

Adaptation Responses

ADAPTING TO RISING TIDES PROJECT

JULY 2013

In considering how to best address the vulnerabilities identified in the ART subregion, the project team and working group determined the need for comprehensive approach that went beyond a simple list of strategy names. The result was the development of the ART subregional adaptation responses that clearly link actions to the vulnerability(s) that they would reduce, identify when it is important to take a phased or sequential approach, and acknowledge alternative actions that will require considering trade-offs and costs/benefits. For the cross-sector, cross-jurisdictional issues identified in the ART project, the adaptation responses are a springboard for participating agencies, organizations and communities to collectively begin to take action together. For the issues identified that affect a single jurisdiction or agency, the subregional adaptation responses are the foundation from which an adaptation plan can be developed or individual actions can be selected, refined and initiated.

The ART adaptation response contains three core elements: (1) a key vulnerability; (2) actions to directly address the vulnerability; and (3) the likely steps, partners, and processes necessary to initiate and administer the actions. Additionally, each action was characterized by its type and priority, and the scale(s) at which it would be implemented.

The ART adaptation responses consist of three elements:

A **key vulnerability** provides a direct link to the outcomes of the assessment so that the most critical issues identified are addressed. Including the key vulnerability is a clear and transparent means to ensure that each action is connected to an identified planning issue.

One or more **actions**. While some vulnerabilities can be addressed by a single action most require multiple actions. Many actions can be taken at the same time, while others act as a series of sequential steps that incrementally build towards resilience.

Implementation options are a guide for those that want to initiate actions. The options identify the possible actors that will need to be at the table, whether actions could be incorporated into existing planning or collaborative processes, or if new initiatives will be needed.

Components of an Adaptation Response

Assessment findings for the ART subregion were summarized within and across the twelve asset categories evaluated. This organization allowed the project team to identify asset categories that had similar vulnerabilities identified relationships and dependencies among the assets, eliminated redundancies, and highlighted the unique vulnerabilities of specific asset categories.

Five broader asset categories were developed from the original 12 asset categories assessed within the subregion:

- **Overarching** – Vulnerabilities that cut across many or all asset categories.
- **Community Land Use** – Community Land Use, Facilities and Services, Contaminated Lands and Hazardous Material Sites
- **Transportation** – Ground Transportation, Airport and Seaport
- **Utilities** – Energy, Pipelines & Telecommunications, Stormwater and Wastewater
- **Shorelines** – Natural Shorelines, Structural Shorelines and Parks and Recreation Areas

Key vulnerabilities were identified for these broader categories and this formed the basis of subregional scale adaptation responses.

Key Vulnerability

The ART subregional adaptation responses start with a key vulnerability that had been classified using the system developed by the ART project to characterize and communicate vulnerabilities and risks¹. The vulnerability classifications – information, management, physical and functional – classifications make it easier to identify specific and appropriate actions, the potential actors to be involved, and the processes and scales at which to implement the actions.

For example, “information vulnerabilities” describe assets and issues where a lack of information or inadequate access to information makes it difficult to assess the problem and develop an appropriate response. Information vulnerabilities that were identified during the ART assessment include a lack of information on the condition of shoreline protection; difficulty in obtaining access to information regarding the elevations and condition of ground transportation; and a lack of analysis and data on how ground water will be affected by rising sea levels. These kinds of vulnerabilities are more economically and effectively

¹ See Chapter 3 of the ART Vulnerability and Risk Assessment Report for a description of the classification system (www.adaptingtorisingtides.org/vulnerability-and-risk-report/).

addressed through evaluations or assessments conducted at a regional or system-wide scales. Informational vulnerabilities are often the necessary first step before more refined assessments can be conducted or actions prioritized and implemented.

Understanding the type of vulnerability can more quickly lead to a targeted and appropriate response to resolve the real issues faced, avoiding potentially costly and unnecessary actions.

Action

Each action in the adaptation responses is described and identified by action types² - evaluation, policy development, coordination, program/operation, and education/outreach. These action types communicate the activities and processes required, and provide a means to identify actions requiring similar kind of efforts.

Implementation Options, Possible

The adaptation responses include implementation options that highlight the potential actors –the agencies, organizations, individuals or groups – who should be involved and the processes into which the actions could be integrated.

Possible Actors in the ART Subregion

Possible actors are identifies in the ART subregional adaptation responses that will likely be involved in action initiation and administration. Actors include those that are likely to lead action implementation (often asset owners or operators), as well as potential decision-making or funding partners, regulatory or permitting agencies, non-profit and community organizations, the private sector, landowners, and the owners and operators of adjacent properties or interconnected infrastructure.

Not all of the actors identified will either choose or need to be engaged in implementation. In other cases, the list of possible actors is not comprehensive and it will be necessary to seek a broad range of participation from all levels of governance³ – from the private sector, to community organizations, to surrounding neighborhoods, organizations and agencies, as well as others with adjacent or interconnected assets.

Acronym	Full Name
ACEH	Alameda County Environmental Health
ACFCWCD	Alameda County Flood Control & Water Conservation District
ACPHD	Alameda County Public Health Department
AT&T	American Telephone and Telegraph Company
ABAG	Association of Bay Area Governments
BAAQMD	Bay Area Air Quality Management District
BART	Bay Area Rapid Transit

² Action Type was adapted from the Association of Bay Area Government's (ABAG) Regional Resilience Initiative Action Plan, available at http://quake.abag.ca.gov/resilience_initiative/.

³ For information on issues regarding governance and adaptation, see the *Adapting Governance to Rising Tides Issue Paper* available at <http://www.adaptingtorisingtides.org/governance/>.

Caltrans	California Department of Transportation
CalEMA	California Emergency Management Agency
CPUC	California Public Utilities Commission
CTC	California Transportation Commission
CCJPA	Capital Corridor Joint Powers Authority
CUPA	Certified Unified Program Agency
CBO	Community Based Organization
CMA	Congestion Management Agency
CDPH	California Department of Public Health
DBW	Department of Boating and Waterways
DFW	Department of Fish and Wildlife
DPW	Department of public works
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
EBDA	East Bay Dischargers Authority
EBMUD	East Bay Municipal Utility District
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HARD	Hayward Area Recreation and Park District
JPC	Joint Policy Committee
MTC	Metropolitan Transportation Commission
NOAA	National Oceanic and Atmospheric Administration
NPO	Non Profit Organization
OPR	Office of Planning and Research
OLSD	Oro Loma Sanitary District
PG&E	Pacific Gas & Electric
PHMSA	Pipeline and Hazardous Materials Safety Administration
RAPC	Regional Airport Planning Committee
RASPA	Regional Airport Systems Planning Analysis
RDA	Regional Development Agency
RWQCB	Regional Water Quality Control Board
BCDC	San Francisco Bay Conservation and Development Commission
SFBRA	San Francisco Bay Restoration Authority
SFEP	San Francisco Estuary Partnership
SWRCB	State Water Resources Control Board
UP	Union Pacific Railroad
USD	Union Sanitary District
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
USACE	US Army Corps of Engineers
DOT	US Department of Transportation
WETA	Water Emergency Transportation Authority

Possible Processes

For the ART subregional adaptation responses, the possible planning mechanisms, governance structures or collaborative approaches that could be used to implement adaptation actions were grouped into eight broad categories. These include most of mechanisms, structures and approaches that agencies, organizations and stakeholders in the ART subregion currently use, as well as a new initiative category that indicates the possible need for changes to existing laws and policies, other organizational shifts, or a need for new funding sources.

