income less than 80% of the area median income (AMI). Within this set of low- income communities, communities of particular concern include those that: are historically underrepresented in environmental policymaking and/or projects, bear a disproportionate environmental and health burden, are most vulnerable to climate change impacts due to lack of resources required for community resilience, or are severely burdened by housing costs, increasing the risk of displacement,” (San Francisco Bay Restoration Authority 2017). This forward-thinking definition was spearheaded by the San Francisco Bay Restoration Authority’s Advisory Committee’s environmental justice representatives and their networks, who are part of the Resilient Communities Initiative, a coalition of social equity organizations in the San Francisco Bay Area that are bringing significant community leadership to climate adaptation and resilience planning, since their inception in 2013. Additionally, at their July 20th meeting, BCDC approved the initiation process for amending the San Francisco Bay Plan to include social equity policies (BCDC Sept 2017).

IX. Implementation

There are various ways to incorporate and implement sea level rise tools, but included are a few worth noting. NOAA’s Office of Ocean and Coastal Resource Management suggests evaluating, selecting, and prioritizing actions. In evaluating, they propose reviewing the social, technical, administrative, political, legal, economic, and environmental opportunities and constraints of each option. They suggest prioritizing actions that are win-win options, no-regrets options, low-regrets options, and/or flexible adaptation options, (NOAA Office of Ocean and Coastal Resource Management 2010). Find this guidance in Appendix C. In *Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments*, the authors emphasize making modifications to existing tools for implementing adaptation. Some of these existing tools include: zoning rules and regulations, taxation, building codes/designs, utility rates/fee setting, public safety rules and regulations, and the issuance of bonds, (Center for Science in the Earth System (The Climate Impacts Group); Joint Institute for the Study of the Atmosphere and Ocean; University of Washington; King County, WA; ICLEI 2007). Many of these are expounded upon in Appendix A and B. One specific implementation framework gaining traction is trigger-based adaptation or adaptation pathways. Specific actions are scheduled when certain triggers

occur or thresholds are passed. This allows for strategic, flexible, and structured decision-making, (CoastAdapt 2017). See Appendix C for more information on the pathways approach.

Another challenge can occur in where, or in which planning documents, to implement the chosen adaptation tools. Although tools can be implemented throughout planning generally, the CCC is advising the 61 cities and 15 counties along California's coast to implement sea level rise adaptation in their LCPs to be consistent with the California Coastal Act, (California Coastal Commission 2015). The Implementation Plan of LCPs can house many of the tools described in this document. See Appendix C for the CCC's resources on using LCPs to adapt to sea level rise. In addition, SB379 states, "...upon the next revision of a local hazard mitigation plan on or after January 1, 2017, or, if the local jurisdiction has not adopted a local hazard mitigation plan, beginning on or before January 1, 2022, require the safety element [of the General Plan] to be reviewed and updated as necessary to address climate adaptation and resiliency strategies applicable to that city or county," (CA SB. 379 2015).

X. Lessons Learned and Next Steps

As communities around the country adapt to climate change, it is important to glean good practices and lessons learned. Although there are many reports depicting lessons learned, included are a few that seem particularly salient. Vogel et al's¹⁷, *Climate Adaptation: The State of Practice in U.S. Communities*, gives communities wishing to undertake climate change adaptation several tactical recommendations. These include: "start now; look for co-benefits, cross-sector leveraging, and opportunities to piggyback climate adaptation onto other salient community issues; employ commonly used tools to mainstream adaptation; use windows of opportunity to advance climate adaptation; build flexibility into policies, projects, and programs; consider the needs and capabilities of more vulnerable populations; craft outreach or engagement efforts, as needed, to build community support; take prudent risks and adjust over time; consider local context when determining whether to explicitly frame actions in terms of 'climate change;' provide leadership; and use partnerships to advance adaptation," (Vogel et al 2016).

In a report by Headwaters Economics, ten cities were evaluated and offered the following lessons, "focus on an immediate recognizable threat; recognize local values, and be flexible; start with an existing process; utilize local activists; look for leadership in unexpected places; involve elected officials early; work with the right department, and dedicated staff; reach out to the community; facilitate peer-to-peer learning, and offer positive examples; recognize limited capacity; don't get trapped by the climate debate; use outside expertise that: has legitimacy with leaders, understands community organizing, and provides technical details; don't wait for perfection; use economic and fiscal arguments; make use of regional compacts; and recognize mitigation can be a first step," (Headwaters Economics 2012).

After analyzing 33 cities and towns along the North Atlantic coast, Schechtman and Brady¹⁸ drew several conclusions about coastal climate change adaptation. First and foremost, they found the integration of

¹⁷ *Climate Adaptation: The State of Practice in U.S. Communities* was written by Abt Associates with funding from the Kresge Foundation. Authors include: Jason Vogel, Karen M. Carney, Joel B. Smith, Charles Herrick, Megan O'Grady, Alexis St. Juliana, Heather Hosterman, Lorine Giangola (from Abt Associates) and Missy Sults (independent adaptation consultant).

¹⁸ Judd Schechtman, J.D., M.U.P. is from Rutgers University, Bloustein School of Planning and Public Policy and Michael Brady is from Rutgers University, Department of Geography. Both were NOAA-funded graduate fellows for this report.

coastal hazard response into existing plans (namely comprehensive and hazard mitigation plans) to be an integral low-cost first step. Second, they found NOAA and state coastal management offices to be essential partners, especially for funding. Other findings included: the importance of community outreach and engagement, that not all adaptation strategies need extensive modeled data, that coordination with state and federal entities could be improved, and that requirements and incentives are strong drivers for action, (Schechtman and Brady 2013).

