

# **Options for Implementing the Hawai'i State Planning Act Climate Change Adaptation Priority Guidelines**

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**Coastal Resilience Networks (CRest) Project**

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## **Note and Disclaimer**

This draft report is intended for distribution to and review by the State of Hawai'i Office of Planning Ocean Resources Management Plan (ORMP) Working Group, Integrated Planning Committee, and the county planning departments. This draft report does not represent the official position of the State of Hawaii Office of Planning at this time. The report is a starting point for further developing and implementing climate change, and particularly sea-level rise, adaptation guidance at the state and county levels. The project is funded by the Coastal Resilience Networks (CRest) Grant Program, grant number NA11NOS4730130.

# Executive Summary

Climate change has emerged as a significant consideration in planning for Hawai'i's environmental, social, and economic future. Recognizing the need to address current and future climate change impacts, in 2012 the Hawai'i State Legislature amended the Hawai'i State Planning Act (HSPA) to incorporate a new section, "Climate change adaptation priority guidelines," which sets forth ten specific guidelines to aid climate change adaptation efforts in Hawai'i (CCA Priority Guidelines).

The purpose of this report is to present to the Ocean Resources Management Plan (ORMP) Integrated Planning Committee of the State of Hawai'i Office of Planning (OP), and to Hawai'i's four Counties (i.e., City and County of Honolulu, County of Hawai'i, County of Kauai, and County of Maui), a preliminary discussion of potential options for implementing the CCA Priority Guidelines through planning and regulatory measures. Based in part on interviews with key State and County government agency personnel conducted in 2012, this report seeks to identify and assess a suite of management tools and related planning and regulatory options. These tools may aid not only in implementing the CCA Priority Guidelines, but may also contribute toward the development of a first-generation climate change adaptation strategy for Hawai'i.

The options presented in this report are not exhaustive and are intended to facilitate dialogue that will contribute to climate change adaptation guidance, with a special focus on sea-level rise. The options must undergo further prioritization, refinement, and adjustment to the land use management process of each County prior to implementation. In addition, issues such as cost, resource allocation, and administrative feasibility must be more thoroughly identified and addressed.

Part A of this report focuses on opportunities to incorporate adaptation into County-level comprehensive planning. After first providing an overview of Hawai'i's multi-tiered planning regime, Part A assesses the ability of County development plans to implement the CCA Priority Guidelines; highlights the 2011 North Shore Sustainable Communities Plan for the City and County of Honolulu as an example of a "no-regrets" approach for addressing climate change in County development planning processes; and concludes with suggested adaptation implementation tools for evaluating and updating plans.

Part B presents options for implementing the CCA Priority Guidelines through the County-administered special management area permit programs, shoreline setback laws, and flood ordinances, and also the State environmental review and land use districting processes. The order in which these potential options are discussed corresponds to the likely need for ordinance, rule, or statutory amendments.

The following is a summary of the specific options to implement the CCA Priority Guidelines, with a particular focus on sea-level rise (SLR), which are identified and discussed in this report:

## County-Level Comprehensive Planning

1. Evaluate the extent to which current plans address climate change impacts (Appendix A.1).
2. Incorporate policies and priority guidelines regarding climate change impacts, generally, and sea-level rise, in particular, into plans (Appendix A.2).

## SMA Permit Program

3. Use the model SMA permit evaluation checklist (Appendix B.1) as a component of the SMA permit application and review process.

### **Shoreline Setback Laws**

4. Develop a model shoreline setback ordinance that accounts for accelerated shoreline erosion due to future sea-level rise based upon the available methods.
5. In evaluating shoreline variance applications, consider the model guidance for “hardship” variance evaluation (Appendix B.2).

### **Floodplain Regulations**

6. Work with FEMA to update federal flood insurance maps to incorporate best-available information on climate change and sea-level rise, eventually including a 100-year storm event under future sea-level rise scenarios.
7. Apply 100-year floodplain regulations to 500-year floodplain.
8. Develop building standards in the existing 100-year floodplain that are more protective than the federal minimum standards.
9. Adopt or expand county-administered community rating system programs.
10. Develop an overlay zone adjacent to existing special flood hazard areas by overlaying sea-level rise inundation maps with federal flood insurance maps.

### **Environmental Review**

11. When evaluating a project under the “significance” criteria, consider whether a proposed action is likely to suffer damage or exacerbate impacts from climate change and sea-level rise based upon a climate change hazard assessment (Appendix B.3).
12. When considering project alternatives, evaluate relocation, elevation, and “soft” protection.
13. When proposing mitigation measures, incorporate climate-resilient precautions.

### **State Land Use Classification**

14. Require climate change hazard assessments (Appendix B.3) in Land Use District boundary amendment petitions. Exempt smaller projects or repairs that do not increase risks to public safety.
15. For approved boundary amendments, require safety buffers that run with the land along seaward boundaries and around natural inundation buffers, as necessary. Permit low-impact activities, such as access, within the buffer zones.
16. Based on assessment of climate change impacts, risks, and vulnerabilities, include recommendations for reclassifying lands, where appropriate, to protect public health and safety; also, include options for compensating landowners or incentivizing landowners to relocate.

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# Introduction and Overview

*The time for a long-term statewide plan for the effects of our changing climate is now.*

- Governor Neil Abercrombie, March 2012

The purpose of this report is to present to ORMP, OP and the Counties a preliminary discussion of potential options for implementing the CCA Priority Guidelines. Based in part on interviews with key State and County government agency personnel conducted in 2012, this report seeks to identify and assess a suite of management tools. These tools may aid not only in implementing the CCA Priority Guidelines, but may also serve as an effective first-generation sea-level rise adaptation strategy for Hawai'i. The options presented in this report are not exhaustive and are intended to facilitate dialogue that will contribute to sea-level rise adaptation guidance. The options must undergo further prioritization, refinement, and adjustment to the land use management process of each County prior to implementation. In addition, issues such as cost, resource allocation, and administrative feasibility must be more thoroughly identified and addressed.

## Climate Change Indicators and Impacts

It is widely acknowledged that climate change is a significant consideration in planning for Hawai'i's environmental, social, and economic future. For example, the December 2012 Pacific Islands Regional Climate Assessment (PIRCA) study, *Climate Change and Pacific Islands: Indicators and Impacts*, reports several notable indicators of climate change in Hawai'i and the Pacific Island region:

- Carbon dioxide (CO<sub>2</sub>) concentrations are rising.
- Surface air temperature is rising.
- Sea level is rising.
- Sea-surface temperature is rising.
- Upper-ocean heat content is rising (stratification is changing).
- Ocean chemistry is changing.
- Rainfall amount and distribution are changing.
- Stream base flow is decreasing.
- Winds and waves are changing.
- Extremes are changing (e.g., drought, rainfall, coastal inundation).
- Habitats (and species distributions) are changing.<sup>1</sup>

In Hawai'i, these climate shifts will continue to contribute to increased coastal erosion and coastal flooding, and associated damage to property, infrastructure, and coastal economic activity; increased exposure to droughts and storms; and uncertainty about the availability, quality, and costs of water – among other likely impacts.<sup>2</sup> In a letter to the PIRCA team, Governor Neil Abercrombie acknowledged that there is sufficient scientific evidence to indicate that Hawai'i must begin comprehensively preparing for climate change. Affirming that “[t]he time for a long-term statewide plan for the effects of our changing climate is now”,<sup>3</sup> Gov. Abercrombie's letter emphasized the need for preservation of fresh

water resources and minimization of the impacts of drought; sustaining aquatic and terrestrial ecosystems; and fostering community resilience to the impacts for sea-level rise.

## **CCA Priority Guidelines: Toward an Emerging Hawai'i Statewide CCA Strategy**

The CCA Priority Guidelines mark a critical development in the area of climate change adaptation policy in Hawai'i and appear well suited to contribute toward the development of a statewide climate change adaptation plan (CCA Strategy). Accordingly, the options assessed in this are intended to serve not only near-term implementation of the CCA Priority Guidelines, but also development of a CCA Strategy for the State over the longer term.

The CCA Guidelines set forth the following ten priority guidelines:

1. "Ensure that Hawaii's people are educated, informed, and aware of the impacts climate change may have on their communities;
2. "Encourage community stewardship groups and local stakeholders to participate in planning and implementation of climate change policies;
3. "Invest in continued monitoring and research of Hawaii's climate and the impacts of climate change on the State;
4. "Consider native Hawaiian traditional knowledge and practices in planning for the impacts of climate change;
5. "Encourage the preservation and restoration of natural landscape features, such as coral reefs, beaches and dunes, forests, streams, floodplains, and wetlands, that have the inherent capacity to avoid, minimize, or mitigate the impacts of climate change;
6. "Explore adaptation strategies that moderate harm or exploit beneficial opportunities in response to actual or expected climate change impacts to the natural and built environments;
7. "Promote sector resilience in areas such as water, roads, airports, and public health, by encouraging the identification of climate change threats, assessment of potential consequences, and evaluation of adaptation options;
8. "Foster cross-jurisdictional collaboration between county, state, and federal agencies and partnerships between government and private entities and other non-governmental entities, including nonprofit entities;
9. "Use management and implementation approaches that encourage the continual collection, evaluation, and integration of new information and strategies into new and existing practices, policies, and plans; and
10. "Encourage planning and management of the natural and built environments that effectively integrate climate change policy."<sup>4</sup>

These guidelines can contribute toward a CCA Strategy, in part because under the HSPA priority guidelines "shall take precedence when addressing areas of statewide concern,"<sup>5</sup> including not only State and County decision-making and allocation of resources, state functional plans, county general plans and development plans, state programs, fund appropriation, but also capital improvement project appropriations, state budgetary review, and state land use decision-making.<sup>6</sup>

A climate change adaptation strategy is a set of public and private actions designed to increase community resilience and reduce vulnerability to climate change-related threats. Developing a climate change adaptation strategy involves anticipating future impacts on human society and ecosystems and acting to prevent or mitigate them. A strategy can coordinate climate adaptation efforts statewide under a coherent planning framework and timeline while allowing for local variation.

A Hawai'i CCA Strategy may draw on current and past climate adaptation efforts in Hawai'i, as summarized in Appendix 1, and may also be modeled on successful climate change and sea-level rise adaptation statewide plans adopted in other states. A review of climate change adaptation strategies from other states indicates that these states are:

- Designating lead agencies or task forces to develop adaptation strategies and adaptation plans;
- Encouraging and supporting climate change scientific research and technical analyses;
- Developing state and local strategies and plans designed to address specific climate change threats such as sea-level rise;
- Demarcating potential sea-level rise impact areas based on best-available analysis;
- Designing tools for conducting climate change vulnerability assessments; and
- Considering changes to state and local land use management tools, such as hazard zoning.

The CCA Priority Guidelines may have many elements in common with an emerging Hawai'i CCA Strategy, and developing mechanisms to implement the CCA Priority Guidelines may serve as a starting point for weaving climate change considerations into state and local management processes in a more comprehensive and strategic manner.

## **Phased Approach to Climate Change Adaptation**

This report advocates for a phased approach in implementing the CCA Priority Guidelines consistent with the understanding that climate change impacts, such as sea-level rise and coastal flooding, will intensify over the ensuing decades. A phased approach to climate change adaptation allows communities, policymakers, planners, businesses, coastal residents, and landowners to focus on certain geographical areas and planning and regulatory measures first, and to implement and modify subsequent measures as technical information, knowledge and experience with adaptation develops and improves. Although adaptation will be a continuous process, this report identifies three specific adaptation phases.

### **Phase 1**

Phase 1 focuses on sea-level rise (SLR). Modest changes achieved through existing land use management plans and programs which currently address coastal erosion, sea-level rise, storm surge, and coastal flooding are assessed. The proposed changes rely primarily on existing technical information and analyses. Most can be accomplished by adjusting existing land use management processes, increasing community outreach. In some instances it may be necessary to amend agency rules or statutes. Phase 1 offers low-cost, "no regrets" options appropriate for a range of future climate scenarios.

### **Phase 2**

Phase 2 initiatives assume increased exposure to sea-level rise, storm surge, coastal flooding, and ground water intrusion. Phase 2 measures will require additional technical information and analysis,



including county-level vulnerability assessments with community input. Phase 2 management initiatives may include a range of adaptation tools such as modified building codes in affected areas, more restrictive hazard zoning, changes to land use and infrastructure policies, and incentives to encourage relocation. Phase 2 may also entail installing structures to protect critical infrastructure in nearshore areas, enhanced warning and evacuation systems, and government transfer or purchase of development rights. For Phase 2 measures, State and County agencies such as the Department of Land and Natural Resources (DLNR), Department of Transportation (DOT), and Department of Transportation Services (DTS) may develop plans to further implement the CCA Priority Guidelines that are coordinated with County general plans (GPs) and development plans (DPs). Phase 2 also assumes greater coordination with the private sector, including transportation, energy, communications, medical services, food distribution, and visitor industries.

### **Phase 3**

Phase 3 initiatives assume that trends in climate change and sea-level rise will reach a stage requiring major protection and relocation in some areas of the state. Phase 3 would necessitate a comprehensive approach to adaptation that involves more stringent building codes, hazard zoning, and other management tools within a designated sea-level rise impact area. Protective measures for critical infrastructure and other land uses may be necessary in some areas and not cost-effective in other areas. Designating buffers or “no-build” areas, and developing public and private support for relocation of structures, may be appropriate under certain circumstances. Managing the transformation of appropriate coastal areas by the end of the century would require careful analysis, planning, and interaction with communities to ensure a fair and legitimate approach. Finally, a comprehensive approach to climate change adaptation would require planning for facilities and services such as water, energy, and transportation. Such planning should promote greater flexibility and diversity to withstand a variety of climate conditions and greater redundancy and modularity to withstand unexpected service demands and extreme climate events.

This report focuses on Phase 1 options for implementing the CCA Priority Guidelines.

## **Phase 1 “No Regrets” Strategies for Implementing the CCA Priority Guidelines to Address SLR**

Figure 1 of this report, below, identifies sea-level rise adaptation tools for Hawai‘i from in various preceding studies. Building on the results of these prior studies, next steps have included working with State and County agencies to identify and tailor specific sea-level rise management tools to implement the CCA Priority Guidelines consistent with the agencies’ management requirements. This report is based upon this research and consultations.

Part A focuses on opportunities to incorporate climate change adaptation, particularly with regard to SLR, into County-level comprehensive planning. After first providing an overview of Hawai‘i’s multi-tiered planning regime, Part A assesses the ability of County development plans to implement the CCA Priority Guidelines; highlights the 2011 North Shore Sustainable Communities Plan for the City and County of Honolulu as an example of a “no-regrets” approach for addressing climate change in County development planning processes; and concludes with suggested adaptation implementation tools for evaluating and updating plans.

Part B presents options for implementing the CCA Priority Guidelines through the County-administered special management area permit programs, shoreline setback laws, and flood ordinances, and also the

State environmental review and land use districting processes. The order in which these potential options are discussed corresponds to the likely need for ordinance, rule, or statutory amendments.

### **Figure 1. Preceding Climate Change and Sea-Level Rise Adaptation Studies**

Ocean Resources Management Plan (ORMP) Working Group & University of Hawai'i (UH) Center for Island Climate Adaptation and Policy (ICAP), *A Framework for Climate Change Adaptation in Hawaii* (2009).

ICAP, *Shoreline Impacts, Setback Policy & Sea Level Rise* (2009).

Chip Fletcher, ICAP, *Hawaii's Changing Climate: Briefing Sheet, 2010* (2010).

Douglas Codiga, Dennis Hwang & Chris Delaunay, ICAP, *Climate Change and Regulatory Takings in Coastal Hawai'i* (2011).