Capital Planning	Project Planning and Design
Capital improvement plans Caltrans Project in Development (PID)	Private and public development projects Restoration project planning and permits
Codes and Standards	Long-Range Planning
Building codes and standards City ordinances Construction codes Design standards State and federal standards Other standards, e.g., professional organizations or committees	Agency or facility master plan Climate Action Plan Community-based planning Regional Airport Sustainability Plan (RASP) Regional Transportation Plan (RTP) Sustainable Communities Strategy (SCC) Integrated Water Resource Management Plan (IRWMP)
Emergency and Hazard Planning	Land-Use Planning
State or local hazard mitigation plans Emergency response and recovery plans Standardized Emergency Management Systems (SEMS) National Incident Management System	General plan Specific plan Land use plan
Operations	New Initiatives
Annual budgeting Continuity of Operations Plans (COOP) State Highway Operation and Protection Program (SHOPP)	Partnerships and collaborations Ballot measures Legislation

Action Implementation

Actions are also characterized according to potential priority, phasing, and scale of action implementation. Four of the action characterizations – Unlocking, Do It Yourself, Multi-Benefit, and Long Lead Time – indicate the potential timing or priority of action initiation, while one – Scale – indicates the possible geographic scales at which an action could be implemented.

Action Characterization	Description
Unlocking	Actions that can enable other actions. Some unlocking actions contribute independently to resilience, while others serve primarily as stepping stones to other actions. Unlocking actions are generally high priority for implementation as they are often the foundation on which many other actions depend. However, depending on the vulnerability the action addresses and the potential magnitude of the consequences, not all unlocking actions will be taken first as other actions may be higher priority or provide multiple benefits and therefore would be easier to gain support and funding for.
Do it Yourself (DIY)	Actions that an asset owner or operator could take on independently without the formation of new partnerships or collaborations. DIY does not imply a 'go it alone' approach, as owners and operator will need to comply with existing regulations and it may be beneficial to seek participation from other entities. DIY does indicate the actions that can be taken without changes to existing regulations, possibly using existing funding streams or operational processes such as regular maintenance or upgrades tied to asset lifecycle
Multi-benefit	Actions that will improve asset performance or provide community benefits beyond improving the resilience to climate change. These benefits may include addressing other hazards such as earthquakes, improving the local quality of life, for example through new recreational opportunities, or encouraging the local economy. Investments in actions that provide multiple benefits that in near term can improve sustainability and help to address existing challenges.
Long Lead Time	Actions that should be implemented early as they generally require the coordination of many partners, will result in formal agreements, joint planning or funding decisions, require difficult decision making or are controversial, include a number of different assets, or require collaborative regional planning or research.
Scale	Indicates the geographic scale at which an action could be carried out. Local actions are those that would be taken at the city or county level; regional actions across the entire nine county Bay Area by the agencies, organizations or entities that operate at this scale; state actions by state agencies or state-wide organizations or entities; or at the federal level by national agencies or partners

The elements of each adaptation response are presented together in the **ART Subregional Adaptation Response Cards**, organized according to the five broader categories. A **Guide** that explains each element presented on the adaptation response cards follows

The ART Subregional Adaptation Responses

Guide to the Adaptation Response Cards

Vulnerability Classification: Indicates whether the vulnerability is related to lack of information, management control challenges, physical qualities or functional qualities.

Vulnerability: A brief description of the subregional vulnerability addressed in the adaptation response. Vulnerabilities are numbered for navigation only and number does not indicate priority.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
Actions are numbered to assist with navigation. They do not indicate ranking or priority. For actions that can be taken sequentially the numbers indicate that order.	The action or actions to address the identified vulnerability. Some responses include a series of related actions that could or should be taken together.	The type of action, categorized into one of five general themes.	The mechanism(s) through which the action could be implemented. Some processes are existing and possibly ongoing, while others will be new initiatives. There can be more than one process by which to implement any given action.	Agencies and organizations that could be involved in implementing the action. Actors include lead agencies (often asset owners or operators), as well as regulators, funders, and other potential partners.	Guidance for selecting and prioritizing actions.

Action Types

- Evaluation – actions to improve data and information or conduct new analyses
- Program/Operation – actions to update plans, procedures or management activities
- Policy development – actions to develop or revise policies and guidelines
- Coordination – actions to initiate or expand partnerships
- Education/ outreach – actions to communicate information and build awareness

Processes

- Long-range planning, e.g., master plan, climate action plan
- Land use planning, e.g., general plan, specific plan
- Capital planning, e.g., capital improvement plan
- Operations, e.g., annual budgeting
- Codes and Standards, e.g., city ordinance, design standards
- Emergency & hazard planning e.g., hazard mitigation plans
- Project planning & design, e.g., private and public development projects
- New Initiatives e.g., legislation, ballot measure

Action Characterization

- Local, Regional, State, Federal: scale(s) of implementation
- Unlocking: enables other actions
- Do it Yourself: land owner or manager could implement within existing laws and policies and with existing funding sources
- Multi-Benefit: confers benefits beyond sea level rise and storm event resilience
- Long Lead Time: Urgent due to long implementation timeframe, near-term impacts, complex planning process, or large number of actors

Overarching Adaptation Response

Adapting to Rising Tides

Information Vulnerability

Vulnerability O1: Information about the effects of sea level rise on groundwater levels and salinity intrusion is insufficient for assessing vulnerability and risk, supporting identification of priority issues, and developing adaptation responses.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
O1.1	Coordinate with local, regional, state, and federal agencies, academic researchers, and the private sector to improve the region's understanding of how sea level rise will affect groundwater levels	Evaluation, Coordination	Long-range Planning, New Initiative	USGS, FEMA, NOAA, USACE, RWQCB, ABAG, Regional Agencies, DTSC, Cities, County, Water Districts, Academic Institutions, Private Sector	Unlocking, Multi-benefit, Regional, Long Lead Time
O1.2	Develop a collaborative monitoring program to measure groundwater levels and salinity intrusion through cost-sharing or other agreements, and make the data publically available through a centralized database	Evaluation, Coordination	Long-range Planning, Operations, New Initiative	USGS, FEMA, NOAA, USACE, RWQCB, ABAG, DTSC, Cities, County, Water Districts, Private Sector	Unlocking, Multi-benefit, Regional, Long Lead Time

Information Vulnerability

Vulnerability O2: There is limited availability of and access to regionally relevant, current and historic weather data needed to understand flood risk.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
O2.1	Develop agreements with state and federal agencies to make historic weather observations easily accessible, improve collection of current weather and water condition data, and provide summarized weather data through a centralized coordinated database	Coordination	New Initiative	NOAA, USGS, USACE, FEMA, DWR, BCDC, SCC, RWQCB	Multi-benefit, Unlocking, Regional, State, Long Lead Time

