



# SUISUN CITY FOCUS AREA

## EXAMPLE APPLICATION OF THE ADAPTATION PLANNING PROCESS



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## DISCLAIMER

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## ACRONYMS / ABBREVIATIONS

Acronym	Signification
AADT	Annual Average Daily Traffic
ABAG	Association of Bay Area Governments
ART	Adapting to Rising Tides
BayCAN	Bay Area Climate Adaptation Network
BCDC	Bay Conservation and Development Commission
CHARG	San Francisco Bay Regional Coastal Hazards Adaptation Resiliency Group
Guidance	Plan Step Guidance
FEMA	Federal Emergency Management Agency
JPA	Joint Powers Authority
CBO	Community-based Organization
CFR	Code of Federal Regulations
DPW	Department of Public Works
DWR	California Department of Water Resources
OLU	Operational Landscape Unit
MTC	Metropolitan Transportation Commission
NFIP	National Flood Insurance Program
PCA	Priority Conservation Area
PDA	Priority Development Area
SFEI	San Francisco Estuary Institute
SLC	State Lands Commission
SLR	Sea Level Rise
STA	Solano Transportation Authority
SMNHA	Suisun Marsh Natural History Association
TWL	Total Water Level
UPRR	Union Pacific Railroad
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

# 1 Introduction

Since its inception in 2010, the Adapting to Rising Tides (ART) program has developed tools and resources to support sea level rise (SLR) and climate change adaptation planning for the nine San Francisco Bay Area counties. Most recently, the program developed an 8-step “Plan Step Guidance” (Guidance) to advance and support adaptation planning by local communities and municipalities (see Figure 1.1). This example application of the Guidance (this report) uses the city of Suisun City (Suisun City) as a preliminary focus area. The goal of this planning exercise is to test the Guidance and provide feedback on how the ART tools and resources can be used to support or reinforce each step.

Suisun City was selected as a focus area because of the ranking of the larger Suisun Slough Operational Landscape Unit (OLU) within the Regional Sea Level Rise Vulnerability Assessment Framework with respect to Regional Transportation Assets, Priority Development Areas (PDAs), Priority Conservation Areas (PCAs), and vulnerable communities (BCDC et al. 2019). Although other OLUs ranked higher within the Framework, the higher-ranking OLUs had either recently completed SLR vulnerability assessments, or already had adaptation planning projects in progress. Due to the large size of the Suisun Slough OLU, and the extent of the Suisun marshes, this exercise focuses on the developed area of Suisun City and its surrounding areas. It was selected because it is the first developed area inundated by SLR within the larger OLU, and because it contains transportation assets of regional importance (e.g., the Union Pacific Railroad, which supports heavy freight goods movement and the Amtrak/Capitol Corridor intercity passenger train system, as well as Highway 12).

This example application of the Guidance did not include community and stakeholder engagement. In practice, the City or its designee would lead the application of the Guidance, and substantive community outreach and engagement would be required to confirm local vulnerabilities, identify a potential suite of actions and strategies to mitigate or reduce those vulnerabilities, and evaluate those actions and strategies to develop preferred solutions. This test application of the Guidance was completed quickly to inform its further development, and the identified adaptation actions and strategies should only be considered as potential examples for Suisun City. This report is *not intended* to represent a completed adaptation plan for Suisun City.