Douglas Codiga & Kylie Wager, ICAP, *Sea-Level Rise and Coastal Land Use in Hawai'i: A Policy Tool Kit for State and Local Governments* (2011).

The specific options identified and discussed in this report were selected based upon criteria identified by State and County government agency personnel. These criteria include relevance to the climate change adaptation priority guidelines, perceived effectiveness as expressed by state and county planners and decision-makers, low regulatory and administrative costs relative to other measures, sufficiently robust to address a range of future climate conditions, easily adjusted in light of updated technical information, and consistent with the existing state and county institutional framework. The options are as follows:

#### **County-Level Comprehensive Planning**

1. Evaluate the extent to which current plans address climate change impacts (Appendix A.1).
2. Incorporate policies and priority guidelines regarding climate change impacts, generally, and sea-level rise, in particular, into plans (Appendix A.2).

#### **SMA Permit Program**

3. Use the model SMA permit evaluation checklist (Appendix B.1) as a component of the SMA permit application and review process.

#### **Shoreline Setback Laws**

4. Develop a model shoreline setback ordinance that accounts for accelerated shoreline erosion due to future sea-level rise using one or more of the available methods.
5. In evaluating shoreline variance applications, consider the model guidance for "hardship" variance evaluation (Appendix B.2).

#### **Floodplain Regulations**

6. Work with FEMA to update federal flood insurance maps to incorporate best-available information on climate change and sea-level rise, eventually including a 100-year storm event under future sea-level rise scenarios.
7. Apply 100-year floodplain regulations to 500-year floodplain.
8. Develop more protective building standards in existing 100-year floodplain than the federal minimum standards.
9. Adopt or expand county-administered community rating system programs.

10. Develop an overlay zone adjacent to existing special flood hazard areas by overlaying sea-level rise inundation maps with federal flood insurance maps.

#### **Environmental Review**

11. When evaluating a project under the “significance” criteria, consider whether a proposed action is likely to suffer damage or exacerbate impacts due to climate change and sea-level rise, as indicated by a climate change hazard assessment (Appendix B.3).
12. When considering project alternatives, evaluate relocation, elevation, and “soft” protection.
13. When proposing mitigation measures, incorporate climate-resilient precautions.

#### **State Land Use Classification**

14. Require climate change hazard assessments (Appendix B.3) in Land Use District boundary amendment petitions. Exempt smaller projects or repairs that do not increase risks to public safety.
15. For boundary amendments, require safety buffers that run with the land along seaward boundaries and around natural inundation buffers, as necessary. Permit low-impact activities, such as access, within the buffer zones.
16. Based on assessment of climate change impacts, risks, and vulnerabilities, include recommendations for reclassifying lands, where appropriate, to protect public health and safety; also, include options for compensating landowners or incentivizing landowners to relocate.

# Part A: Options for Climate Change Adaptation in Comprehensive Planning

This Part discusses opportunities for integrating climate change adaptation into county and community planning efforts. Such integration not only implements the CCA Priority Guidelines but also strengthens efforts to implement climate change adaptation through land use regulations, as discussed in Part B of this report. For example, the special management area permit program and environmental review and land use classification processes all require a degree of consistency with comprehensive plans.

This Part begins with an overview of Hawai'i's multi-tiered planning regime and recommends county development plans as a primary mechanism to adapt to climate change. Next, this Part offers the 2011 North Shore Sustainable Communities Plan as an example of a “no-regrets” approach to address climate change in planning. Finally, planning tools for adaptation, which are summarized in Appendix A, are briefly reviewed and assessed.

## 1. County General Plans and Development Plans

Each of Hawai'i's four Counties is required to prepare a General Plan (GP)<sup>7</sup> that provides the guiding framework for all regulatory decisions, capital improvement projects, plans, and programs within the county. The county GPs must address the applicable provisions of the Hawai'i State Planning Act, HRS Chapter 226.<sup>8</sup>

County GPs must be consistent with the State Plan, formulated with input from State and County agencies and the general public, and must contain interagency coordination provisions.<sup>9</sup> GPs are intended to coordinate and establish a coherent set of broad guidelines for guiding county plans, programs, infrastructure development, and implementing regulations. As such, it is important that the GPs include language identifying climate change as a significant consideration in land-use planning.

Additional options for incorporating climate change adaptation in the GPs include, where applicable:

- Identifying climate change impacts of local concern in the introductory and/or analysis sections;
- Adding climate adaptation goals, objectives, and policies to the appropriate chapters and/or sections; and
- Drafting climate adaptation strategies and best practices into policies, standards, and implementation measures for the course of action section.

The HSPA requires GPs to address certain items. The material in brackets is intended to suggest how, in concept, these items might address climate change adaptation.

- Identifying [hazards and climate impacts as part of] the unique problems and needs of each county and regions within each county;
- Define applicable provisions to the state plan [specifically noting the CCA Priority Guidelines];
- Use sound rationale, [climate] data, analyses, and input from state and county agencies and the general public;
- Include [climate adaptation] objectives to be achieved and [climate adaptation] policies to be pursued with respect to population density, land use, transportation system location, public and community facility locations, water and sewage system locations, visitor destinations, urban

design, and all other matters necessary for the coordinated development of the county and regions within the county;

- [Referencing climate impacts in] indicating the desired physical development patterns for each county and regions within each county;
- Include implementation priorities and actions to carry out [climate adaptation] policies to include but not be limited to land use maps, programs, projects, regulatory measures, standards and principles, and interagency coordination provisions.<sup>10</sup>

County development plans (DPs), community development plans (CDPs), community plans (CPs), and sustainable communities plans (SCPs) (collectively, DPs) are regional land use plans that comprise the second tier of the county planning framework.<sup>11</sup> DPs relate broad GP policy statements into region-specific implementation actions. Most DPs operate under a twenty- to twenty-five-year planning horizon. In addition, the counties prepare functional plans, i.e., public facility plans, to address infrastructure requirements and investment priorities.

Zoning, subdivision ordinances, building codes, and other local land use development regulations serve as tools for implementing DP policies. Similar to the GPs, the DPs are prepared and updated, typically every five or ten years, under the direction of the county planning departments through a participatory community planning process, subject to review and approval by the appropriate County or City Council. In general, there are similarities among the subject areas addressed in the DPs, including the location of development for residential, commercial, and industrial uses; agriculture; public facilities and infrastructure; natural and cultural/historic resources; recreation and open space resources; economic strategies; and capital improvement priorities.

Among planning strategies, DPs are recommended as the first-step strategy for implementing climate change adaptation for the following reasons:

- DPs build upon and utilize existing institutional arrangements that are already understood and regarded as legitimate, or “work with the grain.” This is likely to be very important in creating political support for a more directive climate change agenda.
- Identifying DP policies and guidelines that implement a climate adaptation allows us to address a broader range of land use and infrastructure development activities relevant to climate change, including agriculture.
- Focusing on DPs allows for local variation—an important principle of adaptation. Rather than imposing “top-down” adaptation directives, community participants who work with county consultants can identify policies and guidelines that are particularly relevant to specific coastal environments or regional concerns. Locally identified policies and guidelines targeted to address locally defined climate change problems are more likely to be “owned” by local residents.
- Locally defined policies and guidelines allow for experimentation in adaptation. Because the plans are regularly revised, we can carefully monitor and evaluate specific policies and guidelines embedded in the community plans.
- Focusing on DP policies and guidelines allows us to engage a broader set of implementing agencies. Although the county planning offices and county councils are the primary implementing agencies because they are responsible for assessing major land use proposals as they relate to DP policies and guidelines, other agencies such as the Board of Water Supply

(BWS), the U.S. Army Corps of Engineers (Army Corps), DLNR, and others are responsible for implementing DP policies and guidelines under some circumstances.

- Using the DPs as a major part of the first phase of a comprehensive climate change adaptation strategy arguably makes it less important to identify a climate change impact area in the first phase. For example, the DP guideline to “require all structural and land improvements to provide adequate drainage and flood mitigation measures to reduce storm runoff and flood hazard” could apply throughout a watershed, not just in near-shore areas. Essentially, such an approach allows decision-makers and planners to begin implementing best practices for addressing climate change-related impacts in the absence of scientific certainty or the political will to “draw a line” along the shore.

Given their geographic nature and their ability to guide land use planning and decision-making, both GPs and DPs are ideal mechanisms for incorporating region-specific vulnerabilities delineated on maps, such as coastal erosion or sea-level rise impact areas.

The DPs for each County differ in format, detail, and form, as do the planning frameworks and organizational structures used to update the plans. In addition, each DP is unique because these plans typically represent the community’s long-term vision. Although the CCA Priority Guidelines “serve as a guiding policy for adapting to the expected impacts of climate change through all state and county activities,”<sup>12</sup> including county GPs and DPs, differences in approaches to planning in the content and complexity of plans suggests different approaches by the Counties may be necessary and appropriate. Counties may, however, be expected to incorporate the CCA Priority Guidelines into regular updates to DPs and GPs over time.

## **2. North Shore Sustainable Communities Plan: A “No-Regrets” Approach**

The 2011 North Shore SCP for the City and County of Honolulu may serve as a model for using DPs to implement the climate change adaptation priority guidelines. Although other DP planning efforts in Hawai’i are proposing to use sea-level rise or climate-related hazard language more directly,<sup>13</sup> the North Shore SCP is an example of how climate change adaptation goals may be met indirectly, by crafting policies to address other local interests, such as sustainability, community resilience, and natural hazard preparedness. This “no-regrets” approach to climate change adaptation may be used to identify actions that fulfill multiple goals and which will be beneficial even if climate change impacts turn out to be less severe than currently estimated. A “no-regrets” approach also may be used to develop first-generation actions for integrating climate analysis and adaptation into community-level planning.<sup>14</sup>

This section illustrates the North Shore SCP’s policy hierarchy and highlights potential climate change adaptation policy language that has been incorporated into the SCP. A number of DPs from throughout the state now include similar elements and language.

### **2.1. North Shore Plan Organization**

The North Shore SCP is somewhat similar in structure and content to other DPs prepared by other counties in Hawai’i. The 183-page document contains five main chapters: (1) the North Shore’s Role in O’ahu’s Development Pattern; (2) The Vision for the North Shore’s Future; (3) Land Use Policies and Guidelines; (4) Public Facilities and Infrastructure Policies and Guideline; and (5) Implementation.<sup>15</sup>

Chapter 1, “North Shore’s Role in O‘ahu’s Development Pattern,” summarizes existing land uses, demographic trends affecting the area, and general policies, such as maintaining the area’s rural character, that are intended to guide future land uses in the area.<sup>16</sup> Chapter 2, “The Vision for the North Shore’s Future,” includes a general vision statement for the area and ten “vision elements,” called “principles” in some other DPs. One of the “vision elements” is to “Integrate Principles of Sustainability into Decision-Making Processes.”<sup>17</sup> Another is to “Adapt the *Ahupua‘a* Concept as a Framework for Land Use and Natural Resource Management.”<sup>18</sup> In future versions of the plan, additional vision elements could relate to strengthening coastal resilience or ensuring attention to the impacts of climate change. Chapter 3 identifies the land use policies and guidelines for ten major land use categories and multiple sub-categories: open space and natural environment; agriculture; parks and recreation; historic and cultural resources; residential communities; commercial areas; industrial areas; visitor accommodations; and institutional uses.<sup>19</sup> Several of the major land use categories have sub-categories. Of particular interest are the sub-categories under open space and environment, which includes shoreline areas; wetlands; natural gulches streams and drainageways; agricultural areas, parks, scenic resources, and scenic views; and utility corridors and greenways.<sup>20</sup> Under the parks and land use category there is a sub-category for beach parks and shoreline areas.<sup>21</sup> Chapter 4, “Public Facilities and Infrastructure Policies and Guidelines,” contains policies and guidelines intended to indicate how the development, operation, and maintenance of public facilities and infrastructure should be implemented. The plan focuses on the following nine systems: transportation systems; water systems; wastewater treatment; electrical systems; solid waste handling and disposal; drainage systems; school facilities; public safety facilities; and other community facilities.<sup>22</sup>

Finally, Chapter 5, Implementation, provides guidance to implement the policies and guidelines presented in Chapters 3 and 4. As the North Shore SCP indicates, the City and County of Honolulu implements the SCPs by:

- Initiating zoning map and development code amendments to achieve consistency with the policies and guidelines of the SCP;
- Guiding public investment in infrastructure through Functional Plans and Special Area Plans which support the vision of the SCP;
- Reviewing zoning and other development applications based on how well they support the vision;
- Incorporating SCP priorities through the Public Infrastructure Map and the City’s annual budget process; and
- Conducting a review of the vision, policies and guidelines, and Capital Improvement Program (CIP) priority investments of the North Shore SCP every five years and recommending revisions as necessary.<sup>23</sup>

Chapter 5 also contains a matrix listing 272 policies and guidelines developed for the North Shore SCP. For each policy or guideline, the specific regulatory code, functional plan, or other action is indicated in the second column of the matrix. The third column identifies the agency responsible for implementation, and the fourth column indicates the specific role of the agency in the implementation process.<sup>24</sup>

## 2.2. North Shore SCP and Implementation of the CCA Priority Guidelines

The North Shore SCP policies and guidelines on Open Space and Natural Environment, Shoreline Areas, and Drainageways illustrate several ways in which the DPs could implement the CCA Priority Guidelines using a “no-regrets” approach.

### *Open Space and Natural Environment*

Four of the fifteen policies related to the land use category Open Space and Natural Environment are directly or indirectly related to climate change adaptation:

- Protect and enhance significant natural features and ecologically sensitive lands, including mountain areas, shoreline areas, wetlands, fishponds, natural gulches, streams and drainageways. Provide protective **buffer** zones and setbacks around biologically sensitive areas to minimize habitat disturbance.
- Establish adequate shoreline setbacks that consider shoreline changes resulting from erosion hazards and rising sea levels using data such as the annual average erosion rate from the UH shoreline erosion studies.
- Base governmental expenditures for natural resources management and protection, including shoreline maintenance and improvements, on actual site usage (including visitors) rather than on resident population ratios or land values.
- Improve and enhance access to mountain and shoreline recreational areas by obtaining use of Federal and State lands and waters and acquiring available excess lands.<sup>25</sup>

### *Shoreline Areas*

The North Shore SCP section on Shoreline Areas includes the following adaptation-oriented guidelines:

- Preserve rare and sensitive coastal resources including coastal strand vegetation, sand dunes, and anchialine pools. Establish buffer zones around these areas where necessary.
- Protect nearshore coral reefs and other marine life from damaging activities such as soil erosion, nonpoint source pollution, dredging of coral reefs, and alterations to nearshore water circulation.
- Support research to determine causes of coastal erosion and identify appropriate management strategies to avoid future erosion hazards.
- Encourage interagency coordination and public/private cooperation in developing and implementing beach management plans, with an emphasis on nonstructural approaches.
- Discourage development or activities that result in beach loss, and encourage development practices or activities such as increased shoreline setbacks which result in beach preservation or enhancement.
- Require buildings along the shoreline to adhere to the City’s and Federal Emergency Management Agency (FEMA) minimum building elevations and structural guidelines. In addition, adopt development standards that require new structures to incorporate building styles compatible with coastal hazards such as coastal erosion, tsunami and hurricane over wash.