Information Vulnerability

Vulnerability O3: Flood risk maps rely on historic flooding to determine coastal hazard zones and do not factor in sea level rise. Additionally, many communities do not have access to recent coastal hazard (100-year flood) maps or the underlying data that could support shoreline adaptation planning.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
O3.1	Engage federal agencies including FEMA, NOAA and USGS in a regional coordination effort to ensure the timely update of flood maps and access to data, studies, and models to help the region better understand future risks as sea level rises	Coordination	Long-range Planning, New Initiative	NOAA, USGS, USACE, FEMA, OPR, DWR, ABAG, BCDC, SCC, RWQCB, Cities, County, Flood Control Districts	Unlocking, Multi-benefit, Regional, Long Lead Time

Information Vulnerability

Vulnerability O4: There is a limited understanding of how dynamic baylands habitats such as tidal marshes, intertidal mudflats, and subtidal areas will respond to accelerating sea level rise, or how these habitats will be affected by shoreline adaptation responses (e.g., structural solutions such as levees) that may change tide, wave or sediment conditions.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
O4.1	Establish and support a regional research agenda to advance the understanding of how baylands will respond to accelerating sea level rise in light of declining sediment supply and limited space to migrate inland	Evaluation, Coordination	Long-range Planning, New Initiative	EBRPD, HARD, ACFCWCD, SCC, DFW, BCDC, RWQCB, Port, USACE, USFWS, FEMA, City, County, CBOs, Private Sector, SFBRA	Unlocking, Regional, Long Lead Time
O4.2	Research and test restoration and management actions that will improve baylands resilience	Evaluation	Project Planning and Design	EBRPD, HARD, ACFCWCD, SCC, DFW, BCDC, RWQCB, Port, USACE, USFWS, FEMA, City, County, CBOs, Private Sector, SFBRA	Unlocking, Regional, Long Lead Time
O4.3	Develop and implement a Regional Sediment Management Plan for the Bay	Coordination, Policy Development	Long-range Planning, New Initiative	CSMW, BCDC, USEPA, USACE, RWQCB, LTMS stakeholders, USFWS, NOAA, City DPW, Flood Control Agencies, Private Sector	Unlocking, Multi-benefit, Regional, Long Lead Time

Information Vulnerability

Vulnerability O4 (continued): There is a limited understanding of how dynamic baylands habitats such as tidal marshes, intertidal mudflats, and subtidal areas will respond to accelerating sea level rise, or how these habitats will be affected by shoreline adaptation responses (e.g., structural solutions such as levees) that may change tide, wave or sediment conditions.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
O4.4	Develop a decision-making framework for selecting resilient, multi-objective shoreline adaptation responses given economic, environmental and social equity trade-offs	Policy Development	New Initiative	EBRPD, HARD, ACFCWCD, SCC, DFW, BCDC, RWQCB, Port, USACE, USFWS, FEMA, City, County, CBOs, Private sector, SFBRA	Unlocking, Regional, Long Lead Time

Information Vulnerability

Vulnerability O5: Proactive management of baylands to improve their resilience to sea level rise and storm events involves confronting regulatory requirements related to state and federal threatened, endangered, and special status species. Maintenance, upgrade, repair and restoration of baylands require review and authorization from multiple state and federal agencies, often with limited work windows and restrictions on the type of actions that can be taken.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
O5.1	Research the potential benefits or conflicts of various types of potential baylands adaptation responses to better quantify potential impacts to habitat values and ecosystem services in the short and long term and at the local and regional scale	Evaluation	New Initiative	EBRPD, HARD, ACFCWCD, SCC, DFW, BCDC, RWQCB, Port, USACE, USFWS, FEMA, City, County, CBOs, Private Sector, SFBRA	Unlocking, Regional, Long Lead Time

Management Control Vulnerability

Vulnerability O6: Capital investment planning, design, and funding for new infrastructure or for substantial repairs and improvements to existing infrastructure do not consider sea level rise impacts. Infrastructure designed to remain in place for longer spans of time and that is not built or rebuilt to be resilient to flooding and salt-water exposure will need to be protected or retrofitted long before the end of the expected life of the infrastructure. Resources to maintain or improve existing infrastructure are limited, and investments needed in the future to address sea level rise will affect financial resources, economic opportunities, and communities.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
O6.1	Develop policies or incentives to require or encourage the consideration of sea level rise and storm events in developing, planning, and funding capital investments	Policy Development	Long-range Planning, Land Use Planning, Capital Planning, Codes and Standards	DWR, BCDC, ABAG, MTC, CPUC, Caltrans, CMAs, County, Cities	Do It Yourself, Unlocking, Local, Regional, State
O6.2	Prioritize capital investments and new infrastructure in low-risk areas; in particular, plan and construct new public infrastructure in areas not projected to be at risk of sea level rise or storm events	Policy Development, Program/Operation	Long-range Planning, Land Use Planning, Capital Planning	DWR, BCDC, ABAG, MTC, CPUC, Caltrans, CMAs, County, Cities	Do It Yourself, Local, Regional, State
O6.3	Develop a decision-making framework for determining if substantial repairs or improvements to protect existing infrastructure from sea level and groundwater rise should be made, or if it should be located or relocated in an area not at risk	Policy Development	Long-range Planning, Capital Planning, New Initiative	DWR, BCDC, ABAG, MTC, CPUC, Caltrans, CMAs, County, Cities	Do It Yourself, Unlocking, Local, Regional, State, Long Lead Time

Overarching Adaptation Response

Adapting to Rising Tides

Management Control Vulnerability

Vulnerability O7: Many of the plans, policies, and practices that guide community development, land use planning, emergency planning, and capital investments do not consider sea level rise or the adaptation responses that will be necessary to reduce the vulnerabilities and risks to both natural and built environments associated with sea level rise.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
O7.1	Qualify for and maintain the highest feasible rating under the Community Rating System of the National Flood Insurance Program to reduce flood risks and the cost of private property insurance	Policy Development, Program/Operation	Emergency and Hazard Planning	ABAG, FEMA, CalOES, Cities, County	Do It Yourself, Local
O7.2	Prepare, adopt, implement, and update comprehensive recovery plans to direct how and where state or federal disaster recovery funds are used to rebuild resilient communities after storm events	Policy Development	Emergency and Hazard Planning	ABAG, FEMA, CalOES, Cities, County	Do It Yourself, Multi-benefit, Local, Regional, State, Long Lead Time
O7.3	Require the consideration of sea level rise in land use plans and project designs, e.g., General Plan Safety Elements	Policy Development	Land Use Planning, Codes and Standards	Cities, Counties, OPR	Do It Yourself, Unlocking, Local, Regional, State
O7.4	Evaluate the feasibility of applying adaptive management to Land Use Planning and decision making	Evaluation	New Initiative	BCDC, ABAG, MTC, OPR	Regional, State