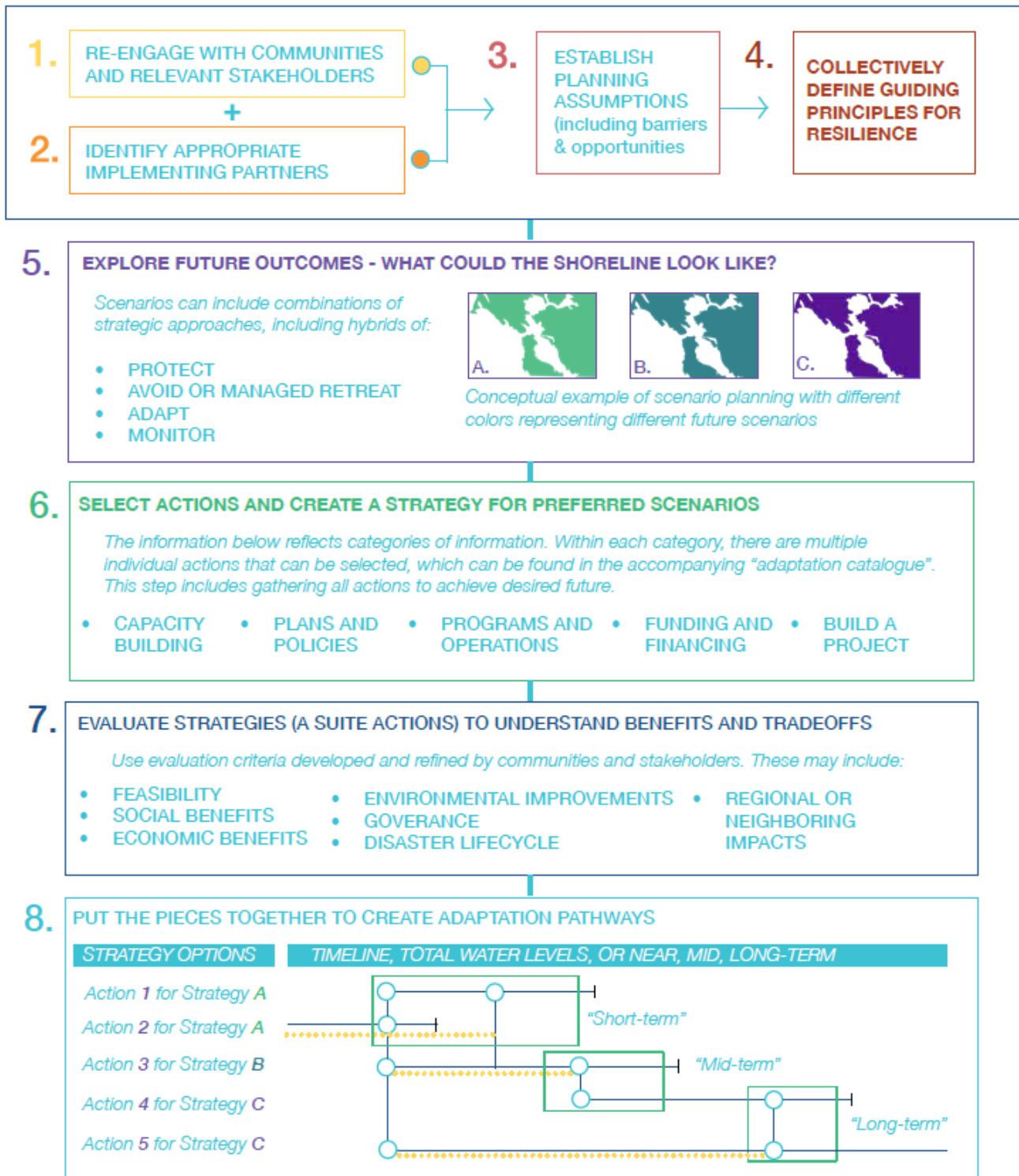


Figure 1.1 Conceptual Diagram of the Plan Step Guidance: Advancing Adaptation

## 1.1 Suisun City Focus Area

Suisun City is in northern San Francisco Bay (see Figure 1.2 and Figure 1.3), within the Suisun Slough OLU (see Figure 1.4). The OLU encompasses the central section of southern Solano County from just west of I-680 in the west, to just north of Highway 12 to the north, to Montezuma Slough in the east. The area includes Suisun City, parts of the cities of Fairfield and Benicia, and parts of unincorporated Solano County. The OLU also includes Suisun Marsh, the largest contiguous brackish (a mixture of fresh and sea water) wetland in the western United States. Suisun City borders Suisun Marsh which comprises approximately 85,000 acres of tidal marsh, managed wetlands, and waterways in southern Solano County. Although the marsh is not designated as a PCA, it is the largest remaining wetland around San Francisco Bay and includes more than ten percent of California's remaining wetland area. The marsh is a wildlife habitat of nationwide importance and it plays an important role in providing wintering habitat for waterfowl of the Pacific Flyway. Because of its size and estuarine location, it supports a diversity of plant communities that provide habitat for a variety of fish and wildlife, including several rare and endangered species.

The Suisun City focus area includes the surrounding marsh areas, the Union Pacific Railroad and Amtrak/Capitol Corridor, Highway 12, and the southern portion of the city of Fairfield (see Figure 1.5). Suisun City has residential housing, commercial and industrial facilities, and the entire city is designated as a PA. The Suisun City community is comprised of two separate block groups, one considered the highest social vulnerability and the other considered high social vulnerability (ACS 2018). This area also includes moderate contamination vulnerabilities due to hazardous cleanup activities, rising shallow groundwater levels in response to SLR, impaired water bodies, and solid waste facilities.