- Place sand from channel, stream, and harbor mouth dredging projects on local beaches in accordance with HRS Chapter 205A.<sup>26</sup>

### *Drainage Systems*

Finally, several drainage system policies are relevant to climate change adaptation:

#### Policies:

- Improve drainage systems in the region to provide adequate protection from flooding and protect the quality of nearshore waters.
- Encourage coordination between public agencies and private landowners to identify needed drainage improvements and develop a phased plan for improvements.
- To the extent possible, integrate planned improvements to the drainage system into the regional open space network.
- Maintain the waters of Waialua Bay, which is designated by the State Department of Health (DOH) as Class AA waters, in as natural and pristine state as possible.
- Administer and enforce zoning controls to restrict future development within identified floodway, flood fringe, coastal high hazard, tsunami inundation areas, and general flood plain districts.
- Require property owners to elevate existing structures above the regulatory flood elevation or relocate to sites beyond flood prone areas.<sup>27</sup>

#### Guidelines:

- Require all structural and land improvements to provide adequate drainage and flood mitigation measures to reduce storm runoff and flood hazard.
- Employ retention and detention methods that allow for the gradual release of storm water. Where feasible, use open spaces, including parking lots, landscaped areas, and parks, to detain or allow ground infiltration of storm water flows to reduce their volume, runoff rates, and the amounts of sediment and pollutants transported.
- Use detention/retention basins as passive recreational areas and to provide recreational access for pedestrians and bicyclists.
- Retain natural gulches as flood plains and open space resources. Restrict development within gulches, and prohibit grading or other disturbance of gulch walls.
- Emphasize control and minimization of nonpoint source pollution in drainage system design. Where hardening of stream channels is unavoidable, improvements should protect habitat, maintain rural character and aesthetic quality, and avoid degradation of coastline and of stream and nearshore water quality.
- Design drainage ways to control 100-year floods. Any future work performed within the 100-year floodplain shall adhere to the requirements of the FEMA and meet all flood-proofing requirements.
- Regularly maintain and clean drainage ways and flood mitigation structures of debris to ensure that they achieve the purpose for which they were designed.

- Employ best management practices to minimize runoff from existing conservation and agricultural land uses, and other areas that may generate sediment and debris.
- Repair and maintain related agricultural irrigations systems and infrastructure.
- Develop a drainage master plan for the Waialua watershed to address erosion and flood protection concerns.
- Conduct public outreach and education programs that explain the potential for flooding and efforts to minimize the effects of flooding.<sup>28</sup>

### **3. Tools for CCA Planning**

At a basic level, GPs and DPs should discuss climate change indicators observed and expected in the county/region and corresponding impacts; identify the need for action; identify a possible course of action and preparedness strategies; and acknowledge that questions and uncertainties remain in a manner that does not predicate inaction. Appendix A.1 contains a model checklist for evaluating the extent to which climate change is currently considered in existing county GPs and DPs.

“No-regrets” goals and policies may be developed to address certain types of climate impacts. Appendix A.2 contains optional goals and policies, organized by areas of concern identified in the climate change adaptation priority guidelines. These areas of concern typically are addressed in most DPs in Hawai‘i. Goals and policies must be crafted to address climate impacts and management issues specific to the county or region.

# Part B: Options for Climate Change Adaptation in the Regulatory Process

As discussed in Part A, incorporating climate change adaptation policies and guidelines into planning, particularly at the community level, can influence regulatory decision-making further down the line. In addition, State and County land use decisions must conform to the HSPA priority guidelines to a degree. Therefore, agencies charged with implementing existing land use regulations need not wait for climate-related County-level comprehensive plan updates to begin applying climate change adaptation strategies in current day-to-day decision-making.

This Part presents options for implementing the CCA Priority Guidelines through the County-administered special management area permit program, shoreline setback laws, and flood ordinances and the State environmental review and land use districting processes. The order in which these potential options are discussed corresponds to the likely need for ordinance, rule, or statutory amendments. Regulatory tools are summarized in Appendix B.

## 1. Special Management Area Permit Program

Under the Hawai'i Coastal Zone Management Act, Chapter 205A, Hawai'i Revised Statutes (HCZMA or Chapter 205A), the County-administered Special Management Area (SMA) permit program<sup>29</sup> protects public health and safety in coastal areas and implements HCZMA objectives and policies including recreational, historic, scenic, open space, marine resources, coastal ecosystems, economic, coastal hazards, development, public participation, and beach protection interests.<sup>30</sup>

The federal Coastal Zone Management Act (CZMA), which governs the HCZMA, explicitly addresses climate change and sea-level rise, affirming that “[b]ecause global warming may result in a substantial sea-level rise with serious adverse effects in the coastal zone, coastal states must anticipate and plan for such an occurrence.”<sup>31</sup> Under CZMA, state programs must further provide for:

the management of coastal development to minimize the loss of life and property caused by improper development in flood-prone, storm surge, geological hazard, and erosion-prone areas and in areas likely to be affected by or vulnerable to sea level rise, land subsidence, and saltwater intrusion, and by the destruction of natural protective features such as beaches, dunes, wetlands, and barrier islands.<sup>32</sup>

In Hawai'i, OP is the lead agency implementing the State and federal coastal zone management programs.<sup>33</sup> Because federal law explicitly requires climate change adaptation and the SMA program regulates specific projects, the SMA program is well suited to implement the CCA Priority Guidelines. Table B.1 summarizes SMA program options.

**Table B.1. Adaptation Options for SMA Permit Program**

Option	CCA Priority Guidelines Implemented	Impacts Addressed	Authority	Statute or Rule Change Required?	Lead Agency	Limitations
Use the model SMA permit evaluation checklist (Appendix B.1) as a component of the SMA permit application and review process.	2, 5, 7, 10.	Coastal hazards, sea-level rise.	HRS §§ 205A-2, 205A-3, 205A-26; county SMA permitting ordinances.	No.	County permitting authorities.	Need stakeholder input to ensure that the SMA permit evaluation checklist is accurate and complete.

Appendix B.1 contains a checklist government agency personnel may use to evaluate climate impacts during the SMA permit evaluation process. To obtain a SMA permit, development must meet specific standards and the permitting authority must impose “reasonable permit terms and conditions,” among other things.<sup>34</sup> The checklist tracks relevant HCZMA provisions concerning development standards and conditions. Notably, the checklist draws from climate change and coastal hazard-related guidance documents published by FEMA, the U.S. Environmental Protection Agency (EPA), the California Natural Resources Agency, the San Francisco Bay Conservation and Development Commission (BCDC), the Georgetown Climate Center, and the South East Climate Partnership of England.

## 2. Shoreline Setback Laws

Shoreline setback lines indicate the closest distance to the shoreline where development may be permitted. Shoreline setback laws are intended to fulfill the HCZMA policy to “locate new structures inland from the shoreline setback to conserve open space, minimize interference with natural shoreline processes, and minimize loss of improvements due to erosion.”<sup>35</sup> The HCZMA requires a minimum shoreline setback of twenty feet and a maximum of forty feet from the certified shoreline.<sup>36</sup> The counties may establish shoreline setback lines at distances greater than forty feet from the certified shoreline.<sup>37</sup> Table B.2 summarizes the options discussed in this section, including shoreline setback calculations and “hardship” variances.

**Table B.2. Adaptation Options for Hawai'i Shoreline Setback Laws**

Option	CCA Priority Guidelines Implemented	Impacts Addressed	Authority	Statute or Rule Change Required?	Lead Agency	Limitations
Develop a model shoreline setback ordinance that accounts for accelerated shoreline erosion due to future sea-level rise, using one or more of the three available methods for doing so.	5, 6, 9, 10.	Sea-level rise, coastal erosion, and other coastal hazards.	HRS § 205A-25(a).	No.	County permitting authorities, UH coastal geology department.	Political will to adopt setback calculations based on future sea-level rise projections.
In evaluating shoreline variance applications, consider the model guidance for "hardship" variance evaluation (Appendix B.2).	5, 6, 7, 10.	Coastal hazards, sea-level rise.	HRS §§ 205A-2, 205A-3; HRS ch. 205A pt. III; County Shoreline Setback Rules	No.	County SMA Permitting Authorities.	Need stakeholder input to ensure that the evaluation guidance is well reasoned and complete. Must comply with U.S. Supreme Court requirements for land use conditions.

### 2.1. Calculating the Shoreline Setback

The County of Kaua'i and the County of Maui both incorporate historical erosion rates into their systems for determining the shoreline setback line on a lot-by-lot basis. Erosion-based shoreline setback formulas, however, may be updated to account for accelerated shoreline retreat caused by sea-level rise using one of the following methods:

1. Using the Bruun Rule, "a geometric model for sandy shorelines that predicts shoreline retreat based on the slope of the beach profile and the expected rate of sea level rise," to adjust historical erosion rates to account for future sea-level rise<sup>38</sup>; or
2. Requiring a sea-level rise assessment at the parcel level for developments proposed in vulnerable areas (e.g. requiring a project-level study of geological, geo-technical, engineering and hydrological evaluations to include an their analysis the effects of sea-level rise).<sup>39</sup>

Setback policies are a critical mechanism for adapting to sea-level rise and accelerated coastal erosion.

### 2.2. Shoreline Setback "Hardship" Variances

HRS Chapter 205A authorizes permitting authorities to grant variances, or exceptions, that allow development within the shoreline setback line.<sup>40</sup> Under certain circumstances, Chapter 205A permits variances upon a showing of "hardship."<sup>41</sup>

To establish hardship, an applicant must show:

1. it “would be deprived of all reasonable use of the land if required to fully comply with the shoreline setback rules”;
2. the proposal is “due to unique circumstances and does not draw into question the reasonableness of . . . the shoreline setback rules”; and
3. the proposal is “the best practicable alternative which best conforms to the purpose of . . . the shoreline setback rules.”<sup>42</sup>

Additionally, permitting authorities must impose conditions on variances to:

- “maintain shoreline access or compensate for its loss”;
- “minimize adverse impacts on beach processes”;
- “minimize risk of structures failing and becoming loose rocks or rubble on public property”; and
- “minimize adverse impacts on public views shoreline views.”<sup>43</sup>

Development *makai* of the shoreline setback could increase vulnerability to climate change impacts, thereby increasing risk to public health and safety. Therefore, careful evaluation of “hardship” variances is necessary. Appendix B.2 contains model guidance for “hardship” variance evaluation. All land use conditions, including SMA variance conditions, must meet legal requirements including certain constitutionality standards established by the U.S. Supreme Court.<sup>44</sup>

### 3. Floodplain Regulations

All four Counties in Hawai‘i participate in the National Flood Insurance Program (NFIP) to qualify homeowners for federally subsidized flood insurance. To participate, the counties must adopt floodplain ordinances that comply with NFIP requirements. The ordinances list building and subdivision standards and permitted uses for a variety of flood hazard districts, indicated on each county's respective Federal Insurance Rate Map (FIRM). The ordinances also include provisions for permitting, variances, and nonconforming uses. The purpose of the NFIP ordinances is to “promote the public health, safety, and general welfare.”<sup>45</sup> Given this purpose and the intersection between climate change, flooding, and storm events, the NFIP is an ideal mechanism for implementing climate change adaptation measures. Options discussed in this section are summarized in Table B.3.

Pursuant to the Biggert-Waters Flood Insurance Reform Act of 2012, passed by Congress on June 29, 2012, and signed by President Obama on July 6, 2012, the NFIP now requires FEMA to consider the “best available science regarding future changes in sea levels” in its mapping program.<sup>46</sup> Therefore, “FEMA should be entitled to consider the overwhelming volume of scientific studies that project increases in sea levels due to global warming—despite omission of explicit reference to climate change in the bill.”<sup>47</sup>

In the absence of more accurate and updated maps accounting for climate change and sea-level rise, communities may, but are not required to, apply 100-year floodplain requirements to the 500-year floodplain designated on FIRMs.<sup>48</sup> In addition, homeowners can qualify for discounts on flood insurance premiums and credits under the NFIP Community Rating System (CRS), a voluntary program, when counties adopt floodplain management regulations that are more stringent than NFIP minimum requirements. The CRS also provides credits for land acquisitions, relocation, flood-proofing, open space

preservation, shoreline setbacks, and other measures that reduce flood damages.<sup>49</sup> FEMA publishes guidance and recommendations for exceeding NFIP requirements.<sup>50</sup>

**Table B.3. Adaptation Options for Hawai'i Floodplain Insurance Programs**

Option	CCA Priority Guidelines Implemented	Impacts Addressed	Authority	Statute or Rule Change Required?	Lead Agency	Limitations
Work with FEMA to update FIRM maps to incorporate best-available information on climate change and sea-level rise, eventually including a 100-year storm event under future sea-level rise scenarios.	1, 2, 3, 4, 7, 8, 9, 10.	Coastal hazards that account for future climate change and sea-level rise.	NFIP.	No.	FEMA, State OP, Counties, in partnership with UH	Present uncertainties about how to incorporate sea-level rise data into floodplain mapping.
Apply 100-year floodplain regulations to 500-year floodplain.	2, 5, 9, 10.	Coastal hazards that account for future climate change and sea-level rise.	Police power to protect public health and safety.	No.	County NFIP authorities.	Uncertainty of impacts in the 500-year floodplain; engineering difficulties in addressing impacts.
Require more protective building standards in existing 100-year floodplain than the NFIP minimum standards.	2, 5, 9, 10.	Coastal hazards that account for future climate change and sea-level rise.	Police power to protect public health and safety.	No.	County NFIP authorities.	Whether to apply requirements on case-by-case basis or to entire 100-year floodplain.
Adopt or expand CRS Programs.	2, 5, 8, 9, 10.	Coastal hazards that account for future climate change and sea-level rise.	NFIP.	No.	County NFIP authorities.	Cost savings flow to homeowners required to purchase insurance, not counties or general public. The program does not pay staff to administer the program.

Develop an overlay zone adjacent to existing special flood hazard areas by overlaying sea-level rise inundation maps with FIRM maps.	1, 2, 3, 4, 7, 8, 9, 10.	Coastal hazards that account for future climate change and sea-level rise.	NFIP.	No.	County NFIP authorities.	Current floodplain ordinances and base flood elevations may be inadequate for accommodating anticipated increases in flood levels.
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The following options are available to county NFIP programs:

- Work with FEMA to update FIRM maps to incorporate best-available information on climate change and sea-level rise.
- Apply 100-year floodplain regulations to 500-year floodplain.
- Require more protective building standards in existing 100-year floodplain than the NFIP minimum standards.
- Adopt or expand CRS Programs.
- Develop an overlay zone adjacent to existing special flood hazard areas by overlaying sea-level rise inundation maps with FIRM maps.

#### 4. Environmental Review

Under the Chapter 343, Hawai'i Revised Statutes, the Hawai'i Environmental Policy Act (Chapter 343), Hawai'i government actions and many private development projects must undergo an environmental review process.<sup>51</sup> The purpose of the Chapter 343 environmental review process is to integrate review of environmental concerns with existing state and county planning processes and disclose potential environmental effects of certain actions. Major features of the process include preparation of an Environmental Assessment (EA) and Environmental Impact Statement (EIS).<sup>52</sup> Environmental review may be triggered by a range of actions, such as the use of state or county land or funds, activities in the State Conservation District, shoreline areas, and the Waikīkī Special District. If the agency determines that the proposed action “may have a significant effect on the environment,” based upon significance criteria found in administrative rules implementing Chapter 343, an EIS must be prepared to further disclose the environmental, economic, social, and cultural effects of proposed actions.<sup>53</sup> The EIS also must propose measures to minimize adverse effects and offer alternatives.<sup>54</sup> An agency or designated authority must accept the final EIS before a proposed action may commence or resume.<sup>55</sup> Because HEPA applies to a range of government and private actions in areas potentially vulnerable to climate change and sea-level rise, it could be a suitable and favorable mechanism for addressing climate change impacts. This section includes options for considering climate when evaluating “significance” criteria. Table B.4 summarizes these options.