Management Control Vulnerability

Vulnerability O7 (continued): Many of the plans, policies, and practices that guide community development, land use planning, emergency planning, and capital investments do not consider sea level rise or the adaptation responses that will be necessary to reduce the vulnerabilities and risks to both natural and built environments associated with sea level rise.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
O7.5	Improve coordination among agencies to ensure consistent regulatory and planning approaches to sea level rise adaptation, and to reduce programmatic or legislative barriers to assessing and addressing future risks	Coordination, Policy Development	Long-range Planning	BCDC, ABAG, MTC, Cities, County	Unlocking, Regional, Long Lead Time
O7.6	Develop incentives for clustered development in low-risk areas using density bonuses, reduced impact fees, tax incentives and streamlined permitting	Policy Development	Long-range Planning, Land Use Planning	BCDC, ABAG, MTC, OPR, Cities, County, California Natural Resources Agency	Do It Yourself, Local, Regional, State
O7.7	Create a voluntary transfer of development rights program to allow property owners to sell development rights in high-risk areas in exchange for rights in a low-risk areas	Policy Development	Land Use Planning, Codes and Standards	Cities, County, State	Do It Yourself, Local, Regional, State
O7.8	Use rolling easements to establish a boundary that moves inward as sea level rises along the Bay shoreline	Policy Development	Long-range Planning, Land Use Planning, Legislation	Cities, County, Special Districts, State	Do It Yourself, Local, Regional, State

Management Control Vulnerability

Vulnerability O8: Non-profit, faith, and community-based organizations play a critical role in building and maintaining community resilience. Many of these organizations do not have the capacity to fully participate in climate planning efforts. Government agencies and organizations also lack the capacity and processes to engage non-governmental organizations in planning and decision-making to ensure the robust, sustained partnerships that will be necessary to address climate change in an equitable, environmentally conscientious, and economically feasible manner.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
O8.1	Conduct community-led campaigns to build public support for community groups and leaders to participate in collaborative efforts to address current and future climate stressors, including sea level rise and storm events	Education/ Outreach	Long-range Planning, New Initiative	BCDC, ABAG, MTC, BAAQMD, Cities, Counties, NPOs, CBOs, CDPH	Unlocking, Local, Regional
O8.2	Work with decision-makers to provide public funds for community groups to participate in local climate resilience building efforts, for example in developing and implementing local climate adaptation plans or conducting public education on local climate impacts and emergency response in multiple languages	Policy Development	New Initiative	BCDC, ABAG, MTC, BAAQMD, Cities, Counties, NPOs, CBOs, CDPH, State, Federal	Unlocking, Regional, State, Federal, Long Lead Time
O8.3	Create and implement a framework that government agencies, organizations and community partners can use to engage in open, transparent, and well publicized planning and decision making processes	Education/ Outreach, Program/ Operation	New Initiative	BCDC, ABAG, MTC, BAAQMD, Cities, Counties, NPOs, CBOs, CDPH	Multi-benefit, Local, Regional, Long Lead Time

Functional Vulnerability

Vulnerability O9: Proper functioning of utilities, which themselves are vulnerable to sea level rise and storm events, is essential for communities to effectively respond during a disaster, and for communities, businesses, the airport, seaport, parks and recreation areas, and natural shorelines to function on a day-to-day basis.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
O9.1	Reduce downstream flood risk and stress on stormwater and flood control systems by minimizing runoff volumes and peak flow rates from new developments and substantial redevelopments using site-specific low impact design (LID) and source control techniques	Policy Development	Land Use Planning, Codes and Standards	Cities, County, RWQCB, SFEP	Do It Yourself, Multi-benefit, Local, Regional
O9.2	Avoid new development and substantial redevelopments that will require expanding the capacity of utilities and infrastructure in areas at risk	Policy Development	Land Use Planning, Codes and Standards	Cities, County, RWQCB, CPUC, City DPW, ACFCWCD	Local, Regional

Functional Vulnerability

Vulnerability O10: Some assets along the Bay shoreline function as a continuous corridor, or as a series of linked segments, and impacts to one segment of the Bay shoreline can compromise the function of the other segments. This is especially true of the system of natural and structural shorelines along the Bay edge; energy, gas, and pipelines infrastructure; and for long, linear ground transportation assets such as the Bay Trail and the regional rail network.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
O10.1	Conduct a regional evaluation of transportation and utility networks that are vulnerable to sea level rise to determine hot spots or weak links that would cause significant disruption to the regional economy and quality of life	Evaluation	Long-range Planning, Operations, Capital Planning	Caltrans, BART, CCJPA, UP, PG&E, Kinder Morgan, EBMUD, EBDA, Cities, County, MTC, Private Sector, Regional Agencies	Do It Yourself, Unlocking, Regional
O10.2	Conduct a regional evaluation of structural shorelines and determine how they are connected/interconnected to natural shorelines in providing flood risk reduction benefits	Evaluation	New Initiative	Cities, County, USACE, EBRPD, HARD, ABAG (Bay Trail), DFW, USFWS, BCDC, City DPW, ACFCWCD, SCC, Regional Agencies	Unlocking, Regional

Physical Vulnerability

Vulnerability O11: Changes in groundwater levels due to sea level rise may increase the risk of liquefaction during an earthquake. Residences, utilities and other infrastructures that are not designed for these conditions are likely to be damaged during an earthquake. Long, linear infrastructure such as utility pipelines, surface roads, and rail lines are highly susceptible to damage during earthquakes, particularly due to liquefaction. Much of the airport is built on Bay fill, which has a high liquefaction potential. During an earthquake, liquefaction could cause damage to runways and other infrastructure, and could cause the perimeter levee to fail.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
O11.1	Conduct a regional study on the impacts of rising sea level on groundwater elevations, and on the potential for increased liquefaction potential	Evaluation	New Initiative	USGS, FEMA, NOAA, USACE, RWQCB, Regional Agencies, ABAG, DTSC, Cities, County, Water Districts, MTC, Caltrans, BCDC, Private Sector	Unlocking, Multi-benefit, Regional
O11.2	Conduct vulnerability assessments of critical infrastructure and land uses in areas exposed to sea level rise and liquefaction to identify strategies that can improve resilience to both hazards	Evaluation	Long-range Planning, New Initiative	ABAG, Caltrans, MTC, BCDC, ABAG, Special Districts, Cities, County, Private Sector	Do It Yourself, Unlocking, Multi-benefit, Local, Regional

Physical Vulnerability

Vulnerability O12: Public health, safety, and welfare are at risk from sea level rise and storm events, particularly where the land uses are predominately residential, e.g., single-family, multi-family, and senior housing. These communities were developed in a manner that makes protecting them from future flood risks extremely challenging. It is likely that planning for future growth in the region will follow this past pattern without consideration of future flooding, increasing the number of people at risk.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
O12.1	Initiate a regional collaboration to discuss and analyze approaches to improve the resilience of current vulnerable communities and how to plan future growth to avoid placing more of the region's population at risk	Evaluation, Coordination	New Initiative	Local, Regional, State, Federal, Private sector, NPOs, CBOs	Unlocking, Regional, Long Lead Time
O12.2	Improve regional coordination on policies targeted at improving Bay Area resilience to climate change	Coordination	Long-range Planning, New Initiative	JPC Agencies	Unlocking, Regional, Long Lead Time