Lastly, The Center for Clean Air Policy's, *Lessons Learned on Local Climate Adaptation from the Urban Leaders Adaptation Initiative*, produced a recipe for local governments adapting to climate change. The recipe includes: "the effective use of 'triggering events' such as, floods, droughts, hurricanes, or storms to focus government and public attention on the imperatives of adaptation; the presence of a 'champion' in top level elected leadership or heading a city department to motivate action; early departmental 'buy-in' and organization for adaptation planning; sources of 'actionable science' accessible, accurate, and understandable for adaptation decision making at the local level; 'down-scaled' climate information at high-enough resolution for assessing local climate impacts and risks to infrastructure and economy created in collaboration with trusted local experts; engaging experts and stakeholders to become more involved and to motivate adaptation planning processes and also including outreach to build public awareness and support; using existing administrative, legal, and financial mechanisms to motivate adaptive behavior including federal, state and local laws and regulations; peer-learning from other local governments working on climate adaptation; treating mitigation and adaptation as complementary measures in terms of funding appropriation, allocation and targeting of strategies that accomplish both; leveraging funding for adaptation planning via philanthropic sources, pro bono work, or as embedded in existing budgets for planning, public works and transportation; and regional engagement on adaptation planning to address issues outside of local jurisdictions at the municipal, watershed, or state level," (Foster, Winkelman, Lowe 2011).

Although not all lessons learned are applicable for every jurisdiction, similar to guiding principles, general themes can be applied to reduce barriers to implementing sea level rise adaptation.

Moving forward, counties and cities can take the tools included in this report and evaluate their feasibility through the lens of existing relevant local laws and regulation, development patterns and geography, departmental capacity, funding, community values and priorities, and more. The implementation section of this report could further be expanded to include other statutes that local jurisdictions need to comply with while adapting to sea level rise. The tool characteristics could also be expounded to include approving entities and consistency requirements. Lastly, the process details of the examples could also be captured by conducting interviews with the various jurisdictions.

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Appendix A: Local Sea Level Rise Adaptation Tools, Descriptions, and Caveats

**Caveats and other notes are found in the footnotes

- Planning Tools

- **Plans**¹⁹ – used by governments to manage a defined area’s future, particularly in terms of development.
 - **General (or Comprehensive) Plan**²⁰ – “The General Plan sets forth the goals, policies and directions the City will take in managing its future. The General Plan is the citizens’ ‘blueprint’ for development; the guide to achieving [the] vision. California law requires each local government to adopt a local General Plan, which must contain at least seven elements: Land Use, Transportation, Housing, Conservation, Noise, Open Space and Safety,” (Long Beach Planning).
 - **Local Coastal Program** (comprised of the Land Use Plan (LUP) and the Implementation Plan (IP)) – “...basic planning tools used by local governments to guide development in the coastal zone, in partnership with the [California] Coastal Commission,” (California Coastal Commission).
 - **Metropolitan Transportation Plan** – “Each metropolitan planning organization (MPO) must prepare a Metropolitan Transportation Plan (MTP), in accordance with 49 USC 5303(i), to accomplish the objectives outlined by the MPO, the state, and the public transportation providers with respect to the development of the metropolitan area’s transportation network,” (Federal Transit Administration 2015).
 - **Hazard Mitigation Plan** – “...allows a locality to identify policies and actions to reduce the risks from hazards. To be eligible for federal disaster and flood insurance, localities must have a regularly updated hazard mitigation plan,” (Wetlands Watch).
 - **Capital Improvement Program (CIP)**²¹ – “Guide future investments in public infrastructure based upon projections of the community’s growth,” (Grannis 2011).

- Regulatory Tools

- **Zoning**²² – “Provide the legal framework that governs the use and development of land in a community. Zoning maps divide the community into different districts based upon the types of uses that are permitted,” (Grannis 2011).

¹⁹ Often, including sea level rise in these types of plans are the first steps local jurisdictions can take. These plans can become a “home” for many of the other tools below. Adding sea level rise to various plans allows for public engagement, (Wetlands Watch).

²⁰ SB379 requires local governments to address climate change adaptation and resilience in the Safety Element of the General Plan, (CA SB. 379 2015).

²¹ One tradeoff is that CIPs that limit development in certain areas can lead to decreased tax revenue, (Grannis 2011).

²² Local governments often will need to adopt a zoning ordinance in order to regulate land use, (Grannis 2011).

- **Overlay Zones/Districts**²³ – “Overlay zones superimpose additional regulations on an existing zone based upon special characteristics of that zone,” (Grannis 2011).
 - **Sea Level Rise Zone** – areas that will be inundated by sea level rise (based on agreed upon models and scenarios).
 - **Protection Zone** – “areas with critical infrastructure and dense urban development, where the locality will permit coastal armoring; local governments could require soft-armoring techniques be employed where feasible,” (Grannis 2011).
 - **Accommodation Zone** – “areas where local governments will allow new development but may limit the intensity and density of new development, limit hard shoreline armoring, and require that structures be designed or retrofitted to be more resilient to flood impacts,” (Grannis 2011).
 - **Retreat Zone** – “area where local governments will prohibit hard armoring, will limit or prohibit rebuilding of damaged structures, or require the removal or relocation of structures that become inundated,” (Grannis 2011).
 - **Preserve Zone** – “areas where local governments will seek to preserve and enhance important natural resources, ecosystems, habitats, or flood buffers,” (Grannis 2011).
- **Special Districts** – “A governmental entity formed to deliver a specific service, like fire protection, water service, recreation or the maintenance of open space,” (Institution for Local Governments 2010).
- **Subdivision Ordinances** – “The division of a tract of land into defined lots, either improved or unimproved, which can be separately conveyed by sale or lease, and which can be altered or developed. The process often includes setting aside land for streets, sidewalks, parks, public areas, and other infrastructure needs, including the designation of the location of utilities,” (Institution for Local Governments 2010). They can be used to concentrate development in desirable areas.
- **Cluster Development**²⁴ – Used to concentrate development in desirable areas. “These programs allow developers to increase densities in specified areas in exchange for the developer’s agreement to designate open space,” (Grannis 2011).
- **Downzoning**²⁵ – changing zoning to reduce density.

²³ Overlay zones/districts are flexible tools that can facilitate other tools, such as rebuilding/redevelopment restrictions, transfer of development credits (or rights) programs, building codes, etc.

²⁴ Cluster development can also be categorized under building codes/design standards. Cluster development requires substantial open space. It may be of limited use in already highly developed areas, (Grannis 2011).

²⁵ Downzoning (and low-density zoning) can reduce intensity of development but can also lead to sprawling land use, (Wetlands Watch).