**Table B.4. Adaptation Options for Environmental Review Law**

Option	CCA Priority Guidelines Implemented	Impacts Addressed	Authority	Statute or Rule Change Required?	Lead Agency	Limitations
When evaluating a project under the “significance” criteria, consider whether a proposed action is likely to suffer damage from or exacerbate impacts from climate change and sea-level rise, as indicated by a climate change hazard assessment (Appendix B.3)	2, 5, 6, 7, 8, 9, 10.	Sea-level rise, rain intensity, coastal flooding.	HRS ch. 343; HAR § 11-200-12(b)(11).	Maybe.	OEQC; agency or person proposing action.	Focuses on procedural requirements. Financial and administrative burden.
When considering project alternatives, evaluate relocation, elevation, and “soft” protection.	2, 5, 6, 7, 8, 9, 10.	Sea-level rise, rain intensity, coastal flooding.	HRS ch. 343; HAR §§ 11-200-10(6), 11-200-17(b)(4).	No.	OEQC; agency or person proposing action.	Focuses on procedural requirements. Financial and administrative burden.
When proposing mitigation measures, incorporate climate-resilient precautions.	2, 6, 7, 8, 9, 10	All.	HRS ch. 343; HAR §§ 11-200-10(7), 11-200-17(b)(3)	No.	OEQC; agency or person proposing action.	Focuses on procedural requirements. Need stakeholder input to ensure that proposed mitigation measures are accurate and complete.

#### 4.1. Significance Criteria

Determining whether a proposed action will have a “significant effect” on the environment under HRS Chapter 343 requires consideration of thirteen criteria, including:

- “Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters”,<sup>56</sup>
- “Curtails the range of beneficial uses of the environment”,<sup>57</sup>
- “Substantially affects the economic or social welfare of the community or state”;<sup>58</sup> and
- “Substantially affects public health.”<sup>59</sup>

Best-available information on climate change impacts should be considered in evaluating the thirteen significance criteria because climate change can exacerbate hazards that Hawai’i already experiences; expand hazardous areas, which often coincide with high-value and densely populated areas; and pose

greater risks to natural features that buffer climate change impacts, such as sand dunes, wetlands, and watersheds. A project-level climate change hazard assessment (Appendix B.3.) can inform how to consider climate change under the Chapter 343 environmental review process.

To ensure that climate change impacts are more consistently considered under Chapter 343, however, the statute could explicitly account for climate change—both adaptation and mitigation. The following draft “significance” criteria (Figure B.1) could be added to the existing administrative rules.

**Figure B.1. Draft “Significance” Criteria for Environmental Review**

<p><b>HAR § 11-200-12(b)</b></p> <p>(11) Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, <del>or</del> coastal waters, or sea-level rise inundation area;</p> <p><u>(-) Increases the scope or intensity of hazards to the public, such as increased coastal inundation, flooding, or erosion that may occur as a result of climate change anticipated during the lifetime of the project.</u></p>
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#### 4.2. Environmental Assessment Content Requirements

EAs and EISs both must contain, among other things, alternatives considered<sup>60</sup> and proposed mitigation measures.<sup>61</sup>

These requirements provide opportunities for incorporating best practice strategies for climate change adaptation in the environmental review process. As applicable, alternatives should include: (1) siting or relocation outside the hazardous area as far *mauka* as feasible; (2) elevation above the base flood elevation; or (3) “soft” protection, as opposed to hard protection such as seawalls. Mitigation measures could include beach nourishment; wind- and flood-resistant materials; permeable paved surfaces, and green roofs.

### 5. State Land Use Classification

HRS Chapter 205 establishes a land use classification, or state zoning, system that applies to all lands in the state.<sup>62</sup> Hawai'i Administrative Rules (HAR) Chapter 15-15 contains more detailed rules for implementing HRS Chapter 205.<sup>63</sup> Under this system, lands are classified as urban, rural, agricultural, or conservation, and each district allows for specific uses and activities within its boundaries.<sup>64</sup> The State of Hawai'i Land Use Commission (LUC) implements HRS Chapter 205 primarily through boundary amendments and special permits.<sup>65</sup> The counties have jurisdiction over permit applications for agricultural lands that are less than fifteen acres, lands classified as urban, or rural, and lands that are not designated as important agricultural lands.<sup>66</sup> Given its application early on in the development process, the state land use classification system could be an effective mechanism for implementing climate change adaptation. This section discusses opportunities for climate change adaptation during various phases in the land use boundary amendment process, as summarized in Table B.5.

**Table B.5. Adaptation Options for State Land Use Classification**

Option	CCA Priority Guidelines Implemented	Impacts Addressed	Authority	Statute or Rule Change Required?	Lead Agency	Limitations
Require climate change hazard assessments (Appendix B.3) in Land Use District boundary amendment petitions. Consider smaller projects or repairs that do not increase risks to public safety.	1, 5, 6, 7, 9, 10.	All, subject to best-available information.	HRS § 205A-1; HAR § 15-15-50.	Maybe.	LUC, county permitting authorities.	Need to work with stakeholders to ensure that the climate change assessment is well reasoned and complete.
For approved boundary amendments, require safety buffers that run with the land along seaward boundaries and around natural inundation buffers, as necessary (Figure B.3). Permit low-impact activities, such as access, within the buffer zone.	5, 6, 10.	Sea-level rise, increased rain intensity, flooding.	HRS § 205A-1.	Yes.	LUC, county permitting authorities.	
Based on assessment of climate change impacts, risks, and vulnerabilities, include recommendations for reclassifying lands, where appropriate, to protect public health and safety; also, include options for compensating landowners or incentivizing landowners to relocate.	3, 5, 6, 7, 8, 9, 10.	SLR, rain intensity, flooding.	HRS § 205A-18.	No.	OP.	Administrative cost.

### 5.1. Climate Change Hazard Assessment at Land Use Classification Phase

LUC boundary amendment decisions that would up-zone lands for higher density uses (e.g., conservation to agricultural or urban), particularly in nearshore areas, will require more robust information about impacts associated with climate change and sea-level rise. This information would allow landowners to make more informed land use choices and decision-makers to better protect public health and safety. For example, LUC decisions must uphold specific district standards, including:

- Urban districts must be “free from the danger of any flood, tsunami, unstable soil condition, or adverse environmental effects”<sup>67</sup>;
- Designating urban districts should take into consideration “[a]vailability of basic services such as . . . water”<sup>68</sup>;
- Conservation districts include “lands necessary for protecting watersheds, water resources, and water supplies”<sup>69</sup>; and
- Conservation districts may include “lands susceptible to floods and soil erosion, lands undergoing major erosion damage and requiring corrective attention by the state and federal government, and lands necessary for the protection of the health and welfare of the public by reason of the land’s susceptibility to inundation by tsunami and flooding, to volcanic activities, and landslides.”<sup>70</sup>

A project-level climate change hazard assessment, included in Appendix B.3, could be an appropriate mechanism for ensuring that land is properly designated to satisfy the above standards.

Requiring a climate change hazard assessment upon submitting a boundary amendment petition may be within the LUC’s authority.<sup>71</sup> Already, applications must include:

- A description of flood and drainage conditions<sup>72</sup>;
- An assessment of the impacts on “the environment, agriculture, recreational, cultural, historic, scenic, flora and fauna, groundwater, or other resources of the area”<sup>73</sup>;
- Availability or adequacy of public facilities such as parks, wastewater systems, and drainage<sup>74</sup>; and
- An assessment of conformity to the Hawai’i state plan and applicable priority guidelines,<sup>75</sup> HRS Chapter 205A,<sup>76</sup> and county GPs, CPs, and zoning.<sup>77</sup>

To better ensure that climate change hazard assessments are consistently conducted and considered, however, the State land use district rules (contained in Chapter 15-15, Hawai’i Administrative Rules) may be amended to explicitly require petitioners to submit climate change hazard assessments with their applications. The rules may specify the required contents of the assessment and the required qualifications of the preparer. The rules may also contemplate exemptions for smaller projects or repairs that do not increase risks to public safety. A draft climate change hazard assessment requirement (Figure B.2) is included below.

**Figure B.2. Draft Climate Change Hazard Assessment Requirement for State Land Use Reclassification**

<p><b>HAR § 15-15-50</b></p> <p>(c) The following information shall also be provided:</p> <p><u>(-) A climate change and sea-level rise hazard assessment for project-related impacts based upon available data and information.</u></p>
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## 5.2. Land Use Commission Decision-making Based on Climate Change Hazard Assessment

Upon considering the extent and degree of climate-related impacts identified in a climate change hazard assessment, the LUC may deny a boundary amendment application or approve it with conditions to adequately protect public health and safety.<sup>78</sup> As recommended in the *Hawaii Coastal Hazard Mitigation Guidebook*, the LUC could require a hazard mitigation “safety buffer” that runs with a land as a condition for development.<sup>79</sup> The rules could explicitly include this condition, using the below draft hazard buffer requirement (Figure B.3).

**Figure B.3. Draft Hazard Buffer Requirement for State Land Use Reclassification**

**HAR § 15-15-90(3)**

(-) Based on the climate change hazard assessment conducted pursuant to § 15-15-50(c)(-) of these rules, or as the commission deems necessary, the petitioner shall establish adequate hazard buffers along the seaward boundary of the tract and around wetlands, beaches, and sand dunes that serve as natural inundation buffers, which buffers shall run with the land; provided, however, that non-residential and non-permanent structures, and recreational uses, shall not be subject to this requirement.

## 5.3. Land Use District Periodic Review

Chapter 205, Hawai'i Revised Statutes charges OP with conducting a boundary review of all state land use classifications every five years that focuses on the state plan, county GPs, county DPs. Thereafter, OP must submit a report to the LUC, may initiate boundary amendments “which it deems appropriate,” and may “seek assistance of appropriate state and county agencies and may employ consultants and undertake studies in making this review.”<sup>80</sup> Although the district periodic review process has not been employed since the early 1990s, it is possible that some lands may be appropriate for reclassification.

If the land use district periodic review process is revived, and the counties include explicit climate change adaptation policies and priority areas in their GPs and/or DPs, OP would be required to consider assessments of climate change impacts, risks, and vulnerabilities in its five-year periodic reviews of state land use classifications and advise the LUC accordingly. OP should prioritize lands that are most vulnerable and at risk to climate change impacts as well as those that are most capable of yielding climate change adaptation and other benefits. These recommendations should include the options of acquisition and eminent domain.

## Conclusion and Next Steps

This report has identified and provided a preliminary assessment of potential Phase 1, no regrets planning and regulatory options to implement the CCA Priority Guidelines and move Hawai'i toward a CCA Strategy. The identified options are preliminary and the report is not intended to provide a comprehensive or exhaustive review of potential approaches. The next steps are for OP to work with the ORMP Integrated Planning Committee to prioritize and further develop the options to aid State and County government agency decision-makers in ongoing efforts put the identified Phase 1 climate change and sea-level rise adaptation measures into action.

Looking forward, selected options must be further refined to meet the particular needs, priorities, and regulatory processes of each jurisdiction. For example, it may be productive for the Counties to confer on criteria for evaluating the type and intensity of proposed development activities that may trigger a hazard assessment (e.g., coastal erosion rate areas or economic valuations), as well as the content requirements of the hazard assessment.

Phase 1 implementation may necessitate funding and expertise support, including providing planning agencies short-term consultancies with hazard experts and local specialists on climate analysis, continued development of policy language and regulatory checklists, and workshops with Counties and educational outreach to developers, construction interests, County councils, and environmental groups.

Finally, the options for Phases 1, 2, and 3 will likely overlap. Some first-generation adaptation activities will set the stage for actions in Phase 2. For example, vulnerability assessments (to develop region-specific climate adaptation strategies for DPs) are suggested for Phase 2. Drafting a GP policy and developing a county-specific methodology for integrating vulnerability assessments into the DP update process, however, are foundational activities that may be pursued in Phase 1.

Given that climate change is a significant consideration in planning for Hawai'i's environmental, social, and economic future, action in the near future on Phase 1 options will serve not only implement the CCA Priority Guidelines but also to establish the foundation for a future CCA Strategy, consistent with Gov. Abercrombie's observation that the time for a long-term statewide plan for the effects of our changing climate is now.

## Appendix 1 Preliminary Survey of Climate Adaptation Efforts

Agency	Study/Project Summary	Outreach/ Work Group	Climate Impact Science	Vulnerability Assessment/ Priority Areas	Develop/ Evaluate Strategies	Implementation	Monitoring
NOAA	NOAA Pacific Services Center. Kauai Online Hazard Assessment (KOHA) Tool. (Overlays GIS data layers to assess hazard exposure by the TMK). <a href="http://www.kauai.gov/EServices/GIS/tabid/433/Default.aspx">http://www.kauai.gov/EServices/GIS/tabid/433/Default.aspx</a>			•			
	NOAA Coastal Services Center. Digital Coast. (NOAA data visualization tool that will display sea-level rise inundation maps for Hawai'i upon completion. The maps are being developed by the UH SOEST Coastal Geology Group through the NOAA UH Sea Grant Coastal Storms Program). <a href="http://www.csc.noaa.gov/csp/projects_pacificislands.html#PacificIslandsDataNationalSeaLevelRiseViewer">http://www.csc.noaa.gov/csp/projects_pacificislands.html#PacificIslandsDataNationalSeaLevelRiseViewer</a>		•				
	NOAA Coastal Services Center. Digital Coast. (Will display historical aerial imagery of Hawai'i shoreline positions and land use).		•				
	NOAA Coastal Services Center. Digital Coast. (Will display a PacIOOS tool to show the future position of soft shorelines due to known erosion rates).		•				
	NOAA, USGS, UH Hilo & UH Manoa. Modeling climate change to dominant vegetation in the NWHI.		•				
USACE	Townscape. Ala Wai Watershed Analysis Final Report. (2003). <a href="http://www.alawaiwatershed.com/documents/AlaWai_WatershedAnalysis_FinalReport_July2003.pdf">http://www.alawaiwatershed.com/documents/AlaWai_WatershedAnalysis_FinalReport_July2003.pdf</a>		•				
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USGS	Burkett, V.R. & Davidson, M.A. Coastal Impacts, Adaptation, and Vulnerabilities: 2012 Cooperative Technical Input Report to the 2013 National Climate Assessment. <a href="http://www.coastalstates.org/wp-content/uploads/2011/03/Coastal-Impacts-Adaptation-Vulnerabilities-Oct-2012.pdf">http://www.coastalstates.org/wp-content/uploads/2011/03/Coastal-Impacts-Adaptation-Vulnerabilities-Oct-2012.pdf</a>		•	•			
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	<b>Study/Project Summary</b>	<b>Outreach/ Work Group</b>	<b>Climate Impact Science</b>	<b>Vulnerability Assessment/ Priority Areas</b>	<b>Develop/ Evaluate Strategies</b>	<b>Implementation</b>	<b>Monitoring</b>
<b>USGS (cont)</b>	Fletcher, C. et al. Atlas of Natural Hazards in the Hawaiian Coastal Zone (2002). <a href="http://pubs.usgs.gov/imap/i2761/">http://pubs.usgs.gov/imap/i2761/</a>		●				
	Streamflow Trends in Hawai'i since 1913, including change-point analysis (PIWSC)		●				
	Mapping of wave impact and storm-induced inundation levels for islands of high conservation value. (Conducted for Midway Atoll and Laysan Island using historical data and DEMs for a variety of sea-level rise scenarios). <a href="http://www.pacificislandsclimate.org/pawz/">http://www.pacificislandsclimate.org/pawz/</a>		●				
	Pacific Coastal and Marine Science Center. Future wind and wave projections for NPS and USFWS managed parks and refuges. <a href="http://www.pacificislandsclimate.org/pawz/">http://www.pacificislandsclimate.org/pawz/</a>		●				
	USGS PIERC/PIWSC, PacRisa. An analysis of streamflow and precipitation trends during phases of ENSO and PDO. <a href="http://www.pacificislandsclimate.org/pawz/">http://www.pacificislandsclimate.org/pawz/</a>		●				
<b>NPS</b>	Coastal Geology Group. Pu'ukohola Heiau National Historic Site and Kaloko-Honkohau Historical Park, Big Island. Coastal Hazard Analysis Report. (2009). (This project maps national parks and trails vulnerable to storms, extreme wave events, and sea-level rise using coastal inundation maps ((wave over-topping, sea-level rise scenarios, and tsunami inundation)), shoreline morphology (using DEMs), and historical shoreline change and coastal erosion (using a 2050 projection). <a href="http://www.soest.hawaii.edu/coasts/nps/executiveSummary.php">http://www.soest.hawaii.edu/coasts/nps/executiveSummary.php</a>		●				
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	UC Berkeley. GIS datasets and maps for various sea-level rise scenarios for 2100 along the Ala Kahakai NHT corridor in relation to wetlands, cultural sites, and anchialine pools and fishponds. <a href="http://www.pacificislandsclimate.org/pawz/">http://www.pacificislandsclimate.org/pawz/</a>		●	●			
<b>UH</b>	Collaborative formed around the PIRCA: Pacific Regional Integrated Sciences and Assessments (PacRISA), Pacific Climate Information System (PaCIS), Pacific Islands Climate Change Cooperative (PICCC).	●					