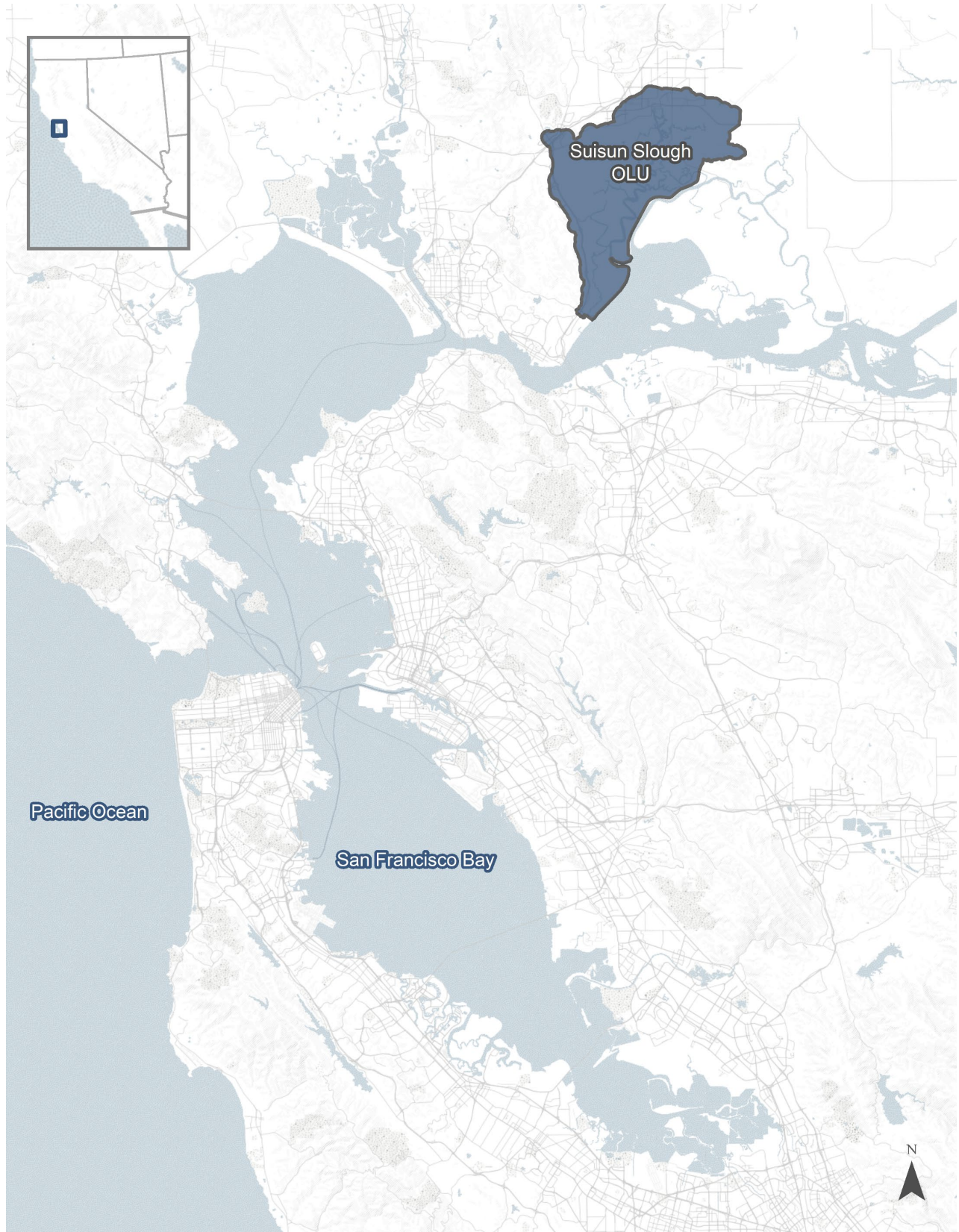