- **Setbacks/Buffers**²⁶ – “Require that development be set back a distance from a baseline [...]. Require landowners to leave, in their natural state, portions of property that support natural and beneficial functions,” (Grannis 2011).
 - **Fixed Mandatory Setbacks** – “require that all structures, including sea walls, be set back a specific distance from a predetermined point,” (Grannis 2011).
 - **Erosion-Based Setbacks**²⁷ – “are determined by a projected shoreline position that assumes a specific increase in sea level and erosion rates over a specific time frame such as the life of the structure,” (Grannis 2011).
 - **Tiered Setbacks** – “require a lesser setback or buffer for smaller structures and a greater setback for larger structures that are more difficult to move if they become damaged and put more people at risk,” (Grannis 2011).
 - **Buffer Zones for Vulnerable Areas** – “An area of land separating two distinct land uses that softens or mitigates the effects of one land use on the other,” (Institute for Local Government 2010).
 - **Wetland Buffers** – “...a setback area between a stream, river, or wetland and any upland development. It maintains the natural vegetation cover along the waterway, which is an essential part of the aquatic ecosystem,” (City of Portsmouth).
 - **Vegetation Preservation Ordinance** – preserving existing vegetation to reduce the threat of erosion.
- **Density Zoning/Transfer**²⁸ – “A way of retaining open space by concentrating densities—usually in compact areas adjacent to existing urbanization and utilities—while leaving unchanged historic, sensitive, or hazardous areas. In some jurisdictions, for example, developers can buy development rights of properties targeted for public open space and transfer the additional density to the base number of units permitted in the zone in which they propose to develop,” (Institute for Local Government 2010).
- **Floodplain Management**²⁹ – “As a requirement to participate in the National Flood Insurance Program (NFIP), local governments must impose minimum regulations on

²⁶ Setbacks/buffers can also be categorized under floodplain management and building codes/design standards. Although similar in design, setbacks and buffers often have different goals. While setbacks are commonly used to protect the built environment, buffers are typically used to protect the natural environment, (NOAA Office of Ocean and Coastal Resource Management 2010). Setbacks/buffers limit the amount of development on a property which can, in some cases, reduce the developmental value of the property. They may be a short-term solution depending on the long-term effects of sea level rise to a parcel, (Grannis 2011). Setbacks/buffers can help reduce repetitive loss by requiring them after a damaging event, (Reiblich, Wedding, Hartge 2017).

²⁷ Maui, Hawai’i has adopted a strict erosion based setback in order to avoid future potential takings claims. Erosion-based setbacks can be difficult for local jurisdictions to implement because they require scientific data, (Grannis 2011).

²⁸ Density Zoning/Transfer can be used to facilitate transfer of development credits (or rights) programs or the purchase of development rights.

²⁹ Most floodplain management tools can earn communities points under FEMA’s CRS program.

development in floodplains. [...] Governments could impose additional restrictions on development in floodplains above NFIP minimum standards,” (Grannis 2011).

- **Restricting/Reducing Development** – restricting or reducing allowable uses of land.
- **Open Space Regulations** – incentivizing open space through floodplain regulations.
- **Cumulative Substantial Improvement Ordinances³⁰** - improvements, modifications, additions, and rebuilds are built to specific floodplain regulations.
- **Freeboard/Elevation Requirement³¹** - “...the elevation of a building’s lowest floor to a height above the minimum base flood elevation (BFE) during the initial construction process,” (Wetlands Watch).
- **Policy Prohibiting Hazardous Materials in the Floodplain** – ordinance prohibiting specific hazardous materials (i.e. ammonia, sulfur, acetone, etc.) in the floodplain, (FEMA).
- **Prohibiting/Limiting Enclosures** – prohibiting or limiting enclosure uses under an elevated structure.
- **Community Rating System (CRS) Program Participation³²** - participation in FEMA’s CRS program entails going above and beyond NFIP requirements for floodplain management. Participation also affords landowners reduced flood insurance rates.
- **Limiting/Prohibiting Fill for Elevation** – prohibiting or limiting using fill for structure elevation.
- **Policy for Protection of Critical Infrastructure** – policy ensuring the protection of infrastructure that is critical to health and safety before, during, and after a flood, including hospitals, emergency response, nursing homes, shelters, and infrastructure that could worsen impacts such as hazardous materials facilities, power generation facilities, wastewater treatment plants, etc., (FEMA 2017).

³⁰ Cumulative Substantial Improvement Ordinances can also be categorized under rebuilding/redevelopment restrictions and in building codes/design standards.

³¹ Freeboard/elevation requirements can also be categorized under building codes/design standards. These requirements are a “band-aid” short-term solution that do not move structures out of vulnerable areas. They can significantly increase building costs and can reduce or remove ADA access of structures. They may be constrained by height limitations. Although structures are elevated, floors, piles, and wiring are still subject to issues caused by flooding, such as rot, (Wetlands Watch). As sea levels rise and elevated houses are in the public trust, public access can be impeded.

³² CRS program participation can also be categorized under building codes/design standards. Participation in the CRS program and using future projected flood rates (going beyond the base requirements of the NFIP) will be important as sea levels rise as the NFIP’s flood insurance rate maps (FIRMs) are based on historical data, (Grannis 2011). Many of the other tools in this document are included in CRS program participation, such as: freeboard/elevation requirement, prohibiting/limiting enclosures, limiting/prohibiting fill for elevation, policy for protection of critical infrastructure, extending V-Zone standards to A-Zone, flood-resistant building materials, and more. Participation in the CRS program lowers flood insurance costs for landowners which can increase its political support and implementation, (Grannis 2011).