PICC, PAC RISA, PaCis and PIRCA. Climate Change and Pacific Islands: Indicators and Impacts: Report for the 2012 Pacific Islands Regional Climate Assessment (PIRCA). Input to the National Climate Assessment 2013 Report. <a href="http://www.pacificrisa.org/projects/pirca/">http://www.pacificrisa.org/projects/pirca/</a>		•				
<b>Study/Project Summary</b>	<b>Outreach/ Work Group</b>	<b>Climate Impact Science</b>	<b>Vulnerability Assessment/ Priority Areas</b>	<b>Develop/ Evaluate Strategies</b>	<b>Implementation</b>	<b>Monitoring</b>
UH Coastal Geology Group & UH Sea Grant Coastal Storms Program. Sea-level rise and coastal inundation maps for each island. (Urban Honolulu underway. Neighbor islands scheduled for 2014). (Includes: a. potential flooding and coastal inundation at the confluences of high tides (and/or high-waves) and rainfall; b. modeled storm surge inundation at 1', 2', and 3' SLR scenarios). <a href="http://www.csc.noaa.gov/csp/projects_pacificislands.html">http://www.csc.noaa.gov/csp/projects_pacificislands.html</a>		•				
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Eversole, D. & Norcross, Z. Natural Hazard Considerations for Purchasing Coastal Real Estate in Hawaii. (2006). <a href="http://seagrant.soest.hawaii.edu/sites/seagrant.soest.hawaii.edu/files/publications/Purchasing_Coastal_Real_Estate.pdf">http://seagrant.soest.hawaii.edu/sites/seagrant.soest.hawaii.edu/files/publications/Purchasing_Coastal_Real_Estate.pdf</a>	•					
SOEST, NOAA/CRCP, State of Hawaii. Sea-level rise impacts to coastal wetlands and other habitats. Models sea-level rise at coastal sites on Oahu and Maui. <a href="http://www.pacificislandsclimate.org/pawz/">http://www.pacificislandsclimate.org/pawz/</a>		•				
IPRC, SOEST, PacRisa. High resolution climate model for Hawaii for natural resource management. <a href="http://www.pacificislandsclimate.org/pawz/">http://www.pacificislandsclimate.org/pawz/</a>		•				
UH & NPS. HaleNet climate observation network field monitoring and analysis of climate change across a wide range of ecosystems throughout Hawaii. <a href="http://www.pacificislandsclimate.org/pawz/">http://www.pacificislandsclimate.org/pawz/</a>		•				•
IPRC, SOEST. Seasonal mean rainfall scenario maps will be developed for mid and late 21 <sup>st</sup> rainfall projections for Hawaii. The HaleNet climate monitoring system is used with downscaled climate models to generate map data. <a href="http://www.pacificislandsclimate.org/pawz/">http://www.pacificislandsclimate.org/pawz/</a>		•				
PacIOOS. A tool in PacIOOS Voyager will show the future position of soft shorelines due to known erosion rates.		•				

<a href="http://oos.soest.hawaii.edu/pacioos/voyager/">http://oos.soest.hawaii.edu/pacioos/voyager/</a>						
UH Sea Grant Coastal Storms Program & NOAA Coastal Services Center Coastal Inundation Mapping Course. <a href="http://www.csc.noaa.gov/training/coastalin.html">http://www.csc.noaa.gov/training/coastalin.html</a>	●					
UH Sea Level Center. Hawai'i and regional tide-gauge data to support climate change and sea-level rise research. <a href="http://ilikai.soest.hawaii.edu/uhscl/background.html">http://ilikai.soest.hawaii.edu/uhscl/background.html</a>		●				●
<b>Study/Project Summary</b>	<b>Outreach/ Work Group</b>	<b>Climate Impact Science</b>	<b>Vulnerability Assessment/ Priority Areas</b>	<b>Develop/ Evaluate Strategies</b>	<b>Implementation</b>	<b>Monitoring</b>
PIKO. Clearinghouse for climate data, products, services, projects and activities in Hawai'i. <a href="http://www.pacificislandsclimate.org">www.pacificislandsclimate.org</a>	●					
UH, University of Colorado and Wisconsin. Future distribution of cloud forest and species across high mountain ecosystems in Hawaii. Project is conducted on Haleakala but will increase our understanding of watershed function throughout all the islands. <a href="http://www.pacificislandsclimate.org/pawz/">http://www.pacificislandsclimate.org/pawz/</a>		●				
PaCIS, Sea Grant Coastal Storms Program. Pacific Storms Climatology PaCIS. Products for delineating impacts from high seas, heavy rains, and strong winds. <a href="http://www.pacificstormsclimatology.org/">http://www.pacificstormsclimatology.org/</a>		●				
Climate Extremes in the Pacific Integrated Case Studies (EPICS) to Support Vulnerability Assessment and Adaptation Planning (PaCIS, UH Sea Grant Coastal Storms Program). <a href="http://www.pricip.org/ea.php">http://www.pricip.org/ea.php</a>	●					
PEAC Center. Monthly discussions on sea-level, ENSO, rainfall outlook, and reports from around the South Pacific.	●					
IPCC. Climate Change in the Pacific Fact Sheet. <a href="http://hawaiiconservation.org/files/content/resources/publications/position_papers/2009_climate_change/piccc_fact_sheet_12_10.pdf">http://hawaiiconservation.org/files/content/resources/publications/position_papers/2009_climate_change/piccc_fact_sheet_12_10.pdf</a>	●					
PacRisa. Climate science fact-sheets. <a href="http://www.pacificrisa.org/resources/publications/">http://www.pacificrisa.org/resources/publications/</a>	●					
Wallsgrrove, R. & Penn, D. Water Resources and Climate Change Adaptation in Hawaii: Adaptive Tools in the Current Law and Policy Framework. (2012). PacRisa, WRRC, ICAP. <a href="http://www.pacificrisa.org/resources/publications/">http://www.pacificrisa.org/resources/publications/</a>					●	
Marra, J. Finucane, M., Spooner, D. & Smith, M. Climate Change and Pacific Islands: Indicators and Impacts. (2012). PacRisa. (Publication includes case studies). <a href="http://www.pacificrisa.org/resources/publications/">http://www.pacificrisa.org/resources/publications/</a>		●				
Zhang, C., et. Al. Configuration and evaluation of the WRF model for the study of Hawaiian regional climate. (2012). PacRisa <a href="http://www.pacificrisa.org/resources/publications/">http://www.pacificrisa.org/resources/publications/</a>		●				
UH Manoa. Traditional Ecological Knowledge to understand climate change impacts in Kaupulehu, Hawaii. <a href="http://www.pacificislandsclimate.org/pawz/">http://www.pacificislandsclimate.org/pawz/</a>		●				
Fletcher, C. Hawaii's Changing Climate Briefing Sheet. (2010)		●				

	<a href="http://www.islandclimate.net/publications/">http://www.islandclimate.net/publications/</a>						
	Fletcher, C. Sea-level rise presentations to OP, CZM Program and county cabinets. <a href="http://www.soest.hawaii.edu/coasts/sealevel/">http://www.soest.hawaii.edu/coasts/sealevel/</a>	●					
	Wager, K. Climate Change Law and Policy in Hawai'i Briefing Sheet. (2012) <a href="http://www.islandclimate.net/publications/">http://www.islandclimate.net/publications/</a>	●					
	Codiga, D., Hwang, D., & Delaunay, C. Climate Change and Regulatory Takings in Coastal Hawai'i. (2011). ICAP. <a href="http://www.islandclimate.net/publications/">http://www.islandclimate.net/publications/</a>				●		
	<b>Study/Project Summary</b>	<b>Outreach/ Work Group</b>	<b>Climate Impact Science</b>	<b>Vulnerability Assessment/ Priority Areas</b>	<b>Develop/ Evaluate Strategies</b>	<b>Implementation</b>	<b>Monitoring</b>
	Codiga, D. & Wager, K. Sea-Level Rise and Coastal Land Use in Hawai'i: A Policy Tool Kit for State and Local Governments. (2011). ICAP. <a href="http://www.islandclimate.net/publications/">http://www.islandclimate.net/publications/</a>				●		
	ICAP. Sea-level rise policy workshops with planners and decision-makers (2011)	●					
	Burkett, M. Climate Change & the Impacts to Food & Agriculture. (2009). ICAP <a href="http://www.islandclimate.net/publications/">http://www.islandclimate.net/publications/</a>				●		
	Burkett, M. & Hwang, D. Shoreline Impacts, Setback Policy, and Sea Level Rise White Paper. (2009) <a href="http://www.islandclimate.net/publications/">http://www.islandclimate.net/publications/</a>	●					
	Burkett, M. Litigating Climate Change Adaptation: Theory, Practice and Corrective (Climate) Justice. (2012). Environmental Law Institute. <a href="http://www.eli.org">http://www.eli.org</a>				●		
	NOAA & UH Law School. Coastal Resilience Network (CRest). (In partnership with Office of Planning, this project works with the land-use sector to develop and implement first-generation climate adaptation strategies). <a href="http://www.islandclimate.net/projects/crest/">http://www.islandclimate.net/projects/crest/</a>				●		
	UH Pacific Islands Climate Science Center (forthcoming consortium of partners across the entire science community)	●	●				
<b>DLNR</b>	Model and mapping of dam failure scenarios (DLNR Dam Safety Division). <a href="http://www.hidlnr.org/eng/dam/Overview.aspx">http://www.hidlnr.org/eng/dam/Overview.aspx</a>			●			
	Online Flood Hazard Assessment Tool (FHAT). (Assesses a TMK in relation to FIRM maps, Letters of Map Change (LOMC), NGS benchmrks, and stream cross sections. The report function of the tool can generate a hazard assessment report for the parcel. The tool can also produce an Elevation Certificate (EC) which is a required form for properties proposing to build in a special flood hazard area. This allows an applicant or surveyor to initiate an EC directly from the FHAT tool). <a href="http://www.arcgis.com/home/item.html?id=f243760aa84c4d26a2a5eb33c604fc5d">http://www.arcgis.com/home/item.html?id=f243760aa84c4d26a2a5eb33c604fc5d</a>			●			
	Upland/Natural Area Reserves System Vulnerability assessment (DOFAW). <a href="http://hawaii.gov/dlnr/dofaw">http://hawaii.gov/dlnr/dofaw</a>			●			

	DAR, Kamehameha School, USFS. Distributed Hydrology, Soils, Vegetation Model (DST) and decision-support tool. Will show how climate scenarios will impact water yield and when/where specific management actions are needed. <a href="http://www.pacificislandsclimate.org/pawz/">http://www.pacificislandsclimate.org/pawz/</a>		•				
	Plan Pacific. Kailua Beach and Dune Management Plan. (2010). (Developed through a partnership with NOAA, UH Sea Grant, and DLNR OCCL). <a href="http://seagrant.soest.hawaii.edu/kailua-beach-and-dune-management-plan">http://seagrant.soest.hawaii.edu/kailua-beach-and-dune-management-plan</a>					•	
	USFS, UCLA. Series of climate-ecosystem stations on leeward and windward sides of the islands. <a href="http://www.pacificislandsclimate.org/pawz/">http://www.pacificislandsclimate.org/pawz/</a>						•
	<b>Study/Project Summary</b>	<b>Outreach/ Work Group</b>	<b>Climate Impact Science</b>	<b>Vulnerability Assessment/ Priority Areas</b>	<b>Develop/ Evaluate Strategies</b>	<b>Implementation</b>	<b>Monitoring</b>
	Erosion Management Alternatives for Hawaii (OCCL and Sea Grant) <a href="http://hawaii.gov/dlnr/occl/manuals-reports/dune-managmeng.pdf">http://hawaii.gov/dlnr/occl/manuals-reports/dune-managmeng.pdf</a>					•	
	Coastal Erosion Management Plan (COEMAP) (OCCL and Sea Grant) <a href="http://hawaii.gov/dlnr/occl/documents-forms/policies-plans/coemap.pdf/view?">http://hawaii.gov/dlnr/occl/documents-forms/policies-plans/coemap.pdf/view?</a>					•	
	OCCL Beach Nourishment Projects.						
<b>The Nature Conservancy</b>	TNC, NOAA PSC, Kāko'o 'Ōiwi, The Ko'olaupoko Hawaiian Civic Club. He'eia Fishpond restoration. (Part of the Hawaiian Islands Sentinel Site Cooperative. Focuses on food security, coral reef health through Lo'i, fishpond, and wetland restoration and to generate traditional ecological knowledge through participatory mapping). <a href="http://www.csc.noaa.gov/digitalcoast/stories/hirestoration">http://www.csc.noaa.gov/digitalcoast/stories/hirestoration</a>					•	
<b>OP</b>	Hawaii State Plan: Priority Guideline for Climate Change Adaptation <a href="http://www.capitol.hawaii.gov/session2012/bills/GM1403_PDF">http://www.capitol.hawaii.gov/session2012/bills/GM1403_PDF</a>				•		
	Hawaii ORMP Plan 2012 Public Review Draft <a href="http://hawaii.gov/dbedt/czm/ormp/ormp_update_reports/FINAL%20ORMP%20PUBLIC%20REVIEW%20DRAFT_REV.pdf">http://hawaii.gov/dbedt/czm/ormp/ormp_update_reports/FINAL%20ORMP%20PUBLIC%20REVIEW%20DRAFT_REV.pdf</a>					•	
	ORMP Integrated [Climate] Planning and Outreach Committees	•				•	
	Visioning Hawaii's Adaptation to Climate Change Workshop <a href="http://hawaii.gov/dbedt/czm/ormp/reports/visioning_hawaii_adaptation_to_climate_change_aug_2011.pdf">http://hawaii.gov/dbedt/czm/ormp/reports/visioning_hawaii_adaptation_to_climate_change_aug_2011.pdf</a>	•			•		
	ORMP Working Group & ICAP. A Framework for Climate Change Adaptation in Hawaii. (2009). <a href="http://www.islandclimate.net/publications/">http://www.islandclimate.net/publications/</a>				•		
<b>Hawai'i Tourism Authority</b>	HTA & UH Sea Grant. Climate Change Impacts to Hawaii's Hospitality Industry & Coastal Communities: Benchmark Analysis and Outreach. <a href="http://sct.seagrant.soest.hawaii.edu/sites/seagrant.soest.hawaii.edu/files/sct/cct_factsheet.pdf">http://sct.seagrant.soest.hawaii.edu/sites/seagrant.soest.hawaii.edu/files/sct/cct_factsheet.pdf</a>	•		•			
<b>DOT/ OMPO</b>	SSFM International. Vulnerability Assessment of Transportation Assets for O'ahu Pilot Study. OMPO. <a href="http://www.oahumpo.org/climate_change/CC_Report_FINAL_Nov_2011.pdf">http://www.oahumpo.org/climate_change/CC_Report_FINAL_Nov_2011.pdf</a>			•			
	Hawai'i Island Commercial Harbors 2035 Master Plan					•	