Information Vulnerability

Vulnerability C1: Up-to-date information regarding the characteristics of communities, including the locations and specific needs of certain populations, is generally not available or easily accessible when needed for emergency response. Collecting and maintaining this type of information requires coordination with non-profit, community, and faith based groups to ensure accuracy of information and to provide a trusted partner to help communities understand the importance of these efforts.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C1.1	Develop and maintain a centralized database of non-profit, community, and faith-based organizations, equipment and service providers, and others that can communicate with communities at risk	Program/operation	Emergency and Hazard Planning, New Initiative	Cities, County, ACPHD, NPOs, CBOs, Private Sector	Unlocking, Multi-benefit, Local
C1.2	Develop and maintain a voluntary database that includes specific needs within each community related to emergency response	Program/operation	Emergency and Hazard Planning, New Initiative	Cities, County, ACPHD, NPOs, CBOs, Private Sector	Unlocking, Multi-benefit, Local
C1.3	Develop and maintain an emergency communication protocol for city, county, regional, and state agencies; local, community and faith-based organizations; and facilities that serve communities and that can be activated during a flood or storm event	Program/operation	Emergency and Hazard Planning, New Initiative	CalOES, FEMA, ABAG, Cities, County, ACPHD, NPOs, CBOs, Private Sector	Multi-benefit, Local, Regional, State

Information Vulnerability

Vulnerability C2: There is a lack of centrally coordinated information systems for contaminated lands and hazardous material sites, which is needed for effective emergency and adaptation planning and for setting remediation, monitoring, and enforcement priorities to reduce risks.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C2.1	Review existing information systems to identify gaps in completeness, quality, and accessibility, and to determine if they contain the information needed to plan for emergencies, sea level rise, storm events, and elevated groundwater levels	Evaluation	New Initiative	DTSC, RWQCB, CUPAs, USEPA, ACEH	Do It Yourself, Unlocking, Multi-benefit, Local, Regional
C2.2	Coordinate the information in existing data repositories using cross-referencing or geo-referencing	Coordination, Program/operation	New Initiative	DTSC, RWQCB, CUPAs, USEPA, ACEH	Multi-benefit, Local, Regional
C2.3	Establish agreements among agencies and organizations that regulate or manage contaminated lands and hazardous material sites to use consistent data collection, management, and sharing methods	Policy Development	New Initiative	DTSC, RWQCB, CUPAs, USEPA, ACEH	Multi-benefit, Local, Regional, State, Long Lead Time
C2.4	Develop and keep current a centralized information system that has key emergency and adaptation planning information about contaminated lands and hazardous materials sites	Program/operation	New Initiative	DTSC, RWQCB, CUPAs, USEPA, ACEH	Multi-benefit, Local, Regional, Long Lead Time

Management Control Vulnerability

Vulnerability C3: There are no effective regulatory or financing mechanisms to prioritize the remediation of contaminated lands that will be affected by sea level rise. Additionally, these sites may not provide the most appropriate redevelopment opportunities, further diminishing any incentive to conduct cleanup activities.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C3.1	Conduct studies of contaminated lands to gather critical information needed to assess vulnerability and risk from sea level rise, storm events, and elevated groundwater	Evaluation	New Initiative	DTSC, RWQCB, USEPA, ACEH, Cities, County, Private Sector	Do It Yourself, Unlocking, Local, Regional
C3.2	Address potential increased risks due to sea level rise, storm events, and elevated groundwater in designing, funding, and permitting new remediation efforts	Policy Development, Program/operation	Codes and Standards, Project Planning and Design	DTSC, RWQCB, USEPA, ACEH, Cities, County, Private Sector	Do It Yourself, Local, Regional
C3.3	Prioritize the remediation of contaminated sites based on the timing of exposure to sea level rise, storm events, and elevated groundwater, degree of vulnerability, and extent of the consequences	Policy Development, Program/operation	Long-range Planning, Codes and Standards, New Initiative	DTSC, RWQCB, USEPA, ACEH, Cities, County, Private Sector	Do It Yourself, Local, Regional

Management Control Vulnerability

Vulnerability C4: Neighborhoods are informal networks whose function depends on the relationship among the individuals and services within them. These informal connections are easily severed during disasters and are often difficult to rebuild once disrupted. Neighborhoods without a strong social network, where residents do not know each other, or are not invested in the overall community good, are especially vulnerable to sea level rise and storm events.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C4.1	Provide expanded Community Emergency Response Team (CERT) trainings, refresher classes, and annual exercises that include flooding preparedness and response	Education/outreach	Emergency and Hazard Planning	ABAG, CalOES, FEMA, Cities, County, ACPHD, CBOs, NPOs	Multi-benefit, Local, Regional
C4.2	Coordinate with non-profit, community, and faith-based organizations to build strong social networks in neighborhoods, in particular those with certain characteristics such as less mobile or medically dependent residents	Coordination	Emergency and Hazard Planning, New Initiative	CalOES, FEMA, Cities, County, ACPHD, CBOs, NPOs, Private Sector	Multi-benefit, Local
C4.3	Provide technical assistance to neighborhoods to support the development and maintenance of disaster plans, including storm evacuation procedures and shelter-in-place guidelines	Education/outreach, Program/operation	Emergency and Hazard Planning	ABAG, CalOES, FEMA, Cities, County, ACPHD	Multi-benefit, Local

Management Control Vulnerability

Vulnerability C4 (continued): Neighborhoods are informal networks whose function depends on the relationship among the individuals and services within them. These informal connections are easily severed during disasters and are often difficult to rebuild once disrupted. Neighborhoods without a strong social network, where residents do not know each other, or are not invested in the overall community good, are especially vulnerable to sea level rise and storm events.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C4.4	Develop and support neighborhood and community-based response centers to distribute information and supplies after a disaster	Education/outreach, Program/operation	Emergency and Hazard Planning	CalOES, FEMA, Cities, County, ACPHD, CBOs, NPOs, Private Sector	Multi-benefit, Local, Regional
C4.5	Develop a "Maintain-a-Drain" program that encourages neighborhoods to keep storm drains free of debris, reducing potential flood risks	Education/outreach, Program/operation	Long-range Planning, New Initiative	City DPW, ACFCD, ACPHD, ACEH, CBOs, RWQCD, Private Sector	Do It Yourself, Multi-benefit, Local

Management Control Vulnerability

Vulnerability C5: Certain populations within the subregion are especially vulnerable to sea level rise and storm events. These include young children, the elderly, people with mobility or medical needs, people without automobiles, renters, people without insurance, the linguistically isolated, people at or below poverty level and caretakers of young children, the elderly and animals.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C5.1	At community or neighborhood-scales, assess how sea level rise and storm events will affect vulnerable populations	Evaluation	Long-range Planning, New Initiative	ABAG, BCDC, MTC, Cities, County, CBOs, NPOs	Do It Yourself, Unlocking, Local
C5.2	Through a multi-agency effort, develop policies or guidance on improving resilience to sea level rise through appropriate community development, land use and infrastructure planning, and project design	Coordination, Policy Development	Long-range Planning, New Initiative	ABAG, BCDC, MTC, Cities, County, CBOs, NPOs	Local, Regional, Long Lead Time
C5.3	Identify and research critical gaps in information needed by decision-makers to understand and respond to the needs of all of those in their communities, including the level of financial and technical assistance needed to minimize impacts from job loss and potential relocation	Evaluation	Long-range Planning, Land Use Planning	ABAG, BCDC, MTC, ACPHD, Cities, County, CBOs, NPOs, Private Sector	Unlocking, Local, Regional