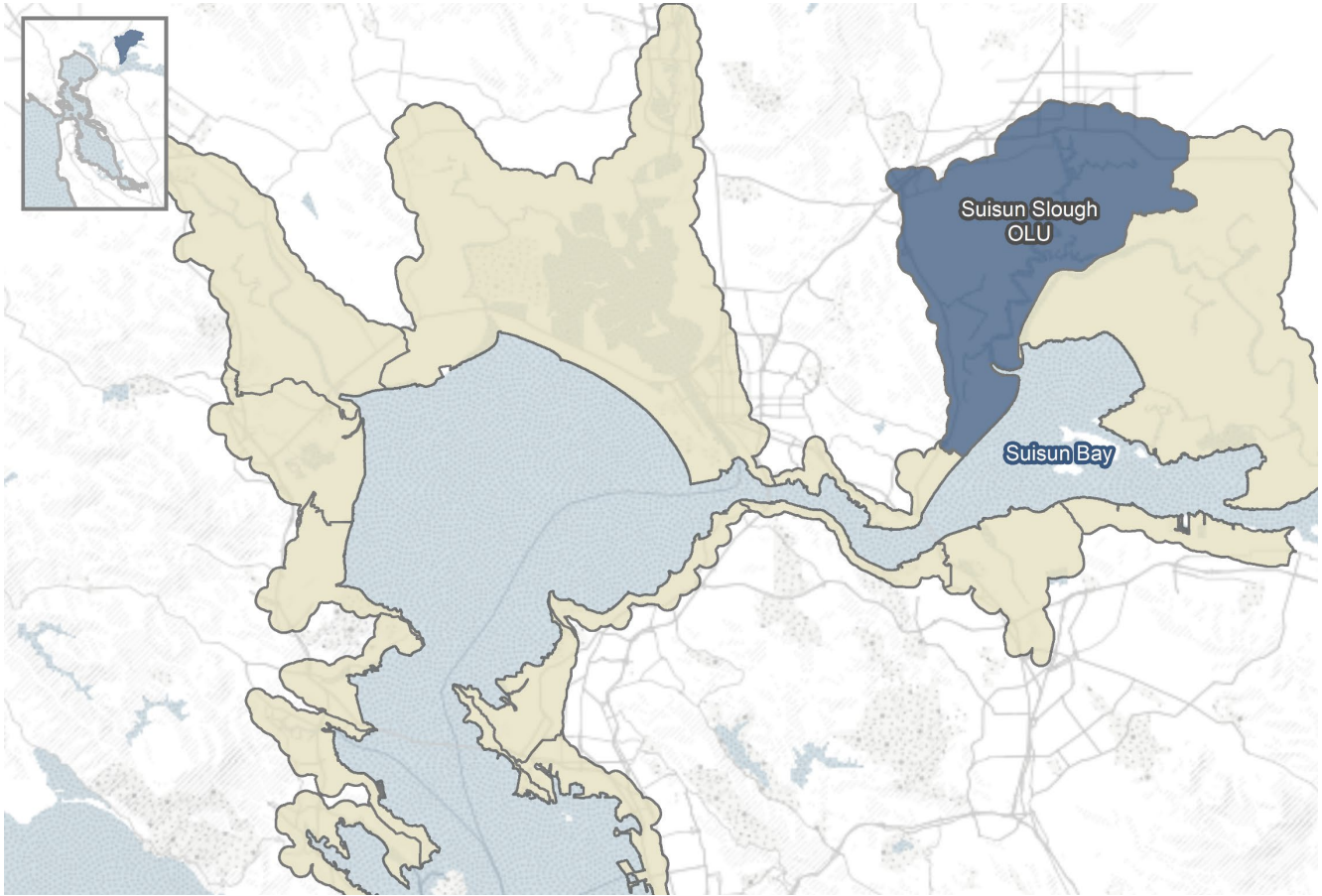