	<a href="http://www.hawaiiharborsplan.com/master_plan_process.htm">http://www.hawaiiharborsplan.com/master_plan_process.htm</a>						
	Statewide Long-Range Land Transportation Plan (HDOT)					●	
<b>Hawai'i County</b>	Owens, T., Hwang, D. Bohlander, A. Benesovksa, A. Buika, J., Morrison, B. Facing our Future: Adaptive Planning for Sea Level Rise in Maui and Hawai'i Counties. (2012) (UH Sea Grant) <a href="http://seagrants.soest.hawaii.edu/publications">http://seagrants.soest.hawaii.edu/publications</a>					●	
<b>Hawai'i County</b>	<b>Study/Project Summary</b>	<b>Outreach/ Work Group</b>	<b>Climate Impact Science</b>	<b>Vulnerability Assessment/ Priority Areas</b>	<b>Develop/ Evaluate Strategies</b>	<b>Implementation</b>	<b>Monitoring</b>
	Hamakua CDP, Strategies Under Consideration, Public Review Draft. (Collaborative effort between the county, community and NOAA PSC to integrate into the disaster readiness chapter, a shoreline safety zone to define special building restrictions or guidelines to mitigate damages from climate impacts and coastal hazards). <a href="http://www.hawaiicounty.cdp.info/hamakua-cdp">http://www.hawaiicounty.cdp.info/hamakua-cdp</a>					●	
	Hwang, D. Coastal Subsidence in Kapoho. Puna, Island of Hawaii. (2007). <a href="http://hawaii.gov/dlnr/occl/manuals-reports/Coastal%20Subsidence%20Final.pdf">http://hawaii.gov/dlnr/occl/manuals-reports/Coastal%20Subsidence%20Final.pdf</a>			●			
<b>City and County of Honolulu</b>	East Honolulu Sustainable Communities Plan. (Public Review Draft will be released). (Addresses sea-level rise). <a href="http://dev.honolulu.gov/Planning/DevelopmentSustainableCommunitiesPlans/EastHonoluluPlan.aspx">http://dev.honolulu.gov/Planning/DevelopmentSustainableCommunitiesPlans/EastHonoluluPlan.aspx</a>			●		●	
	Honolulu Board of Water Supply. Watershed Management Plans for Ko'olau Loa and Wai'anae. (Addressing sea-level rise). <a href="http://www.hbws.org/cssweb/display.cfm?sid=1406">http://www.hbws.org/cssweb/display.cfm?sid=1406</a>					●	
<b>Maui County</b>	Climate change adaptation trainings conducted by NOAA PSC and PDC.	●					
	Owens, T., Hwang, D. Bohlander, A. Benesovksa, A. Buika, J., Morrison, B. Facing our Future: Adaptive Planning for Sea Level Rise in Maui and Hawai'i Counties. (2012) (UH Sea Grant) <a href="http://seagrants.soest.hawaii.edu/publications">http://seagrants.soest.hawaii.edu/publications</a>					●	
	DLNR OCCL. Beach Management Plan for Maui. <a href="http://hawaii.gov/dlnr/occl/manuals-reports">http://hawaii.gov/dlnr/occl/manuals-reports</a>					●	
	Maui Island Plan (Draft). <a href="http://www.co.maui.hi.us/index.aspx?NID=1122">http://www.co.maui.hi.us/index.aspx?NID=1122</a>					●	
<b>Kaua'i County</b>	UH Sea Grant study, Kaua'i Climate Change and Coastal Hazards Assessment (UH Sea Grant)				●		
	Pacific Islands Regional Gap Analysis for Hazard Planning Implementation. Piloted in Kaua'i and the Marshall Islands (UH Sea Grant)		●		●		

# Appendix A:

## Adaptation Implementation Tools for Planning

### A.1. Checklist for Evaluating Climate Change Considerations in Plans

#### *General Plan*

- ✓ Does the plan describe the long-term implications of climate change and the possible impacts to the county?
- ✓ Are the implications and possible impacts capable of being measured or monitored? If not, is there a comment explaining why not?
- ✓ How is the timeframe for climate change effects handled? Is there adequate explanation of the need to act within the framework of the current plan, although effects may become apparent only during the preparation of future plans?
- ✓ Does the plan identify adaptation strategies for potential climate changes in relation to specific assets or activities (water supply, wastewater, storm water, transportation, agriculture, pest management, parks and reserves management, etc.)? (Adaptive responses should be specific and targeted to the asset/activity.)
- ✓ Does the plan prioritize which adaptation strategies are most important for the jurisdiction?
- ✓ If a change in level of service, or additional capacity, is identified because of climate change considerations (i.e., requirements will be beyond the current level of service or capacity), is this scenario explicit and explained in the plan or supporting documentation?
- ✓ Are there indicators and measurable goals to monitor the implementation of the climate change measures identified? Is it possible to identify implementation mechanisms, costs and program proponents?
- ✓ Does the Plan include a statement about the levels of uncertainty involved in climate change, and an estimate of the uncertainty provided?

#### *Development Plans*

- ✓ Does the plan describe the long-term implications of climate change and the possible impacts to the planning region?
- ✓ Is it desirable to describe the possible impacts of climate change in relation to the specific subject areas addressed in the plan (e.g., water supply, wastewater, storm water, transportation, agriculture, pest management, parks and reserves management, etc.)?
- ✓ Are adaptation strategies expressed in terms of objectives and policies?
- ✓ Is the approach and policy for climate change consistent with the State Planning Act, HRS 226, and the county's GP?
- ✓ Are areas of enhanced risk (e.g., hazard zones and vulnerable infrastructure systems) due to climate change identified? Can appropriate policies be developed to address these sensitive areas?
- ✓ Do the policies and guidelines relating to natural hazards preparedness and increasing community resiliency take into account climate change and its implications?
- ✓ Are mechanisms, costs, and program proponents for implementation clearly identified?
- ✓ Are there indicators and measurable goals to monitor the implementation of the climate change measures?

## A.2 Optional Climate Change Adaptation Goals & Policies, by Impact and Area of Concern

Area of Concern	Potential Impacts	Preparedness Goal	Possible Adaptation Policies	Agencies to Consult
<b>Agriculture</b>	Reduced food sustainability and food security due to changes in crop yields and growing conditions (e.g., changes in climate, soil nutrient content, water salinity/availability, crop dominance).	Maintain a pre-determined level of food crop production.	<ul style="list-style-type: none"> <li>Assess current capacity to improve food sustainability and food security.</li> <li>Encourage variation in crop production.</li> </ul>	NRCS, USFWS, NOAA, USACE, DOA, DLNR, DOH, LUC, UH CTAHR, UH, independent farmers and landowners
	Increased pressure to urbanize/convert agricultural lands for other uses (e.g., urban uses retreat from low-lying coastal areas, use of agricultural lands for alternative energy generation such as wind, solar, and biofuel crops).	Protect important agricultural lands and ensure that agriculture is the primary use of such lands.	<ul style="list-style-type: none"> <li>Identify important agricultural lands that are to be protected from future urbanization.</li> <li>Direct urban uses to areas identified for such use.</li> <li>Monitor the use of agricultural lands.</li> </ul>	
	Changes in dominant species types and increased risk of pest outbreaks.	Implement management strategies and farming techniques that support adaptation, including modification of aquaculture and crop types.	<ul style="list-style-type: none"> <li>Create incentives for the use of new production methods and crop types.</li> <li>Promote natural alternatives to pesticides and fertilizers.</li> </ul>	
	Increased demand for irrigation water and changes in the availability of water resources.	Improve agricultural water supply and use.	<ul style="list-style-type: none"> <li>Promote new irrigation technologies to improve water use efficiency.</li> <li>Promote water conservation measures.</li> <li>Diversify and expand irrigation infrastructure.</li> </ul>	
	Increased runoff and erosion from vacant, unused farmland.	Control the amount of runoff and soil erosion from vacant, unused farmland.	<ul style="list-style-type: none"> <li>Educate farmers and landowners to ensure that best management practices are followed.</li> </ul>	

Area of Concern	Potential Impacts	Preparedness Goal	Possible Adaptation Policies	Agencies to Consult
<b>Conservation lands (<i>mauka</i> areas)</b>	Increased pressure to urbanize conservation lands for other uses.	Protect conservation lands.	<ul style="list-style-type: none"> <li>• Direct urban uses to areas identified for such use.</li> </ul>	USDA Forest Service, USFWS, NOAA, USACE, DLNR, OCCL, DOA, independent landowners
	Loss and migration of native species; also increased competition from invasive/non-native species.	Maintain species diversity and pristine native habitats.	<ul style="list-style-type: none"> <li>• Expand or adjust protected areas to allow for shifts in species distribution.</li> <li>• Ensure adequate protection of native species and habitats.</li> </ul>	
<b>Coastal and nearshore marine areas</b>	Loss of shorelines and beaches for public use and recreation.	Reduce impacts from shoreline erosion. Ensure an adequate amount of public recreation areas.	<ul style="list-style-type: none"> <li>• Support beach nourishment in designated areas.</li> <li>• Enhance and integrate opportunities for passive and active recreation within the urban landscape.</li> <li>• Enact variable shoreline setbacks to reduce the impacts from erosion and prevent erosion-causing activities.</li> </ul>	NRCS, USFWS, NOAA, NMFS, USACE, WESPAC, DLNR, DOH, LUC, UH, independent farmers and landowners
	Greater risk to communities, including property damage and loss, personal injury and/or loss of life, due to higher intensity of natural hazards.	Minimize property damage and reduce vulnerability to natural hazards.	<ul style="list-style-type: none"> <li>• Establish new setbacks, elevation standards, building codes, and other coastal hazard mitigation measures for development in coastal areas and to enhance protection of existing ocean front property.</li> <li>• Protect and restore coastal landforms and wetland ecosystems as a natural line of protection from storm surges and flooding.</li> </ul>	
	Negative impacts on fisheries and reef degradation/bleaching due to ocean warming and acidification.	Maintain or enhance coastal habitats.	<ul style="list-style-type: none"> <li>• Protect nearshore coral reefs and other marine life from damaging activities.</li> <li>• Remove invasive non-native species from marine environments.</li> </ul>	
	Salt water intrusion and loss of wetlands, coastal ponds, and estuaries.	Maintain the quality of nearshore resources, including wetlands, coastal ponds, and estuaries.	<ul style="list-style-type: none"> <li>• Ensure adequate buffers around riparian areas.</li> <li>• Support wetland and natural habitat restoration projects.</li> </ul>	



Area of Concern	Potential Impacts	Preparedness Goal	Possible Adaptation Policies	Agencies to Consult
<b>Natural and cultural resources</b>	Loss of natural and cultural resources (e.g., fisheries, coral reefs, wetlands, and anchialine ponds, historic and traditional Native Hawaiian cultural sites).	Protect natural and cultural resources.	<ul style="list-style-type: none"> <li>Promote reforestation of marginal lands to increase soil moisture retention and increase habitat.</li> <li>Develop public-private partnerships in the management of natural and cultural resources.</li> <li>Pursue land acquisitions and other creative incentives/strategies to safeguard from future development.</li> </ul>	Same as above
	Threats to scenic views and open spaces due to migration away from the shoreline.	Reduce impacts to scenic views and open space features.	<ul style="list-style-type: none"> <li>Identify and map significant scenic views and open space features to be protected.</li> </ul>	
<b>Education</b>	Flooding and property damage to building assets/campuses in low-lying areas.	Minimize operational interferences for educational facilities.	<ul style="list-style-type: none"> <li>Provide funding for priority improvement projects.</li> <li>Protect/retrofit/relocate vulnerable facilities.</li> </ul>	DOE, Counties, independent private schools
	Changes in school enrollments and future enrollment projections as population centers shift.	Capacity to accommodate changes in school enrollments.	<ul style="list-style-type: none"> <li>Expand, construct, or shutter school facilities to reflect changes.</li> </ul>	
	Increased need for education about climate change and sea-level rise.	Ensure that residents are knowledgeable about climate change and sea-level rise.	<ul style="list-style-type: none"> <li>Establish climate change and sea-level rise educational programs.</li> <li>Integrate climate change and adaptation issues into existing educational programs.</li> </ul>	
<b>Energy</b>	Greater emphasis on reducing statewide dependence on imported oil.	Increase the use of available alternative energy resources.	<ul style="list-style-type: none"> <li>Provide economic incentives to promote installation of wind- and solar-powered electrical generation systems.</li> </ul>	DBEDT Energy Office, County Agencies, public utilities
	Same as above	Reduce energy consumption.	<ul style="list-style-type: none"> <li>Require the use of energy-efficient fixtures and the installation of either solar or wind-powered electrical generation systems on all new homes.</li> <li>Support consumer education programs that focus on conserving energy in the home.</li> </ul>	

Area of Concern	Potential Impacts	Preparedness Goal	Possible Adaptation Policies	Agencies to Consult
<b>Energy (cont.)</b>	Same as above	Decrease carbon emissions.	<ul style="list-style-type: none"> <li>• Improve public transit options and expand options for alternative modes of travel.</li> <li>• Increase public awareness about the benefits of public transit and other non-vehicular travel mode.</li> <li>• Focus on mixed-use and smart growth development strategies that discourage private automobile use.</li> </ul>	
	Increased disruptions to electrical generation and delivery systems due to flooding.	Improve system redundancies and resiliency, and reduce potential for flooding.	<ul style="list-style-type: none"> <li>• Incorporate modifications to protect/retrofit/relocate vulnerable infrastructure.</li> </ul>	
<b>Higher Education</b>	Flooding and property damage to building assets/campuses in low-lying areas.	Reduce flooding impacts to vulnerable facilities.	<ul style="list-style-type: none"> <li>• Provide funding for priority improvement projects.</li> <li>• Harden/repair or relocate vulnerable facilities.</li> </ul>	UH, counties
	Same as above	Reduce automobile dependency.	<ul style="list-style-type: none"> <li>• Improve public transit options and expand options for alternative modes of travel.</li> <li>• Increase public awareness about the benefits of public transit and other non-vehicular travel modes.</li> </ul>	
<b>Health</b>	Increased potential for disease and other public safety issues due to flooding (e.g., vector- or water-borne disease).	Improve disease surveillance and protection.	<ul style="list-style-type: none"> <li>• Increase disease monitoring.</li> <li>• Work with the DOH to promote disease prevention programs.</li> </ul>	DOA, DOH, UH, County Agencies, community organizations, private healthcare providers
	Increased frequency and severity of heat waves.	Reduce impacts of extreme heat events.	<ul style="list-style-type: none"> <li>• Identify and organize/publicize shelters and coping strategies in response to heat extremes.</li> <li>• Support initiatives to plant trees that provide shade and cooling.</li> </ul>	
	Decreased fresh water supplies.	Reduce water demand.	<ul style="list-style-type: none"> <li>• Encourage the use of low-flow fixtures and other water conservation strategies.</li> <li>• Protect aquifers and fresh water supplies.</li> <li>• Implement new technologies to develop alternative water sources (such as desalination plants or recycled wastewater).</li> </ul>	