Management Control Vulnerability

Vulnerability C5 (continued): Certain populations within the subregion are especially vulnerable to sea level rise and storm events. These include young children, the elderly, people with mobility or medical needs, people without automobiles, renters, people without insurance, the linguistically isolated, people at or below poverty level and caretakers of young children, the elderly and animals.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C5.4	Develop community-led education and outreach campaigns designed for specific local populations on the risks of sea level rise and storm events	Education/outreach	Long-range Planning, Land Use Planning, Emergency and Hazard Planning	ABAG, BCDC, MTC, ACPHD, Cities, County, CBOs, NPOs	Do It Yourself, Multi-benefit, Local
C5.5	Identify the specific needs and characteristics of the community being served and, if necessary, revise emergency response policies, procedures, and trainings, including strategies for managing those needs such as providing specialized equipment or evacuation procedures, e.g., for those that care for animals (shelters, zoos, pet owners)	Policy Development, Program/operation	Long-range Planning, Land Use Planning, Emergency and Hazard Planning	ABAG, BCDC, MTC, ACPHD, Cities, County, CBOs, NPOs, Private Sector	Do It Yourself, Multi-benefit, Local, Regional

Management Control Vulnerability

Vulnerability C6: Planning and resources are inadequate to address contingencies and secondary impacts associated with widespread or long-lasting sea level rise or storm event impacts, especially if residential neighborhoods, elder care facilities, or similar land uses are affected. In addition, out-of-date emergency plans, lack of compliance with existing plans, and poor coordination among local, regional, and state authorities increases vulnerability of populations, facilities, and services.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C6.1	Review and update emergency plans to address sea level rise and storm event contingencies and secondary impacts that are broad-scale (e.g., county or Bay Area-wide) and/or severe (e.g., long-lasting and/or deep inundation)	Program/operation	Emergency and Hazard Planning	ABAG, BCDC, MTC, CalOES, FEMA, ACPHD, Cities, County, CBOs, NPOs, Private Sector	Do It Yourself, Local, Regional
C6.2	Expand or form multi-agency and cross-jurisdictional partnerships (including community-based organizations) to improve the capacity to address the needs of people in the community, particularly those with special mobility, care, or medical needs, during a disaster or emergency	Coordination	Emergency and Hazard Planning, New Initiative	ABAG, BCDC, MTC, ACPHD, Cities, County, CBOs, NPOs, Private Sector	Multi-benefit, Local, Regional, Long Lead Time
C6.3	Develop and keep current hazard mitigation plans meeting established standards to ensure eligibility for state and federal emergency funds	Program/operation	Emergency and Hazard Planning	ABAG, CalOES, FEMA, Cities, Counties, Special Districts	Do It Yourself, Multi-benefit, Local, Regional

Management Control Vulnerability

Vulnerability C6 (continued): Planning and resources are inadequate to address contingencies and secondary impacts associated with widespread or long-lasting sea level rise or storm event impacts, especially if residential neighborhoods, elder care facilities or similar land uses are affected. In addition, out-of-date emergency plans, lack of compliance with existing plans, and poor coordination among local, regional, and state authorities increases vulnerability of populations, facilities, and services.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C6.4	Develop contingency plans and procedures to address the need for short-term sheltering and long-term housing for displaced residents, with particular attention to certain populations and those with specific needs such as animal caretakers	Program/operation	Emergency and Hazard Planning	ABAG, CalOES, FEMA, ACPHD, Cities, County, CBOs, NPOs, Private Sector	Do It Yourself, Multi-benefit, Local, Regional
C6.5	Coordinate emergency plans and information sharing among individual facilities, neighborhoods, Special Districts, utilities, cities, counties and regional and state authorities, including establishing protocols for responding to NOAA weather forecasts (e.g., when to close, shelter-in-place, or evacuate)	Coordination, Program/operation	Emergency and Hazard Planning	ABAG, MTC, ACTC, Caltrans, BART, Port, CCJPA, WETA, UP, CalOES, FEMA, NOAA, Cities, County, Special Districts, Utilities, CBOs, NPOs, Private Sector	Multi-benefit, Local, Regional, State, Long Lead Time
C6.6	Establish mutual aid agreements and initiate or strengthen joint protocols with adjoining jurisdictions for cooperative disaster response	Coordination, Policy Development	Emergency and Hazard Planning	Cities, Counties, CalOES, FEMA	Do It Yourself, Multi-benefit, Regional

Management Control Vulnerability

Vulnerability C6 (continued): Planning and resources are inadequate to address contingencies and secondary impacts associated with widespread or long-lasting sea level rise or storm event impacts, especially if residential neighborhoods, elder care facilities or similar land uses are affected. In addition, out-of-date emergency plans, lack of compliance with existing plans, and poor coordination among local, regional, and state authorities increases vulnerability of populations, facilities, and services.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C6.7	Develop and maintain a multi-disciplinary communication interoperability plan to facilitate emergency communications among first responders from different cities, counties, Special Districts, state and federal agencies	Program/operation, Policy Development	Emergency and Hazard Planning	ABAG, MTC, CalOES, FEMA, Cities, County, CBOs, NPOs, Private Sector	Multi-benefit, Local, Regional, State
C6.8	Work with national organizations, e.g., Humane Society of the United States and the American Humane Association, to develop preparedness, response, and recovery plans for facilities housing animals	Coordination, Program/operation	Emergency and Hazard Planning, New Initiative	ABAG, CalOES, Cities, County, CBOs, NPOs, Private Sector	Do It Yourself, Multi-benefit, Local, Regional
C6.9	Require facilities that generate, transport, and/or store hazardous materials to consider vulnerability and risks of sea level rise, storm events, and elevated groundwater in emergency plans, facility operations plans, and capital improvement plans	Policy Development, Program/operation	Capital Planning, Operations, Emergency and Hazard Planning	CalOES, DTSC, RWQCB, USEPA, ACEH, Cities, County, Private Sector	Local, Regional, High Priority