- **Extending V-Zone Standards to A-Zone³³** - extending V-Zone (areas subject to additional damage from wave action in the 100-year floodplain) standards to the A-Zone (100-year floodplain), (FEMA 2017).
- **Building Codes/Design Standards³⁴** – “Establish requirements for building construction to maximize protection from flooding,” (Grannis 2011).
 - **Compact Development/Designs³⁵** – The intent is... “To encourage development in existing areas to conserve land and protect farmland and wildlife habitat. To promote livability, walkability, and transportation efficiency, including reduced vehicle distance traveled,” (U.S. Green Building Council).
 - **Flood-Resistant Building Materials** - using flood resistant or flood-proof building materials in construction or renovation to enable floodable designs.
 - **Floodable Designs** – building designs (including the use of flood-resistant building materials) that allow for a certain level of flooding with no or negligible damage.
 - **Low Impact Development³⁶** – “...systems and practices that use or mimic natural processes that result in the infiltration, evapotranspiration or use of stormwater in order to protect water quality and associated aquatic habitat,” (EPA Jun 2017).
- **Special Conditions/Conditional Development³⁷** – “[Local governments can] impose special conditions as a condition of a development permit. Conditions can be designed to mitigate the impacts of development...” (Grannis 2011).
 - **Impact Fees³⁸** – “The developer is required to pay a fee to cover the costs of potential emergency response, future armoring, to mitigate impacts to natural resources from future armoring, to flood proof infrastructure that services the new development, [or other adaptation activities]” (Grannis 2011).
 - **Exactions³⁹** – “A contribution or payment required as an authorized precondition for receiving a development permit; usually refers to mandatory dedication (or fee in lieu of dedication) requirements found in many subdivision regulations,” (Institute for Local Governments 2010).
 - **Land Use Restrictions** – land is restricted to specific (less intensive) uses.

³³ Extending V-Zone Standards to A-Zone can also be categorized under building codes/design standards.

³⁴ Building code and design standard enforcement is critical to their success. This can be achieved through permit approval, design and plan review, site visits, and continual training and education, (NOAA Office of Ocean and Coastal Resource Management 2010).

³⁵ Compact development/design is best paired with zoning that regulates development in the floodplain and other building codes. However, design can be difficult to implement in areas already heavily developed, (NOAA Office of Ocean and Coastal Resource Management 2010).

³⁶ Low impact development can also be categorized under urban greening for stormwater management.

³⁷ Special conditions/conditional development can be politically unpopular as they can increase development costs, reduce the structure’s life, or decrease the amount of space for development. Since conditions are often negotiated between landowners and regulators, inconsistencies can occur. Zoning ordinances must include the consideration of sea level rise or other relevant criteria for regulators to exact conditions, (Grannis 2010). Several special conditions/conditional development tools present a takings risk. Governments can prevent a takings challenge here by articulating essential nexus + rough proportionality, (Wolf 2013).

³⁸ Impact fees can also be categorized under adaptation funding mechanisms.

³⁹ Exactions can also be categorized under market-based tools as a way of acquiring property.

- **Dedications** – “The landowner dedicates an easement to preserve natural buffers, floodways, or to provide public access,” (Grannis 2011).
- **Deed Restrictions** – “A private legal restriction on the use of land recorded in the deed. The restriction burdens or limits the use of the property in some way,” (Institute for Local Governments 2010).
- **Site Capacity/Performance Standards** - “...are based on the capacity of a site to sustain new development. Local municipalities may analyze local site conditions on developable property to determine the extent and type of development the site can or should sustain based on its unique conditions,” (Land Use Law Center, Pace University School of Law 2008).
- **Special Area Ordinances** – “...adopted to protect sensitive resources facing development pressures or risks from threats including sea level rise. Regulations governing such areas may require that proposed development undergo scrutinized environmental impact assessments; may prohibit uses other than non-intensive recreational ones; or may divide land within the critical area into classifications supporting development, limited development, and strict resource conservation,” (Land Use Law Center, Pace University School of Law 2008).
- **Rebuilding/Redevelopment Restrictions**⁴⁰ – “Limit a property owner’s ability to rebuild structures destroyed by natural hazards...” (Grannis 2011).
 - **Limited Rebuilding** – “Landowners are allowed to build smaller, more resilient structures to replace older, damaged structures; or landowners could be required to provide for additional setbacks,” (Grannis 2011).
 - **Prohibited Rebuilding** – “Landowners are prohibited from rebuilding destroyed properties when they are located in identified flood- or erosion-prone areas; or landowners are prohibited from rebuilding structures that have been repetitively damaged,” (Grannis 2011).
 - **Conditional Rebuilding** – “Landowners are allowed to rebuild properties largely as they were but with the condition that they will not build protective armoring or that they will remove structures when threatened by erosion or inundation,” (Grannis 2011).
 - **Non-Conformities** – “A use that was valid when brought into existence, but by subsequent regulation becomes no longer conforming. It is a generic term and includes (1) non-conforming structures (by virtue of size, type of construction, location on land, or proximity to other structures), (2) non-conforming use of a conforming building, (3) non-conforming use of a non-conforming building, and (4) non-conforming use of land. Thus, any use lawfully existing on any piece of property that is inconsistent with a new or amended general plan, and that in turn is a violation of a zoning ordinance amendment subsequently adopted in conformance with the general plan, will be a non-conforming use. Typically,

⁴⁰ Rebuilding/redevelopment restrictions are not proactive and therefore may not reduce risk immediately. They require a structure to be significantly damaged before implementation. They can be politically unpopular, especially in large-scale rebuilding periods (post disastrous events). Restrictions for repetitive-loss structures can be more feasible, (Grannis 2011).

non-conforming uses are permitted to continue for a designated period of time, subject to certain restrictions,” (Institute for Local Governments 2010).

Reconstruction or improvements made to non-conforming structures can require the structure to come into conformity with various zoning regulations.

- **Development/Redevelopment Moratorium**⁴¹ – “...a local law or ordinance that suspends the right of property owners to obtain development approvals while the community takes time to consider, draft, and adopt land use plans or rules to respond to new or changing circumstances not adequately covered by its current laws...” (Land Use Law Center, Pace University School of Law 2008).
- **Protection Permitting/Prohibition** – a policy to regulate or facilitate shoreline protection.
 - **Hard-Armoring Permitting Policy** - “Using permitting processes to regulate the construction of hard-engineered structures that provide flood and erosion control,” (Grannis 2011).
 - **Time Limited Hard-Armoring** – setting time limits on the life of hard-armoring structures
 - **Natural or Nature-Based (or Green/Soft) Infrastructure Permitting Policy** – A policy to, “[f]acilitate ‘soft’ coastal protection projects that replenish or mimic natural buffers...” (Grannis 2011).
 - **Prohibition of Hard-Armoring**⁴² – the prohibition or restriction of hard-armoring as flood protection.
 - **Assumption of Risk** – landowner assumes the risk (of flooding, sea level rise, wave action, erosion, etc.) as well as the injury and damage from such risks.
 - **Waiver of Liability** – landowner waves any claim or liability.
 - **Indemnity** – permitting authority will be exempt from any and all damages or losses.