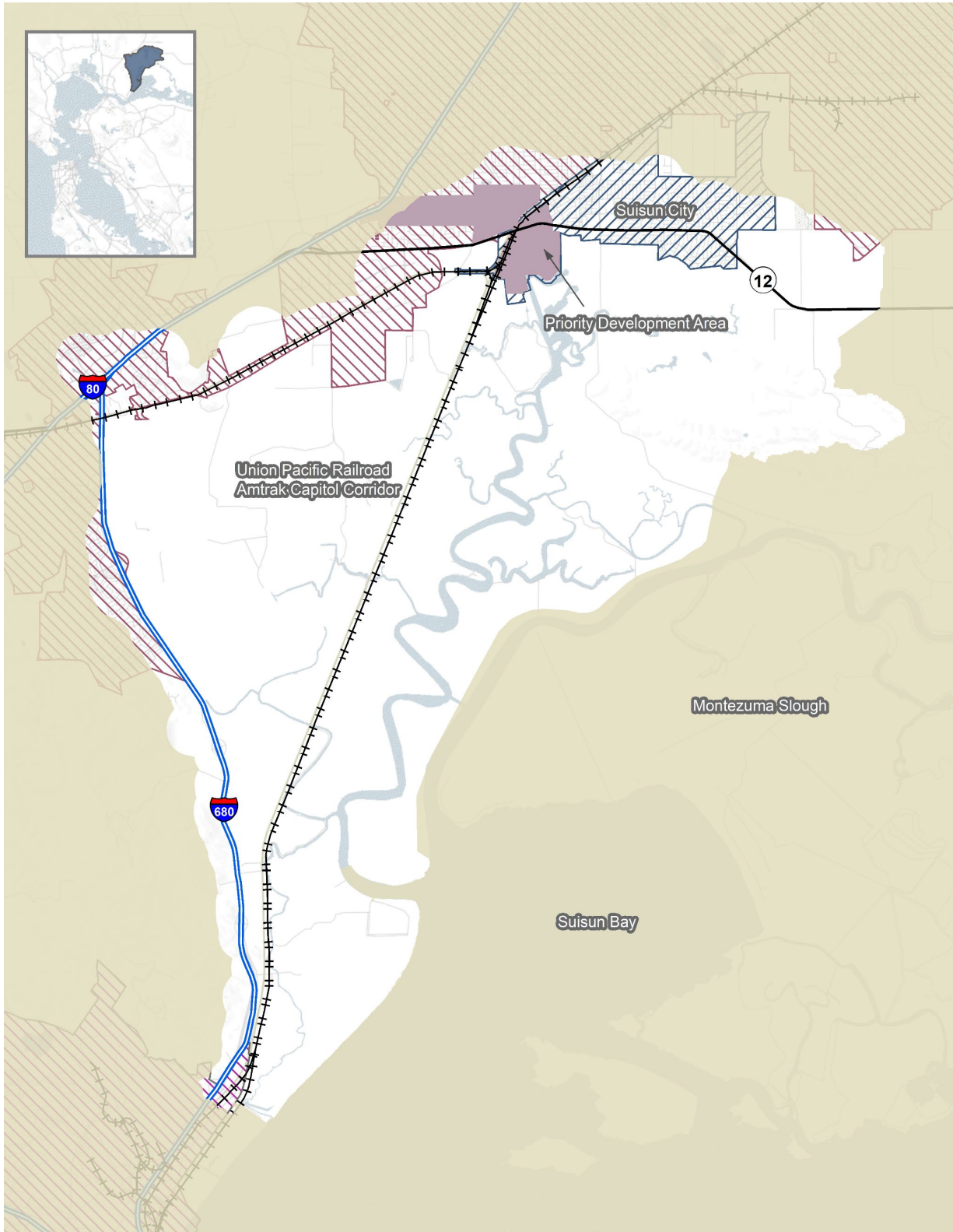