Functional Vulnerability

Vulnerability C7: Certain land uses and facility types within the subregion are particularly difficult to protect, evacuate, and rebuild due to the critical functions they serve. These include residences, elder care facilities, hospitals, childcare facilities, schools, and animal shelters.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C7.1	Evaluate the continued siting of of certain land uses (schools, hospitals, childcare facilities, animal shelters, and residential development) in high risk areas that are difficult or expensive to protect, and in many cases cannot be protected, evacuated, or rebuilt in a manner ensuring public health, safety and welfare	Evaluation	Long-range Planning, Land Use Planning	ABAG, MTC, Cities, County	Unlocking, Local, Regional
C7.2	Prioritize buyout of properties with certain land uses that are damaged or at high risk of damage from sea level rise or storm events	Program/operation	Emergency and Hazard Planning, Long-range Planning	FEMA, CalOES, Cities, County, Special Districts, Private Sector	Local, Regional, State, Federal
C7.3	Develop and implement a community outreach process to educate a broad audience including facility owners, asset managers, private business owners, and the general public on the risks, costs, and benefits of hazard reduction strategies in comparison to relocation of vulnerable land uses	Education/outreach	Emergency and Hazard Planning, New Initiative	FEMA, CalOES, ABAG, Cities, County, Special Districts, CBOs, NPOs, Private Sector	Unlocking, Local, Regional

Functional Vulnerability

Vulnerability C8: Community facilities such as hospitals, long-term care facilities, and those that serve at-risk, less mobile or medically dependent populations, are vulnerable since the individuals they serve cannot easily be evacuated or sheltered and require on-site care, specialized equipment, and a high level of coordination.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C8.1	Develop plans and procedures to obtain or distribute specialized equipment needed to either shelter-in-place or evacuate at-risk, less mobile, or medically dependent populations	Program/operation	Emergency and Hazard Planning	Cities, ACPHD, County, CBOs, NPOs, Private Sector	Do It Yourself, Local
C8.2	For facilities that provide key community services, develop and communicate to staff, emergency personnel, elected officials, and the public the expected standards for levels of service during and after a storm event	Policy Development, Education/outreach	Emergency and Hazard Planning	Cities, ACPHD, County, CBOs, NPOs	Do It Yourself, Local
C8.3	Reduce dependency on facilities that provide critical community services that are vulnerable to sea level rise by building alternative facilities or by increasing the capacity of existing facilities in areas not at risk from sea level rise	Policy Development	Long-range Planning, Land Use Planning	Cities, ACPHD, County, CBOs, NPOs	Local, Long Lead Time

Functional Vulnerability

Vulnerability C9: Facilities that provide key community services are vulnerable if they cannot maintain operations, if connections to services such as power, clean water, and safe food supplies are not available, or if they cannot be easily accessed. This is of particular concern for facilities that play a role in emergency response and recovery such as schools, hospitals, shelters, and nursing homes.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C9.1	Conduct vulnerability and risk assessments of individual facilities that provide key community services and develop site-specific strategies to reduce service disruptions or closures	Program/operations	Long-range Planning, New Initiative	Cities, ACPHD, County, CBOs, NPOs, Private Sector	Do It Yourself, Unlocking, Local
C9.2	Develop policies or incentives to encourage/require facilities providing key community services to implement changes to facility structures or operations that would reduce potential for disruption or closure due to sea level rise or storm events	Policy Development	Long-range Planning, Land Use Planning, Emergency and Hazard Planning	ABAG, CalOES, FEMA, Cities, ACPHD, County, CBOs, NPOs, Private Sector	Do It Yourself, Local, Regional
C9.3	Develop policies or incentives to encourage/require access to auxiliary water and power sources, e.g., on-site power generators with sufficient fuel for several days, portable generators, or pre-negotiated rental or leasing agreements for portable sources	Policy Development	Long-range Planning, Land Use Planning, Emergency and Hazard Planning	ABAG, CalOES, FEMA, Cities, ACPHD, County, CBOs, NPOs, Private Sector	Do It Yourself, Multi-benefit, Local, Regional

Functional Vulnerability

Vulnerability C9 (continued): Facilities that provide key community services are vulnerable if they cannot maintain operations, if connections to services such as power, clean water, and safe food supplies are not available, or if they cannot be easily accessed. This is of particular concern for facilities that play a role in emergency response and recovery such as schools, hospitals, shelters, and nursing homes.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C9.4	Develop policies or incentives to encourage/require emergency response plans and procedures to consider how power, water, and food necessary to maintain the function of key community services during a flood emergency, will be delivered given that many access routes and transportation modes may also be disrupted	Policy Development	Long-range Planning, Land Use Planning, Emergency and Hazard Planning	ABAG, CalOES, FEMA, Cities, ACPHD, County, CBOs, NPOs, Private Sector	Do It Yourself, Multi-benefit, Local, Regional
C9.5	Develop policies or incentives to encourage/require the establishment of facilities providing key community services in locations that are not at risk of flooding, restrict the development of new key community services in such areas, and relocate existing facilities that are damaged by flooding and need to be substantially rebuilt to areas not at risk	Policy Development	Long-range Planning, Land Use Planning	ABAG, CalOES, FEMA, Cities, ACPHD, County, CBOs, NPOs, Private Sector	Local, Regional, Long Lead Time

Physical Vulnerability

Vulnerability C10: Most residences, employment sites, and community facilities are highly susceptible to damage from sea level and groundwater rise because of their construction methods or materials. When flooding damages these structures, the release of hazardous materials including paints, cleaners, oils, batteries, pesticides, asbestos, and medical waste can occur.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C10.1	Develop and implement requirements for real estate agents and lessors of residential and commercial properties to disclose the risk of sea level rise	Policy Development	Codes and Standards	Cities, County, CA Department of Insurance, CalOES, FEMA, HUD, NPOs, Private Sector	Local, Regional, State, Federal
C10.2	Work with building industry to develop and distribute guidelines for reducing damages by designing or retrofitting structures to accommodate saltwater exposure and periodic low levels of flooding	Policy Development	Codes and Standards	Cities, County, FEMA, HUD, NPOs, Private Sector	Unlocking, Local, Regional, State, Federal
C10.3	Provide incentives or require that structures be retrofitted using waterproof shutters, shields or doors and salt-resistant materials to reduce flood damage, with a particular focus on retrofitting critical community facilities	Program/operation, Policy Development	Codes and Standards, New Initiative	Cities, County, FEMA, HUD, NPOs, Private Sector	Do It Yourself, Local, Regional, State, Federal

Physical Vulnerability

Vulnerability C10 (continued): Most residences, employment sites, and community facilities are highly susceptible to damage from sea level and groundwater rise because of their construction methods or materials. When flooding damages these structures, the release of hazardous materials including paints, cleaners, oils, batteries, pesticides, asbestos, and medical waste can occur.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C10.4	Provide incentives or require that entrances, windows and foundations be raised above future flood elevations for all new construction or substantial reconstruction in areas likely to be at risk from sea level rise	Program/operation, Policy Development	Codes and Standards, New Initiative	Cities, County, FEMA, HUD, CalOES, NPOs, Private Sector	Do It Yourself, Local, Regional, State, Federal
C10.5	Provide flood protection assistance to community residents, e.g., technical advice and materials such as sand bags and plastic sheeting, and ensure vulnerable populations have access to these materials at low or no cost	Program/operation	Emergency and Hazard Planning	Cities, County, FEMA, HUD, CalOES, NPOs, Private Sector	Do It Yourself, Local, Regional, State, Federal
C10.6	Encourage owners of property in floodplains to purchase flood insurance and educate the public that most homeowner insurance policies do not cover a property that is flood damaged	Education/outreach	New Initiative	Cities, County, FEMA, HUD, CalOES, NPOs, Private Sector	Do It Yourself, Local, Regional, State, Federal