- Market-Based Tools

- **Tax and Other Development Incentives**⁴³ – Encourage preferred patterns of development with mostly monetary incentives.
 - **Tax Abatement (or Deferment) Programs** – “[Programs] freeze, for a specified period of time, increases in property taxes if the property is used for a specific purpose,” (Grannis 2011).
 - **Tax Credit Programs**⁴⁴ – “[Programs] provide a one-time credit against business, personal income, or property tax,” (Grannis 2011).
 - **Relocation/Retrofit Tax Incentives** – tax incentives for relocation away from vulnerable areas or for retrofitting development to accommodate flooding.

⁴¹ Development/redevelopment moratoriums are often used after a large disaster to allow government officials time to evaluate and plan redevelopment in devastated areas, (Grannis 2011).

⁴² The prohibition of new hard-armoring presents a takings risk but can be avoided by identifying background principles, (Wolf 2013).

⁴³ Tax incentives can lead to a loss in tax revenue and to an expectation that compensation comes with all development restrictions, (Grannis 2011).

⁴⁴ Tax credit programs are often used to encourage redevelopment in blighted areas, (Grannis 2011).

- **Siting Incentives** – tax incentives to site development in a certain location.
- **Land Use Value (or Preferential) Assessments**⁴⁵ – “...lower tax assessments to landowners who agree to preserve their property... Taxes are assessed based upon the property’s current use value, not its potential use value. In this way...assessment programs remove the incentive of property owners to develop property to keep pace with property tax increases,” (Grannis 2011).
- **Transferable Development Credits (or Rights) Programs**⁴⁶ – “Restrict development in one area and allow for the transfer of development rights to another area more appropriate for intense use.” Includes the creation of a development rights bank and identification of "sending and receiving" areas, (Grannis 2011).
- **Adaptation Funding Mechanisms** – mechanisms used to fund sea level rise adaptation.
 - **Special Assessments** – “...charges levied on property to pay for benefits received from some local improvement,” (Reiblich, Wedding, Hartge 2017).
 - **Geological Hazard Abatement Districts (GHADs)**⁴⁷ – “...a special district formed to prevent, mitigate, abate, or control some geologic hazard,” (Reiblich, Wedding, Hartge 2017).
 - **County Service Areas**⁴⁸ – “A type of special district that may provide any service that a county may provide in unincorporated areas. The service must not be one that the county already provides to the same extent on a countywide basis. County Service Areas are commonly used for road and drainage maintenance in new subdivisions. The basic premise of a County Service Area is to fund a service that the county would not otherwise be able to fund through traditional sources, like property tax or sales tax. County Service Areas are governed by the county board of supervisors and funded by a direct assessment paid by property owners who benefit from the services provided,” (Institutional for Local Governments 2010).
 - **Redevelopment Agencies**⁴⁹ – “A local agency created by a city or county to promote the redevelopment of blighted areas. Redevelopment agencies identify blighted areas, then create and implement plans to redevelop those areas. They may work with other public agencies or private partners in implementing

⁴⁵ In land use value assessments, development is not restricted in perpetuity which may increase social acceptability but also may deem them temporary solutions. Additional parcels can be easily added to land use value assessment districts, (Wetlands Watch).

⁴⁶ Transferable development credits (or rights) programs are not widely implemented because of the difficulty in correctly calibrating the market as well as their volunteer nature. Often, both the sending and receiving areas need to be downzoned, (Grannis 2011). They can also be administratively complex, (Wetlands Watch). These programs are also a zoning tool and can be paired with overlay zones to identify sending and receiving areas. To ensure that sending areas are preserved, sending landowners should execute a permanent conservation easement, (Herzog and Hecht 2013). These programs may give the perception of an economic loss, (Wetlands Watch).

⁴⁷ Although GHADs have freedom and power, they are not democratic and can be expensive to form and maintain, (Reiblich, Wedding, Hartge 2017). GHADs are a type of special district and can also be categorized under zoning tools.

⁴⁸ County Service Areas can also be categorized under zoning tools as a type of special district.

⁴⁹ Redevelopment Agencies have since been dissolved in CA but have been replaced by Community Revitalization and Investment Authorities with similar objectives (CA AB. 2 2015).

redevelopment plans. Redevelopment agencies have authority to acquire real property, the power of eminent domain, authority to develop and sell property without bidding, and the authority and obligation to relocate persons displaced by redevelopment. Redevelopment agencies can use a variety of financing tools, including Tax Increment Financing, selling bonds, and borrowing from federal or state governments, or private sources,” (Institute for Local Governments 2010).

- **Catastrophe Bonds**⁵⁰ – “...insurance schemes that offer more risk-bearing capacity than traditional insurance policies. These bonds are a mechanism for creating reinsurance for a set time period in a specific location,” (Reiblich, Wedding, Hartge 2017).
- **Mello-Roos Bonds** – “Locally issued bonds that are repaid by a special tax imposed on property owners within a community facilities district established by a public agency. The bond proceeds can be used for public improvements and for a limited number of services,” (Institute for Local Governments 2010).
- **Community Preservation Funds** – “Community preservation monies are raised locally through the imposition of a surcharge of not more than 3% of the tax levy against real property, and municipalities must adopt [the Community Preservation Act] by ballot referendum,” (Community Preservation Coalition).
- **Stormwater Management Fees** – a fee (often based on the amount of impervious area on a parcel or other base amounts) to fund stormwater management activities (Storm Water Management Program, City of Palo Alto 2016).
- **Environmental Impact Bond** – a bond to help finance natural (or green) infrastructure to manage stormwater runoff (DC Water, Goldman Sachs, Calvert Foundation 2016).
- **Spending Tools** – sea level rise adaptation tools requiring spending.
 - **Acquisitions**⁵¹ – “Acquire property at risk from flooding or other hazards,” (Grannis 2011).
 - **Buyouts**⁵² – purchasing of private property.
 - **Eminent Domain** – “The power of the government to take private property and convert it into public use. The Fifth Amendment provides that the government may only exercise this power if they provide just compensation to the property owners,” (Cornell Law School Legal Information Institute 2007).
 - **Conservation Easements**⁵³ – “Provide a flexible mechanism by which public entities can preserve land in its natural state while allowing land to remain in

⁵⁰ If multiple catastrophic events occur unexpectedly, catastrophe bonds may end up losing money, (Reiblich, Wedding, Hartge 2017).