Area of Concern	Potential Impacts	Preparedness Goal	Possible Adaptation Policies	Agencies to Consult
<b>Health (cont.)</b>	Flooding/damage to community health facilities situated in vulnerable zones.	Reduce impacts to vulnerable facilities.	<ul style="list-style-type: none"> <li>• Protect/retrofit/relocate vulnerable facilities.</li> </ul>	
<b>Historic Preservation</b>	Damage to or loss of historic resources from flooding and inundation.	Maintain and, to the extent possible, protect significant historic and cultural resources.	<ul style="list-style-type: none"> <li>• Assess current conditions and identify the historic resources most vulnerable to climate changes.</li> <li>• Develop public-private partnerships in the management of historic and cultural resources.</li> </ul>	SHPD, County Agencies, community organizations
<b>Water resources</b>	Diminished water quality from saltwater intrusion into fresh and brackish water aquifers and stream estuaries.	Expand and diversify water supplies.	<ul style="list-style-type: none"> <li>• Implement new technologies that supplement declining natural fresh water supplies (e.g., recycled water treatment and irrigation systems, desalination plants).</li> </ul>	DLNR, CWRM, Drought Council, LUC, County water departments
	Reduced aquifer recharge and declining fresh water supplies.	Protect aquifer health.	<ul style="list-style-type: none"> <li>• Enhance existing groundwater supplies through aquifer storage and recovery.</li> </ul>	
	Increased urbanization may reduce prime recharge areas.	Promote functional and healthy watersheds (or <i>ahupua'a</i> ), including upland forests, drainage basins, open space and coastal areas.	<ul style="list-style-type: none"> <li>• Promote reforestation of upland zones.</li> <li>• Protect environmentally sensitive habitats.</li> <li>• Encourage urban landscaping techniques that reduce runoff.</li> </ul>	
	Less rainfall, and more frequent and severe drought conditions.	Similar to above	<ul style="list-style-type: none"> <li>• Adapt agricultural and industrial practices to make the most efficient use of available water resources</li> <li>• Encourage high-efficiency delivery systems for irrigated agriculture.</li> </ul>	
	Increased water demand due to higher temperatures.	Reduce water demand and increase water conservation.	<ul style="list-style-type: none"> <li>• Require conservation measures, such as rainwater harvesting and the use of low-flow fixtures.</li> </ul>	

Area of Concern	Potential Impacts	Preparedness Goal	Possible Adaptation Policies	Agencies to Consult
<b>Housing</b>	Property damage and loss from increased rate of erosion, storm surges and flooding.	Minimize property damage from coastal erosion and flooding.	<ul style="list-style-type: none"> <li>• Develop building standards that include greater resistance to high winds and flooding.</li> <li>• Encourage property owners to pursue retrofitting of existing structures.</li> <li>• Guide (or restrict) new construction away from areas vulnerable to sea-level rise.</li> </ul>	FEMA, LUC, County Agencies, Board of Realtors, public utilities
	Increased demand for housing located in "safe" zones (e.g., outside low-lying coastal areas).	Increase the number of new housing units constructed in non-risk zones.	<ul style="list-style-type: none"> <li>• Provide economic incentives for building in non-risk zones.</li> <li>• Require sellers of coastal properties to disclose potential hazards to buyers.</li> </ul>	
	Increased demand for energy-efficient technologies and "green" building strategies in new home construction.	Expand the use of energy-efficient technologies and "green" building strategies in new home construction.	<ul style="list-style-type: none"> <li>• Require the use of energy-efficient fixtures and the installation of either solar or wind-powered electrical generation systems on all new homes.</li> <li>• Support consumer education programs that focus on conserving energy in the home.</li> </ul>	
<b>Recreation</b>	Loss of shorelines, beaches and natural areas used for public recreation.	Ensure an adequate amount of public recreation areas.	<ul style="list-style-type: none"> <li>• Integrate drainage system improvements into the regional open space network, as possible.</li> </ul>	County agencies, DLNR
	Increased pressure to develop and actively use parklands.	Similar to above	<ul style="list-style-type: none"> <li>• Enhance and integrate opportunities for passive and active recreation within the urban landscape.</li> <li>• Discourage the conversion of recreational areas for other uses.</li> </ul>	
<b>Transportation (roads/highways, airports, harbors, public transit systems)</b>	Disruptions to transportation facilities and networks due to flooding and submersion of coastal infrastructure (e.g., flooding/inundation along coastal roads, shipping delays at harbor facilities and airports, bridge collapse).	Reduce flooding impacts on infrastructure.	<ul style="list-style-type: none"> <li>• Support the implementation of priority infrastructure improvement projects.</li> <li>• Strengthen infrastructure for flooding conditions, including larger bridges and culverts and other storm water conveyance systems.</li> </ul>	Counties, DOT, DLNR, USACE, USCG, OP, LUC, shipping and cargo industries, public utility companies

Area of Concern	Potential Impacts	Preparedness Goal	Possible Adaptation Policies	Agencies to Consult
<b>Transportation (cont.)</b>				
	Greater dependence on ocean transportation networks due to higher fuel costs and submerged land-based transportation facilities.	Improve harbor facilities to take into account higher sea levels.  Reduce dependency on imported goods, to the extent possible.  Utilize new technologies and energy sources that lower transportation costs.	<ul style="list-style-type: none"> <li>• Support the implementation of priority infrastructure improvement projects.</li> <li>• Assess current capacity to improve food sustainability and food security.</li> <li>• Encourage the consumption of locally grown food and products.</li> </ul>	
	Increased demand for public transit options as fuel costs rise and fossil fuel dependency declines.	Reduce automobile dependency.	<ul style="list-style-type: none"> <li>• Improve public transit options and expand options for alternative modes of travel.</li> <li>• Increase public awareness about the benefits of public transit and other non-vehicular travel modes.</li> </ul>	
<b>Utilities (includes municipal water, wastewater treatment, electrical and drainage systems)</b>	Disruptions to operations due to flooding and submersion of utility systems and generation/treatment facilities.	Reduce flooding impacts on utility systems and generation/treatment facilities.	<ul style="list-style-type: none"> <li>• Support the implementation of priority infrastructure improvement projects.</li> <li>• Protect/retrofit/relocate vulnerable utility systems and facilities.</li> </ul>	USACE, DOH, DLNR, DOA, County agencies.
	Increased pipeline corrosion resulting in higher operational and maintenance costs.	Reduce flooding impacts on submerged pipelines.	<ul style="list-style-type: none"> <li>• Support the implementation of priority infrastructure improvement projects.</li> <li>• Protect/retrofit/replace submerged pipelines to address corroding/aging infrastructure.</li> </ul>	
	Increased demands on flood control systems, storm water management systems and drainage areas.	Minimize non-point source pollution and runoff.  Improve on-site water retention.	<ul style="list-style-type: none"> <li>• Protect and enhance significant natural features and ecologically sensitive areas.</li> <li>• Employ retention and detention methods that allow for the gradual release of storm water.</li> <li>• Integrate drainage system improvements into the</li> </ul>	

Area of Concern	Potential Impacts	Preparedness Goal	Possible Adaptation Policies	Agencies to Consult
<b>Utilities (cont.)</b>		Promote functional and healthy watersheds (or ahupua'a), including upland forests, drainage basins, open space and coastal areas.	regional open space network, as possible. <ul style="list-style-type: none"> <li>Encourage urban landscaping techniques that reduce runoff.</li> </ul>	
	Inadequate capacity of utility systems to accommodate development (possible if development quickly retreats from existing developed areas).	Identify and expand capacity to accommodate projected levels of development.	<ul style="list-style-type: none"> <li>Support the implementation of priority infrastructure improvement projects.</li> <li>Partner with federal and state agencies to address and fund deficiencies.</li> </ul>	
<b>Economy</b>	Inundation of beachfront hotels and visitor facilities, and loss of beaches that attract tourists.	Minimize property damage from coastal erosion and flooding.	<ul style="list-style-type: none"> <li>Work with the tourist industry to build resilience and capacity to adapt to changing conditions.</li> <li>Direct major new construction projects away from vulnerable areas.</li> <li>Support beach nourishment in designated areas.</li> </ul>	USACE, DBEDT, PUC, County agencies, visitor industry bureaus, private companies and industries.
	Increased travel and transportation costs (higher airfare and shipping costs) from higher worldwide fuel demand and declining oil sources.	Reduce dependency on imported goods, to the extent possible.  Utilize new technologies and energy sources that lower transportation costs.	<ul style="list-style-type: none"> <li>Assess current capacity to improve food sustainability and food security.</li> <li>Encourage the consumption of locally grown food and products.</li> </ul>	
	Emergence of new industries and technologies, such as alternative energy producers (solar, wind, geothermal, wave power, fuel cell), recycling, shoreline and geo- engineering, vertical farming.	Support job creation in emerging "green" industries and technologies.	<ul style="list-style-type: none"> <li>Support education and job training programs to develop a skilled workforce.</li> <li>Provide incentives to encourage investment in new businesses.</li> </ul>	
	Increased immigration of Pacific Islanders moving to Hawai'i to escape submerged islands.	Manage immigration in a way that minimizes effects on existing residents.	<ul style="list-style-type: none"> <li>Establish programs and services to assist new immigrants.</li> <li>Partner with Federal and State and agencies to</li> </ul>	

Area of Concern	Potential Impacts	Preparedness Goal	Possible Adaptation Policies	Agencies to Consult
			manage immigration and fund programs for immigrants.	

# Appendix B:

## Adaptation Implementation Tools for Regulatory Processes

### **B.1. SMA Permit Evaluation Checklist**

**STEP 1: STANDARDS, HRS § 205A-26(2)** (“No development shall be approved unless the authority has found . . . [t]hat the development is consistent with . . . any guidelines enacted by the legislature.”)

*Is the project consistent with the climate change adaptation priority guidelines?*

Potentially relevant priority guidelines:

- ✓ “Encourage the preservation and restoration of natural landscape features, such as coral reefs, beaches and dunes, forests, streams, floodplains, and wetlands, that have the inherent capacity to avoid, minimize, or mitigate the impacts of climate change”;
- ✓ “Explore adaptation strategies that moderate harm or exploit beneficial opportunities in response to the actual or expected climate change to the natural and built environments”;
- ✓ “Promote sector resilience in areas such as water, roads, airports, and public health, by encouraging the identification of climate change threats, assessment of potential consequences, and the evaluation of adaptation options”; and
- ✓ “Encourage planning and management of the natural and built environments that effectively integrate climate change policy.”<sup>81</sup>

**STEP 2: REASONABLE TERMS AND CONDITIONS, HRS § 205A-26(1)** (“All development in the special management area shall be subject to reasonable terms and conditions . . . .”)

*Does the development provide adequate access, by dedication or other means, to beaches, recreation areas, and natural reserves? HRS § 205A-26(1)(A)*

- ✓ Public access should be sited and designed, managed, and maintained, to avoid significant adverse impacts from future sea-level rise and coastal flooding for the life of the project.<sup>82</sup>

*Does the development include adequate and properly located public recreation areas and preservation of wildlife preserves? HRS § 205A-26(1)(B)*

- ✓ Preservation of wildlife preserves should take into account climate-caused species and habitat migration for the life of the project.<sup>83</sup>

*Does the development include provisions for solid and liquid waste to minimize adverse impacts on SMA resources? HRS § 205A-26(1)(C)*

- ✓ Shutoff valves should be installed to isolate water and sewer lines.<sup>84</sup>

*Will alterations to existing landforms and vegetation cause minimum adverse effect to water resources and scenic and recreational amenities and minimum danger of floods, storm surge, or siltation? HRS § 205A-26(1)(D)*

- ✓ Buffer zones should be established between development and natural features that mitigate flooding and runoff, such as wetlands and sand dunes.<sup>85</sup>

*Will the construction of structures cause minimum danger of floods, wind damage, storm surge, landslides, erosion, or siltation? HRS § 205A-26(1)(D)*



- ✓ The developer should have defined and evaluated vulnerability to all coastal hazards, including short- and long-term erosion.<sup>86</sup>
- ✓ New projects should be: (1) set back from the shoreline so that it is not subject to wave energy, (2) built up so that the bottom floor is above the 100-year flood elevation that takes into account sea-level rise, or (3) designed to tolerate periodic flooding.<sup>87</sup>
  - (1) Set back. The building should be located as far landward as feasible.<sup>88</sup>
  - (2) Build up. The lowest floor should be located above, not at, the current base flood elevation (which does not consider sea-level rise); this also could reduce federal flood insurance costs if the jurisdiction is participating in the community rating system, discussed in part B.6.<sup>89</sup>
  - (3) Resilient Design.
    - The project should be designed to be resilient to a mid-century sea-level rise projection and also adaptable to longer-term impacts.<sup>90</sup>
    - The building should use flood damage-resistant materials below *and* above the current base flood elevation.<sup>91</sup>
- ✓ Use of non-structural fill material should be minimized where flow diversion, wave run-up, or reflection are concerns.<sup>92</sup>
- ✓ Fill material should be similar to existing soils.<sup>93</sup>
- ✓ Building materials should be capable of performing adequately throughout the lifetime of the structure.<sup>94</sup>
- ✓ The project should be strong enough or able to be strengthened to withstand increased wind speeds due to climate change.<sup>95</sup>
- ✓ Where reasonable, buildings should incorporate green roofs or green walls.<sup>96</sup>
- ✓ Drainage systems should be capable of with withstanding more intense rainfall.<sup>97</sup>
- ✓ Outdoor paved areas should utilize permeable surfaces.<sup>98</sup>
- ✓ Outdoor enclosed areas should be minimized to reduce damage to stored contents and reduce flood-borne debris?<sup>99</sup>
- ✓ Lattice, insect screening, or louvers should be used instead of solid breakaway walls.<sup>100</sup>
- ✓ Electrical, heating, ventilation, plumbing, and other equipment should be located on the landward side of building and/or behind a structural element.<sup>101</sup>
- ✓ Storage of damageable items and hazardous materials should be avoided.<sup>102</sup>
- ✓ Structures and water transfers should maximize water efficiency.<sup>103</sup>
- ✓ Projects should use grey water or recycled water where possible.<sup>104</sup>
- ✓ Urban runoff should be minimized.<sup>105</sup>

## **B.2. Guidance for Shoreline Setback “Hardship” Variance Evaluation**

### **STEP 1: REASONABLE USE OF LAND**

- ✓ The proposed use of the land should be reasonable in light of climate change impacts such as sea-level rise and its impacts on the water table, coastal flooding, beach erosion, and vulnerability to storm damage.
- ✓ New buildings should be prohibited within the shoreline setback area, subject to exceptions provided in HRS § 205A-44(b).
- ✓ Generally, new infrastructure is not a reasonable use of the shoreline setback area.
- ✓ In some cases, alterations and repairs to existing buildings or infrastructure could constitute a reasonable use of land.
- ✓ Hard armoring, if legal in Hawaii, could constitute a reasonable use of land if necessary to protect existing development, use, or infrastructure that is consistent with applicable land use policies.<sup>106</sup>
- ✓ Beach or dune nourishment activities, landscape planting, and irrigation should be considered reasonable uses of land *makai* of the shoreline setback line.