Physical Vulnerability

Vulnerability C10 (continued): Most residences, employment sites, and community facilities are highly susceptible to damage from sea level and groundwater rise because of their construction methods or materials. When flooding damages these structures, the release of hazardous materials including paints, cleaners, oils, batteries, pesticides, asbestos, and medical waste can occur.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C10.7	Participate in and seek to qualify for the highest feasible rating of the Community Rating System of the National Flood Insurance Program to reduce flood risks and private property insurance costs	Program/operation	Land Use Planning, Emergency and Hazard Planning	Cities, County, FEMA	Do It Yourself, Local
C10.8	Encourage residents and landowners to use hazardous waste disposal and drop off locations to reduce the amount of potentially hazardous materials released during a flood event.	Education/outreach, Program/operation	Land Use Planning, Emergency and Hazard Planning	Cities, County, ACEH, CBOs, NPOs, Private Sector	Do It Yourself, Local

Physical Vulnerability

Vulnerability C11: Sites that generate, treat, store, or transport hazardous materials are particularly vulnerable since flood damage could cause a release of potentially harmful materials.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C11.1	Require that hazardous materials are stored above projected flood levels or are protected from flood damage	Policy Development	Codes and Standards	DTSC, RWQCB, Cities, County, ACEH, CUPAs, CBOs, NPOs, Private Sector	Do It Yourself, Local, Regional
C11.2	Enforce compliance with all state hazardous materials requirements	Program/operation	Operations	DTSC, RWQCB, CalOES, Cities, County, ACEH, CUPAs	Local, Regional, State

Physical Vulnerability

Vulnerability C12: Essential mechanical and electrical equipment in buildings are highly water and salt sensitive, and are often located below-grade or on the ground floor.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C12.1	Monitor groundwater and salinity levels near vulnerable infrastructure by leveraging existing data or collecting site-specific data as necessary	Program/operation	Operations, New Initiative	City, County, Special Districts, Private Sector	Do It Yourself, Unlocking, Local
C12.2	Increase inspection and maintenance of infrastructure that is sensitive to water or salt in areas at risk from sea level rise, storm events, or elevated groundwater levels	Program/operation	Operations	City, County, Special Districts, Private Sector	Do It Yourself, Multi-benefit, Local
C12.3	Review and update standards, codes, and regulations for the construction and placement of new facilities and infrastructure to avoid or address sea level rise, storm events, and elevated groundwater levels	Policy Development	Codes and Standards	City, County, Special Districts, Private Sector	Unlocking, Do It Yourself, Local
C12.4	Follow existing or develop new standards requiring that waterproof materials be used in the construction of new infrastructure and in the repair or protection of existing infrastructure	Policy Development, Program/operation	Operations, Project Planning and Design, Codes and Standards	City, County, Special Districts, Private Sector	Do It Yourself, Local
C12.5	Follow existing or develop new standards to ensure corrosion-resistant materials or cathodic coatings are used when installing new or upgrading existing cables and pipelines	Policy Development, Program/operation	Capital Planning, Project Planning and Design, Codes and Standards	City, County, Special Districts, Private Sector	Do It Yourself, Local

Physical Vulnerability

Vulnerability C12: Essential mechanical and electrical equipment in buildings are highly water and salt sensitive, and are often located below-grade or on the ground floor.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C12.6	Follow existing or develop new standards to ensure sensitive components are elevated above anticipated flood levels	Policy Development, Program/operation	Operations, Project Planning and Design, Codes and Standards	City, County, Special Districts, Private Sector	Do It Yourself, Local

Physical Vulnerability

Vulnerability C13: Structures with habitable space below grade are vulnerable to sea level rise, storm events, and elevated groundwater.

Action Number	Action	Action Type	Process	Possible Actors	Action Characterization
C13.1	Develop and implement disclosure requirements for real estate agents and lessors for residential and commercial properties with regard to future flood and groundwater exposure due to sea level rise and the particularly high vulnerability of habitable below-grade space	Policy Development, Program/operation	Codes and Standards	Cities, County, CA Department of Insurance, CalOES, FEMA, HUD, NPOs, Private Sector	Unlocking, Do It Yourself, Local, Regional, State
C13.2	Evaluate eligibility and rates of required insurance and FEMA flood insurance for structures that have habitable below-grade space in areas likely to be affected by sea level and groundwater rise	Evaluation	New Initiative	Cities, County, CA Department of Insurance, CalOES, FEMA, HUD, NPOs, Private Sector	Unlocking, Local, Regional, State
C13.3	Create incentives for property owners to repurpose below-grade space to less vulnerable or temporary uses	Program/operation	Codes and Standards	CA Department of Insurance, CalOES, FEMA, HUD, NPOs, Private Sector	Do It Yourself, Local, Regional, State
C13.4	Prohibit below-grade habitable space in new development that will be exposed to sea level rise, storm events, and elevated groundwater	Policy Development	Land Use Planning, Codes and Standards	Cities, County, CA Department of Insurance, CalOES, FEMA, HUD, Private Sector	Do It Yourself, Local, Regional, State
C13.5	Develop and enforce policies for repair and reconstruction to eliminate below-grade habitable space that is damaged by sea level and groundwater rise	Policy Development, Program/operation	Codes and Standards	Cities, County, CA Department of Insurance, CalOES, FEMA, HUD	Do It Yourself, Local, Regional, State

Sources Used to Develop the ART Subregional Adaptation Responses

Input from Subregional ART Working Group
Working Group Meeting #9, March 26, 2013
<http://www.adaptingtorisingtides.org/news-events/>

Adapting to Climate Change: A Planning Guide for State Coastal Managers
NOAA Ocean and Coastal Resources Management Center for Climate Strategies
<http://coastalmanagement.noaa.gov/climate/adaptation.html>

Synthesis of Adaptation Options for Coastal Areas
EPA Climate Ready Estuaries
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Flood Damage Reduction Measures
US Army Corps of Engineers
http://www.nwo.usace.army.mil/nfpc/NFPC_Measures_Matrix.pdf

Center for Climate Strategies Adaptation Guidebook: Comprehensive Climate Action
Center for Climate Action
<http://www.climatechange.ca.gov/ecrcf/docs/CCSAdaptationGuidebook2011.pdf>

California Climate Adaptation Planning Guide
California Natural Resources Agency and California Emergency Management Agency
http://resources.ca.gov/climate_adaptation/local_government/adaptation_policy_guide.html

Climate Ready Water Utilities Updated Adaptation Strategies Guide for Water Utilities
U.S. Environmental Protection Agency
<http://water.epa.gov/infrastructure/watersecurity/climate/upload/epa817k13001.pdf>

Flooded Bus Barns and Buckled Rails: Public Transportation and Climate Change Adaptation
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<http://quake.abag.ca.gov/mitigation/>

Adapting to Climate Change Project Summary Report and Action Plan
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http://www.cbt.org/Initiatives/Climate_Change