⁵¹ Lack of full buyout program participation in an area can lead to a “checkerboard” effect that can lead to decreased property value, blight, and increased vulnerability, (Grannis 2011). Particular attention needs to be paid as to where residents are relocated to avoid increasing overall vulnerability of relocated residents, (McGhee 2017).

⁵² Buyouts can have high up-front costs and can result in loss of tax revenue, (Grannis 2011).

⁵³ Conservation easements are also a tax incentive as the federal government provides a tax deduction to landowners who donate an easement exclusively for conservation, (Grannis 2011). They can occur on the subdivision or regional scale for a more coordinated approach to shoreline management, (NOAA Office of Ocean

private ownership. Landowners grant an easement agreeing to restrict development of the land often for compensation or tax benefits,” (Grannis 2011).

- **Rolling Conservation Easements**⁵⁴ – “[Local governments can] adapt conservation easements to provide a rolling boundary that is designed to preserve the ability of the shoreline to migrate inland,” (Grannis 2011).
- **Land Banking** – “The purchase of land by a local government for use or resale at a later date,” (Institution for Local Governments 2010).
- **Purchase of Development Rights**⁵⁵ – “...similar to a [transfer of development rights program], without the created market to facilitate the transfer of development rights. Localities preserve open space by purchasing future development rights...” (Wetlands Watch).
- **Other Market-Based Tools**
 - **Real Estate Disclosures**⁵⁶ – “Require sellers of real estate to disclose certain property defects to prospective buyers prior to close,” (Grannis 2011).
- **Engineering Tools**⁵⁷
 - **Hard-Armoring**⁵⁸ – traditional engineering approach of physical shoreline protection.
 - **Shore Parallel** – hard-armoring parallel to the physical shoreline. “These structures help hold the land back from the sea and the sea back from the land and/or dissipate wave energy,” (NOAA Office of Ocean and Coastal Resource Management 2010).
 - **Seawalls** – “...a type of built structure designed to protect against encroaching seas. [...] They are built parallel to the shoreline and usually

and Coastal Resource Management 2010). Partnerships with land trusts or other conservation entities is essential for maintaining stewardship of land, (Wetlands Watch).

⁵⁴ Rolling conservation easements can reduce property value in the short-term but overall is less costly than total prohibition of development. They will also require removal and prohibition of hard coastal armoring to allow coastal habitats to migrate in-land. They only bind the specific property so as that property is inundated, the easement would terminate. Rolling conservation easements are largely untested. Legal challenges may be brought forward by several different owners as properties are inundated over time. To ensure their success, terms need to be crafted carefully, (Grannis 2011). It is currently unclear how rolling conservation easements will be applied in relation to the CA Coastal Act, (Reiblich, Wedding, Hartge 2017). The CA Climate Adaptation Strategy encourages local jurisdictions to explore rolling development restrictions for sea level rise adaptation, (Herzog and Hecht 2013).

⁵⁵ Purchase of development rights is an appropriate tool for localities facing development pressures. Communities with strong tourism industries benefitting from open space preservation have had success with purchasing development rights, (Wetlands Watch).

⁵⁶ Real estate disclosures can decrease the value (and tax revenue) of a property, (Grannis 2011).

⁵⁷ Engineered protection tools may be the best option for existing critical infrastructure that cannot be moved.

⁵⁸ There are many hard-armoring adaptation options. Some of the most common are listed here. Hard-armoring has several negative impacts. It can cause erosion, increased flooding (and therefore, decreased property value) of neighboring properties. It can prevent the upland migration of wetlands and beaches, causing them to drown. It can lead to a false sense of security and increase development in vulnerable areas. It can impede public access and destroy recreation and aesthetic values, (Grannis 2011). Hard-armoring devices can be expensive to build, maintain, and repair, (Wetlands Watch). Where hard-armoring is allowed, an exaction can be used to maximize public access, aesthetic value, and ecological protection. If a hard-armoring structure causes permanent flooding to a neighboring property, a takings challenge may be made, (Herzog and Hecht 2013).

consist of concrete, wood, steel, or a mixture of these materials,” (Reiblich, Wedding, Hartge 2017).

- **Bulkheads** – retaining wall to protect against wave action (U.S. Army Corps of Engineers 1995).
- **Revetments** – “...a shoreline protection structure comprised of large rocks atop a durable cloth,” (Reiblich, Wedding, Hartge 2017).
- **Breakwaters** – “...hard engineered structures designed to impede swells from reaching the shore,” (Reiblich, Wedding, Hartge 2017).
- **Riprap** – rock or other rubble used to protect the shoreline.
- **Shore Perpendicular** – hard-armoring perpendicular to the physical shoreline. “These structures interrupt sediment transport and trap sediment to build/rebuild beaches and/or stabilize navigational channels and inlets, (NOAA Office of Ocean and Coastal Resource Management 2010).
 - **Jetties** – “...a long, narrow structure that protects a coastline from the currents and tides,” (National Geographic Society 2012).
 - **Groins** – “...a structure that is perpendicular to the shoreline and extends into the water. They function in trapping sand moving in the along-shore currents,” (Center for Coastal Resources Management at the Virginia Institute of Marine Science).
- **Large Flood Control Structures** – large engineered structures used to control flood waters.
 - **Tide-Gates** – large gate that allows tide to flow in one direction and closes in the other to prevent large scale flooding.
 - **Levees** – embankment to control the flow and direction of a river.
 - **Dikes** – large-scale wall to prevent flooding.
- **Traditional Stormwater Management**⁵⁹ - used to reduce runoff and improve water quality (EPA Mar 2017).
 - **Wider Drainage Ditches** - can allow for more flow.
 - **Updating/Adding Pumps** – can prevent drainage systems from becoming overwhelmed.
 - **Larger Pipes/Culverts** - can allow for more flow.
 - **Converting Culverts to Bridges** – can allow for more flow.
- **Natural or Nature-Based (or Green/Soft) Infrastructure**⁶⁰ – “...using natural ecological systems or processes to reduce vulnerability to climate change related hazards while increasing the long-term adaptive capacity of coastal areas by perpetuating or restoring ecosystem services,” (California 4th Climate Assessment).