### **STEP 2: UNIQUE CIRCUMSTANCES AND THE REASONABLENESS OF THE SHORELINE SETBACK RULES**

- ✓ Unique circumstances should be viewed in light of the purpose of the shoreline setback rules and the statutory objectives and policies of the CZM program, to “reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution”<sup>107</sup>; to “protect beaches for public use and recreation”<sup>108</sup>; and to “conserve open space, minimize interference with natural shoreline processes, and minimize loss of improvements due to erosion.”<sup>109</sup>

### **STEP 3: BEST PRACTICABLE ALTERNATIVE**

- ✓ For alterations and repairs to existing buildings and infrastructure, alternatives considered should include relocation and elevation, such as increasing freeboard elevation, which could qualify the landowner for decreased federal flood insurance, discussed in part B.6. Relocation or increasing freeboard elevation would likely be more practicable than rebuilding in instances where a building has been damaged more than 50% of its value.
- ✓ For hard armoring, alternatives considered should include soft-armoring solutions such as beach and dune nourishment and vegetation.
- ✓ Only if the above alternatives are not practicable should the development be permitted.

### **STEP 4: CONDITIONS**

#### *Maintain shoreline access or compensate for its loss*

- ✓ For existing buildings, the landowner could agree to remove structures once they become inundated as the tide line recedes, threatening public health and safety and the public trust.<sup>110</sup>
- ✓ For existing buildings or hard armoring, the landowner could dedicate a public access easement.<sup>111</sup>

#### *Minimize adverse impacts on beach processes*

- ✓ For existing buildings, the landowner could agree to not seek a variance to build hard-armoring structures in the future should the shoreline retreat. The regulator instead could authorize soft armoring to protect the development.<sup>112</sup>
- ✓ For existing buildings or hard armoring (if legal in Hawaii), the developer could be required to pay an impact fee to cover the costs of beach nourishment to compensate for beach loss.

#### *Minimize risk of structure failure*

- ✓ Buildings, infrastructure, and hard armoring could be required to be capable of withstanding coastal hazards, taking into account sea-level rise, for the life of the structure.<sup>113</sup> For example, buildings could be flood-proofed, hard armoring could use best-available technology, roads could be elevated, and sewer lines could be flood-proofed.<sup>114</sup>

#### *Minimize adverse impacts on public shoreline views*

- ✓ It is important to consider whether requirements such as increased freeboard elevation would adversely impact public shoreline views.

## **B.3. Project-level Climate Change Hazard Assessment**

Project-level hazard assessments can be used to identify potential climate-related impacts to a particular parcel or project. These assessments can inform land use decisions to better protect property and public health and safety. The breadth of climate-related impacts included in a hazard assessment depends on the scope and precision of available data. Specifically, project-level hazard assessments could inform state district boundary amendments, discussed in Section B.4 or environmental review, discussed in Section B.3. The list of model project-level climate change hazard assessment contents below, adapted from an example in the *Hawaii Coastal Hazard Mitigation Guidebook*,<sup>115</sup> can serve as starting point for conducting hazard assessments specific to climate change.

### *Possible Contents*

- Erosion rate.
- Erosion zone, adjusted for sea-level rise and storm erosion factors.
- Wave (V-VE), flood (A-AE-X), and inland zones based on Federal Flood Insurance Rate (FIRM) maps and adjusted for potential erosions.
- Superimposition of property and project maps with erosion and wave zones.
- Other best-available reports, as applicable to the parcel or project, such as:
  - the Atlas of Natural Hazards in the Hawaiian Coastal Zone (Fletcher et al., 2002)
  - wind strength maps
  - flood inundation zones
  - lava flow risk areas
  - sea-level rise inundation maps
  - sea-level rise and water table maps
  - sea-level rise and tsunami inundation zone maps
- Identification of natural inundation buffers such as sand dunes, wetlands, and estuaries.
- Identification of a long-term source of fresh water for the project.
- If critical facilities and structure are proposed in the flood zone, discuss why these facilities are needed there and any mitigation measures to reduce the risk of damage. Critical facilities should not be in the erosion or wave zone.
- Certification. Certify that the assessment was conducted by an experienced qualified professional using best professional judgment. A statement should be made that risks to future residents from coastal erosion, wave inundation and flooding have been minimized. Sufficient information should be included on erosion and flooding that will allow the approving county agency to certify that the site is suitable for its intended use, for structures with inhabitants that may be on site for 70 to 100 years.

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<sup>1</sup> *Climate Change and Pacific Islands: Indicators and Impacts, Report for the 2012 Pacific Islands Regional Climate Assessment 22-25* (V. W. Keener, J. J. Marra, M.L. Finucane, D. Spooner & M.H. Smith eds. 2012) [hereinafter *PIRCA Report*].

<sup>2</sup> *Id.* at 25-28.

<sup>3</sup> Letter from Neil Abercrombie, Governor, State of Hawai'i, to Pacific Islands Regional Climate Assessment (PIRCA) Team (Mar. 7, 2012).

<sup>4</sup> Hawai'i Revised Statutes (HRS) § 226-109.

<sup>5</sup> *Id.* § 226-2.

<sup>6</sup> *Id.* § 226-52.

<sup>7</sup> The City and County of Honolulu is the only jurisdiction in Hawai'i that adopts the general plan (GP) by resolution instead of by ordinance. All of the counties, including Honolulu, adopt county development plans (DPs) by ordinance. The GPs are updated every ten years.

<sup>8</sup> HRS § 226-58.

<sup>9</sup> *Id.*

<sup>10</sup> *Id.*

<sup>11</sup> Each county charter contains its own planning framework, and second-tier, community-level planning varies among the counties. Kaua'i County has six DPs as well as public facility plans. Hawai'i County has functional plans, nine community development plans (CDPs), and area improvement plans. Maui County has an Island Plan and nine community plans (CPs). The City and County of Honolulu has eight sustainable communities plans (SCPs).

<sup>12</sup> 2012 Haw. Sess. Laws, 26th Leg., Act 286, § 1.

<sup>13</sup> One of the proposed objectives in *Strategies Under Consideration*, a booklet outlining proposals for revising the Hāmākua CDP, is to "Identify a shoreline safety zone that integrates the best knowledge and factors sea level rise, potential for tsunami inundation/ evacuation, hurricane storm surge, and coastal bluff erosion." *Hāmākua Community Development Plan, Strategies Under Consideration* 55 (2012).

<sup>14</sup> Counties may develop "no-regrets" strategies that more specifically address the management needs of land uses and infrastructure vulnerable to local climate impacts by overlaying existing GIS data layers and land use maps to identify "impact areas" or by conducting county-level vulnerability assessments.

<sup>15</sup> City & Cnty. of Honolulu, Ord. No. 11-3 (Apr. 20, 2011) [hereinafter *North Shore SCP*].

<sup>16</sup> *Id.* at 1-1 to 1-4.

<sup>17</sup> *Id.* at 2-13.

<sup>18</sup> *Id.* at 2-11.

<sup>19</sup> *See id.* at 3-2 to 3-67.

<sup>20</sup> *See id.* 3-2 to 3-19.

<sup>21</sup> *Id.* at 3-34.

<sup>22</sup> *Id.* at 4-1 to 4-29.

<sup>23</sup> *Id.* at 5-1.

<sup>24</sup> *Id.* at 5-7 to 5-32.

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<sup>25</sup> *Id.* at 3-9.

<sup>26</sup> *Id.* at 3-11 to 3-13.

<sup>27</sup> *Id.* at 4-22.

<sup>28</sup> *Id.* at 4-22 to 4-23.

<sup>29</sup> See HRS ch. 205A, pt. 2.

<sup>30</sup> *Id.* § 205A-2.

<sup>31</sup> 16 U.S.C. § 1451(l).

<sup>32</sup> *Id.* § 1452(2)(B).

<sup>33</sup> HRS §§ 205A-1, 205A-3.

<sup>34</sup> *Id.* § 205A-26.

<sup>35</sup> *Id.* §§ 205A-2(c)(9)(A).

<sup>36</sup> *Id.* § 205A-43(a). State law defines the shoreline as “the upper reaches of the wash of the waves, other than storm or seismic waves, at high tide during the season of the year in which the highest was of the waves occurs, usually evidenced by the edge of vegetation growth, or the upper limit of debris left by wash of the waves.”<sup>36</sup> *Id.* § 205A-1; HAR § 13-222-2.

<sup>37</sup> HRS § 205A-45(a). In the City and County of Honolulu and Hawai‘i County, the shoreline setback is a fixed distance from the certified shoreline. Rev. Ord. Honolulu (ROH) § 23-1.4(a); Hawai‘i Cnty. Planning Dep’t R. (HCPD) § 11-5(a). Kaua‘i and Maui counties incorporate average lot depth and coastal erosion rates into their shoreline setback calculations. Kaua‘i Cnty. Code (KCC) § 8-27.3(b) Table 1, Table 2; Maui Planning Comm’n Shoreline R. (MPC) §§ 12-203-6(a)(i)-(ii).

<sup>38</sup> Tara M. Owens et al., Univ. of Haw. Sea Grant Coll. Program, *Facing Our Future: Adaptive Planning for Sea-level Rise in Maui and Hawaii Counties* 19-20 (2012). In Maine, no shoreline permits are granted for structures greater than 2,500 square feet if two feet of sea-level rise over 100 years is expected to erode the property and cause severe damage to the project. The applicant must determine the future shoreline using the Bruun Rule or another generally accepted coastal engineering model. *Id.* at 20.

<sup>39</sup> Telephone interview with Lesley, Ewing, Senior Coastal Engineer, California Coastal Commission (June, 27, 2012) (stating that the California Coastal Commission staff currently is drafting language for the *California Interim Guidelines for Sea-Level Rise* to include a more quantitative methodology for adding accelerated erosion and inundation from future sea-level rise into the setback calculations. The methodology will account for accelerated erosion and flooding related to anticipated sea-level rise in a similar way laid out by Russell and Griggs (2012). This methodology is best where erosion data are available, because future projections for coastal retreat are extrapolated using existing erosion trends, adding a safety factor proportional to expected future sea level rise and adding increases in storm wave heights appropriate for the particular region of concern.).

<sup>40</sup> HRS §§ 205A-46.

<sup>41</sup> *Id.* §§ 205A-46(a)(8), 205A-46(a)(9).

<sup>42</sup> *E.g.*, ROH § 23-1.8(b)(3)(B).

<sup>43</sup> HRS §§ 205A-46(c).

<sup>44</sup> *Nollan v. California Coastal Comm’n*, 483 U.S. 825 (requiring an “essential nexus”); *Dolan v. City of Tigard*, 512 U.S. 374 (1994) (requiring “rough proportionality”).

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<sup>45</sup> *E.g.*, Haw. Cnty. Code (HCC) ch. 27.

<sup>46</sup> Jessica Grannis, Georgetown Climate Ctr., *Analysis of How the Flood Insurance Reform Act of 2012 (H.R. 4248) May Affect State and Local Adaptation Efforts* 4 (Aug. 1, 2012).

<sup>47</sup> *Id.*

<sup>48</sup> *Id.*

<sup>49</sup> See Fed. Ins. Admin., FEMA, *National Flood Insurance Program Community Rating System, CRS Credit for Higher Regulatory Standards* (2006).

<sup>50</sup> See *e.g.*, FEMA P-55, *Coastal Construction Manual, Principles and Practices of Planning, Siting, Designing, Constructing, and Maintaining Residential Buildings in Coastal Areas* P-55 5-21 to 5-31 (4th ed. 2011) [hereinafter *FEMA P-55*].

<sup>51</sup> See HRS ch. 343.

<sup>52</sup> See *id.*

<sup>53</sup> *Id.* § 343-5.

<sup>54</sup> *Id.* § 343-2.

<sup>55</sup> *Id.* § 343-5.

<sup>56</sup> Hawai'i Administrative Rules (HAR) § 11-200-12(b)(11).

<sup>57</sup> *Id.* § 11-200-12(b)(2).

<sup>58</sup> *Id.* § 11-200-12(b)(4).

<sup>59</sup> *Id.* § 11-200-12(b)(5).

<sup>60</sup> HAR §§ 11-200-10(6), 11-200-17(b)(4).

<sup>61</sup> *Id.* §§ 11-200-10(7), 11-200-17(b)(3).

<sup>62</sup> HRS ch. 205.

<sup>63</sup> HAR ch. 15-15.

<sup>64</sup> HRS § 205A-2; HAR §§ 15-15-18 to 15-15-21.

<sup>65</sup> See HRS ch. 205; HAR ch. 15-15.

<sup>66</sup> HRS §§ 205A-3.1(b), 205A-3.1(c).

<sup>67</sup> HAR § 15-15-18(3).

<sup>68</sup> *Id.* § 15-15-18(2)(B).

<sup>69</sup> *Id.* § 15-15-20(1).

<sup>70</sup> *Id.* § 15-15-20(2).

<sup>71</sup> See Dennis Hwang, *Hawaii Coastal Hazard Mitigation Guidebook* 82-83 (2005).

<sup>72</sup> HAR § 15-15-50(c)(9).

<sup>73</sup> *Id.* § 15-15-50(c)(10).

<sup>74</sup> *Id.* § 15-15-50(c)(11).

<sup>75</sup> *Id.* § 15-15-50(c)(16).

<sup>76</sup> *Id.* § 15-15-50(c)(17).

<sup>77</sup> *Id.* § 15-15-50(c)(18).

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<sup>78</sup> See *id.* § 15-15-90(e) (listing twenty-four mandatory conditions).

<sup>79</sup> Hwang, *supra* note 71, at 85.

<sup>80</sup> HRS § 205A-18.

<sup>81</sup> *Id.* § 226-109.

<sup>82</sup> San Francisco Bay Conservation and Development Commission, *Staff Report, Living with a Rising Bay: Vulnerability and Adaptation in San Francisco Bay and on its Shoreline* 128 (2011) [hereinafter *BCDC Staff Report*].

<sup>83</sup> *Id.* at 88.

<sup>84</sup> *FEMA P-55, supra* note 50, at Table 5-2.

<sup>85</sup> *BCDC Staff Report, supra* note 82, at 129-30.

<sup>86</sup> *FEMA P-55, supra* note 50, at Table 5-2.

<sup>87</sup> *BCDC Staff Report, supra* note 82, at 126.

<sup>88</sup> *FEMA P-55, supra* note 50, at Table 5-2.

<sup>89</sup> *Id.*

<sup>90</sup> *BCDC Staff Report, supra* note 82, at 138.

<sup>91</sup> *FEMA P-55, supra* note 50, at Table 5-2.

<sup>92</sup> *Id.*

<sup>93</sup> *Id.*

<sup>94</sup> South East Climate Change Partnership, *Adapting to climate change: a case study companion to the checklist for development* 53 (2007) [hereinafter *SECCP Checklist*].

<sup>95</sup> *Id.*

<sup>96</sup> *Id.*

<sup>97</sup> *Id.*

<sup>98</sup> *Id.* at 54.

<sup>99</sup> *FEMA P-55, supra* note 50, at Table 5-2.

<sup>100</sup> *Id.*

<sup>101</sup> *Id.*

<sup>102</sup> *Id.*

<sup>103</sup> US Environmental Protection Agency Region 9 & Cal. Dep't of Water Resources, *Climate Change Handbook for Regional Water Planning* 6-11, 6-17 (2011) [hereinafter *EPA Climate Change Handbook*].

<sup>104</sup> *Id.* at 6-13 – 6-14.

<sup>105</sup> *Id.* at 6-18.

<sup>106</sup> *BCDC Staff Report, supra* note 82, at 4.

<sup>107</sup> HRS § 205A-2(b)(6)(A).

<sup>108</sup> *Id.* § 205A-2(b)(9)(A).

<sup>109</sup> *Id.* § 205A-2(c)(9)(A).



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<sup>110</sup> Jessica Grannis, Georgetown Climate Ctr., *Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use* 30 (2011) [hereinafter *Adaptation Tool Kit*].

<sup>111</sup> *Id.*

<sup>112</sup> *Id.*

<sup>113</sup> *BCDC Staff Report*, *supra* note 82, at 126.

<sup>114</sup> *Id.* at 30.

<sup>115</sup> Hwang, *supra* note 71.