⁵⁹ There are many traditional stormwater management tools. Some of the most common are listed here.

⁶⁰ There are many natural or nature-based (or green/soft) infrastructure options. Some of the most common are listed here. See more examples [here](#). Natural or nature-based (or green/soft) infrastructure can be less expensive than hard-armoring but needs regular maintenance and monitoring. It has many benefits beyond sea level rise (and flood) protection. It can provide critical habitat, filter runoff, and preserve recreation opportunities and aesthetic value, (Grannis 2011). It may not be appropriate in areas with high wave energy, (Wetlands Watch).

- **Living Shorelines⁶¹** – “Any shoreline management system that is designed to protect or restore natural shoreline ecosystems through the use of natural elements and, if appropriate, manmade elements. Any elements used must not interrupt the natural water/land continuum to the detriment of the natural shoreline ecosystem,” (Restore America’s Estuaries 2015).
 - **Wetland Restoration⁶²** – “...allow[s] tidal wetlands to proliferate in areas that have been diked or otherwise altered from their original conditions,” (Reiblich, Wedding, Hartge 2017).
 - **Beach Nourishment/Replenishment⁶³** – “...the artificial placing of sand on a beach to replace eroded sand or to protect against future erosion,” (Reiblich, Wedding, Hartge 2017).
 - **Dune Management/Restoration** – “...an engineered project to restore eroded dune systems,” (Reiblich, Wedding, Hartge 2017).
 - **Sediment Management⁶⁴** – “A systems approach to deliberately manage sediments in a manner that maximizes natural and economic efficiencies to contribute to sustainable water resource projects, environments, and communities,” (U.S. Army Corps of Engineers).
- **Urban Greening for Stormwater Management⁶⁵** - the creation or improvement of green space in urban areas that increases groundwater recharge, reduces runoff, and improves urban watershed health.
 - **Limiting/Prohibiting/Removing Impervious Surfaces⁶⁶** – “In developed areas, impervious surfaces such as pavement and roofs prevent precipitation from naturally soaking into the ground. Instead, water runs rapidly into storm drains, sewer systems and drainage ditches and

⁶¹ For further clarity, NOAA defines living shorelines as, “... a broad term that encompasses a range of shoreline stabilization techniques along estuarine coasts, bays, sheltered coastlines, and tributaries. A living shoreline has a footprint that is made up mostly of native material. It incorporates vegetation or other living, natural “soft” elements alone or in combination with some type of harder shoreline structure (e.g., oyster reefs or rock sills) for added stability. Living shorelines maintain continuity of the natural land–water interface and reduce erosion while providing habitat value and enhancing coastal resilience,” (NOAA 2015).

⁶² Several other adaptation tools are typically used in conjunction with wetland restoration. These include: removing or prohibiting hard-coastal armoring, acquisition of land, creation of buffer zones or setbacks, and cluster development or compact development/design, (NOAA Office of Ocean and Coastal Resource Management 2010).

⁶³ Beach nourishment/replenishment requires regular nourishment and may have negative environmental impacts depending on the removal and replacement methods, (Grannis 2011). It can increase property values of beachfront properties and increase recreational areas, (Herzog and Hecht 2013; Wetlands Watch). It is a “band-aid,” short-term strategy and can encourage development in hazardous areas. Nourished/replenished beaches can erode 2-3 times quicker than natural beaches, (Wetlands Watch).

⁶⁴ Successful sediment management includes all levels of government and impacted stakeholders, (NOAA Office of Ocean and Coastal Resource Management 2010).

⁶⁵ There are many urban greening for stormwater management tools. Some of the most common are listed here. Urban greening projects have many benefits other than stormwater management and climate adaptation. These can include: improved water quality, reduced urban heat island effects, improved air quality, increased walkability, and increased neighborhood safety.

⁶⁶ Limiting/prohibiting impervious surfaces can also be categorized under building codes/design standards.

can cause: downstream flooding; stream bank erosion; increased turbidity from erosion; habitat destruction, combined storm and sanitary sewer system overflows; infrastructure damage; and contaminated streams, rivers and coastal water,” (EPA Mar 2017). Limiting or prohibiting impervious surfaces (i.e. traditional parking spaces) can reduce run-off.

- **Bioswales** – “...are storm water runoff conveyance systems that provide an alternative to storm sewers. They can absorb low flows or carry runoff from heavy rains to storm sewer inlets or directly to surface waters,” (Natural Resources Conservation Service 2005).
- **Rain Gardens** – “a depressed area in the landscape that collects rain water from a roof, driveway or street and allows it to soak into the ground. Planted with grasses and flowering perennials, rain gardens can be a cost effective and beautiful way to reduce runoff...” (EPA Jan 2017).

Appendix B: Tool Characteristics and Examples Matrix

See accompanying Excel Spreadsheet. Note: due to the formatting of the Excel spreadsheet, definitions and caveats for strategies and sub-tools/components are not included. Refer to Appendix A for strategy and sub-tool/components definitions and caveats.

Appendix C: Resources

[“2016 California Jurisdictions Addressing Climate Change”](#) (OPR)

[“Adaptation Action Areas: Policy Options for Adaptive Planning for Rising Sea Levels”](#) (South Florida Regional Planning Council)

[“Adaptation Guide”](#) (Wetlands Watch)

[“Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use”](#) (Jessica Grannis)

[“Adapting to Climate Change: A Planning Guide for State Coastal Managers”](#) (NOAA Office of Ocean and Coastal Resource Management)

[“Adapting to the Impacts of Climate Change”](#) (The National Academies Press)

[“Advancing Climate Justice in California: Guiding Principles and Recommendations for Policy and Funding Decisions”](#) (Climate Justice Working Group)

[“ART Approach”](#) (BCDC’s ART Program)

[“Assessing the Feasibility of Adaptation Options”](#) (NOAA Office for Coastal Management)

“Bonus Points: CRS Potential in the GCC Model Sea-Level Rise Ordinance (DRAFT)” (Emily Maus and Jessica Grannis)

[California 4th Climate Assessment \(forthcoming\)](#)

[“Climate Adaptation Policy and Guidance Documents”](#) (OPR)

[“Climate Adaptation: The State of Practice in U.S. Communities”](#) (The Kresge Foundation and Abt Associates: Jason Vogel et al)

[“Climate Change Policies Fact Sheet”](#) (BCDC)

[“Climate Exactions”](#) (J. Peter Byrne and Kathryn A. Zyla)

[“Coastal Adaptation Strategies Handbook”](#) (National Park Service, Department of the Interior)

[“Combatting Sea-Level Rise in Southern California: How Local Governments Can Seize Adaptation Opportunities While Minimizing Legal Risk”](#) (Megan M. Herzog and Sean B. Hecht)

[“Cost-Efficient Climate Change Adaptation in the North Atlantic”](#) (Judd Schechtman and Michael Brady)

[“Dedication of Land in California”](#) (Loyd P. Derby)

[“Developing a Model Ordinance for California Local Governments to Integrate Sea-Level Rise Adaptation into Existing Land Use Plan”](#) (Sean Hecht and Megan Herzog)

[“Enabling and Limiting Conditions of Coastal Adaptation: Local Governments, Land Uses, and Legal Challenges”](#) (Jesse Reiblich, Lisa M. Wedding, Eric H. Hartge)

[“Exactions and Impact Fees”](#) (University of Florida Law School)

[“Executive Summary and Action Matrix from Sea-Level Rise and Coastal Land Use in Hawai’i: A Policy Tool Kit for State and Local Governments”](#) (University of Hawai’i Sea Grant Program – Center for Island Climate Adaptation and Policy), Full report [here](#).

[“Executive Summary – Zoning for Sea-Level Rise: A Model Sea-Level Rise Ordinance and Case Study of Implementation Barriers in Maryland \(DRAFT\)”](#) (Jessica Grannis), Full report [here](#).

[“Final Rising Sea Level Policy Recommendations”](#) (BCDC)

[“Flood Protection Pay-Offs: A Local Government Guide to the Community Rating System”](#) (Shannon Hulst Jarbeau and Mary-Carson Stiff)

[“Guidance for Considering the Use of Living Shorelines”](#) (NOAA)

[“ICARP Adaptation Clearing House”](#) (OPR)

[“Implementing Climate Change Adaptation: Lessons Learned from Ten Examples”](#) (Headwaters Economics)

[“Legal Risk Analysis and Policy Template”](#) (Resilient Coastlines Project of Greater San Diego)

[“Lessons Learned on Local Climate Adaptation from the Urban Leaders Adaptation Initiative”](#) (The Center for Clear Air Policy: Josh Foster, Steve Winkelman, Ashley Lowe)

[“Living Shorelines: From Barriers to Opportunities”](#) (Restore America’s Estuaries)

[“Local Governments Feel the Heat: Principles for Local Government Adaptation to the Impacts of Climate Change”](#) (Sean Hecht)

[“Local Land Use Response to Sea Level Rise”](#) (Land Use Law Center, Pace University School of Law)

[“National Flood Insurance Program - Community Rating System Coordinator’s Manual”](#) (FEMA)

[“Performance of Natural Infrastructure and Nature-based Measures as Coastal Risk Reduction”](#)
(Environmental Defense Fund: Shannon Cunniff and Aaron Schwartz)

[“Plan Integration: Linking Local Planning Efforts”](#) (FEMA)

[“Policies for a Rising Bay Project”](#) (BCDC)

[“Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments”](#) (The Climate Impacts Group, Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, and King County, WA, ICLEI)

[“Preparing for Climate Impacts – Lessons from the Front Lines: A Synthesis Report to The Kresge Foundation”](#) (Jessica Grannis et al)

[“Regional Resilience Framework \(DRAFT\)”](#) (FEMA, U.S. EPA, ABAG)

[“Residential Adaptation Policy Guide: Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs \(DRAFT\)”](#) (California Coastal Commission)

[“RiskMAP”](#) (FEMA)

[“Rising Seas in California: An Update on Sea-Level Rise Science”](#) (Gary Griggs et al)

[“Rolling Easements Primer”](#) (EPA)

[“SF Bay Area Sea Level Rise Stakeholder Group: Meeting Notes”](#) (Climate Readiness Institute: Bruce Riordan)

[“Sea Level Rise Adaptation: Emerging Lessons for Local Policy Development”](#) (Barbara J. Lausche and Luke A. Maier)

[“Sea Level Rise Guidance: Interpretive Guidelines for Addressing Sea Level Rise in Local Coastal Programs and Coastal Development Permits”](#) (California Coastal Commission)

[“Statewide Sea Level Rise Vulnerability Synthesis”](#) (California Coastal Commission)

[“Strategies for Making Sea-Level Rise Adaptation Tools ‘Takings-Proof’”](#) (Michael Allen Wolf)

[“Synopsis of an Assessment: Policy Tools for Local Adaptation to Sea Level Rise”](#) (Barbara J. Lausche)

[“Synthesis of Adaptation Options for Coastal Areas”](#) (EPA)

[“Taking Background Principles Seriously in the Context of Sea-Level Rise”](#) (Sean B. Hecht)

[“The Governance Gap: Climate Adaptation and Sea-Level Rise in the San Francisco Bay Area”](#) (Mark Lubell)

[“The Great American Adaptation Road Trip: Lessons Learned about how Hometowns across the United States are Building their Resilience to Climate Change”](#) (Allie Goldstein and Kirsten Howard)

[“The Public Trust Doctrine: A Guiding Principle for Governing California’s Coast Under Climate Change”](#)
(Center for Ocean Solutions)

[“The State of Adaptation in the United States: An Overview”](#) (Lara Hansen et al)

[“Virginia Case Study – Stemming the Tide: How Local Governments Can Manage Rising Flood Risks”](#)
(Andrew C. Sifton and Jessica Grannis)

[“What is a pathways approach to adaptation?”](#) (CoastAdapt)