Figure 1.2 San Francisco Bay Area



Source: SFEI and SPUR, 2019

Figure 1.3 Northern San Francisco Bay Operational Landscape Units



Source: (Solano County 2015, MTC and ABAG 2018, SFEI and SPUR 2019)  
 Figure 1.4 Suisun Slough Operational Landscape Unit



Source: Google Earth 2019

Figure 1.5 Suisun City Focus Area

## 1.2 Report Organization

This report is organized following the 8-steps in the Guidance, as shown in Figure 1.1; however, equal treatment was not given to each of the steps (and the step numbers don't equate the section numbering in this report). Guidance Steps 1 and 2, which include community outreach and identifying appropriate implementing partners, are discussed in Sections 3 and 4. In these sections, suggestions are provided for the types of outreach and engagement that should occur when the Guidance is followed by the City or its designee. In this example application, no outreach with the community or potential partners occurred.

Steps 3 and 4, discussed in Sections 5 and 6 respectively, focus on establishing planning assumptions and defining guiding principles for resilience. This application relies on the overarching ART guiding principles along with limited desktop research to identify potential opportunities and constraints within the focus area. Ideally, Steps 3 and 4 would be led by the City, and planning assumptions and resilience goals would consider and reflect the unique needs of the City and the community.

This report focuses on Steps 5 and 6 (Sections 7 and 8, respectively), which include exploring shoreline vulnerabilities, identifying a range of potential actions to address the identified vulnerabilities, and combining actions to create strategies that align with the guiding principles for resilience. These sections include descriptions of the resources used, how and why the actions and strategies were selected, and the

challenges that were encountered while applying the Guidance. The strategies are evaluated under Step 7 (Section 9); however, because Suisun City was not engaged in the development of this report, Step 7 is limited to select example evaluation criteria. In a more thorough application, the evaluation criteria would be developed and refined by the City in collaboration with stakeholders. Step 8 (Section 10) includes assembling actions into an “Adaptation Pathway” that helps define when actions should be implemented over time (e.g., near-term, mid-term, long-term). This includes defining the thresholds (e.g., specific future Bay water levels or sea level rise amounts that would result in flooding or other consequences) or triggers (e.g., specific future Bay water levels, changes in the climate science, increased development or population density above planned changes, etc., that would prompt the City to either begin the planning process for the next action in the pathway or review and revise the adaptation pathway to better meet changing conditions).

## 2 Resources

This example application of the Guidance relies on materials developed for the ART program, and on numerous readily available materials, studies, reports, or data layers. This section provides a list of the primary resources used in this report. Additional resources are cited throughout the report, with a full reference list contained in Section 11.

- ART Bay Area Shoreline Flood Explorer, <https://explorer.adaptingtorisingtides.org/>
- ART Bay Area Sea Level Rise Analysis and Mapping (Vandever et al. 2017)
- ART Regional Sea Level Rise Vulnerability Assessment Framework (BCDC et al. 2019)
- California Water Regional Control Board Monitoring Well Data (CAWRCB 2019)
- Google Earth Aerial Imagery and Historical Aerial Imagery
- FEMA National Flood Hazard Layer, <https://hazards-fema.maps.arcgis.com/apps/webappviewer/>
- Hill Slough Restoration Project (BCDC 2017)
- Peytonia Slough Ecological Reserve, <https://www.wildlife.ca.gov/Lands/Places-to-Visit/Peytonia-Slough-ER>
- California Water Resources Control Board groundwater monitoring data (CAWRCB 2019)
- Solano County 2013 – 2015 Groundwater Report: Groundwater Conditions in Solano County (Solano County Water Agency 2015)
- San Francisco Bay Shoreline Adaptation Atlas (SFEI and SPUR 2019)
- Suisun Slough OLU Profile Sheet (BCDC et al. 2020)
- Suisun City Component of the Suisun Marsh Local Protection Program (City of Suisun City 1981)
- Suisun City Downtown Waterfront Priority Development Area Profile and Market Analysis (City of Suisun City 2015a)
- Suisun City General Plan 2035 (City of Suisun City 2015b)
- Suisun City Local Hazard Mitigation Plan (City of Suisun City 2017)
- Suisun City Waterfront District Specific Plan (City of Suisun City 2016a)
- Suisun City Waterfront District Specific Plan Consistency Analysis (City of Suisun City 2016b)
- Suisun Marsh Habitat Management, Preservation, and Restoration Plan (USFWS et al. 2011)

- Tidal Wetland Monitoring Framework for the Upper San Francisco Estuary (IEP TWM PWT 2017)

### 3 Engage with Communities and Relevant Stakeholders

This example application of the Guidance did not include engagement with city or the affected communities, businesses, or landowners. In a real-world application of the Guidance, the local community would be consulted and involved in the identification of SLR vulnerabilities and consequences and have a voice in identifying potential adaptation solutions. In the absence of community and stakeholder engagement, the solutions presented in Section 8 should only be considered as potential example actions and strategies and the solutions should not be inferred to represent an actual adaptation plan or adaptation pathway for Suisun City.

Although this application does not include community engagement, it does provide suggestions for how this step could be performed, including recommending the points in the process where community engagement would be beneficial and identifying a range of potential stakeholders that could participate in the process. Ideally, community and stakeholder engagement should begin at the start of the planning process, which is why the Guidance recommends this as Step 1 (see Figure 1.1).

The development of a community engagement plan can help focus this effort. The plan should consider whom to engage, how to engage with multiple engagement methods, and when to engage stakeholders and community members. Engagement opportunities should be identified to also connect with stakeholders who do not typically attend public meetings, obtain information online, or access local media outlets. In particular, the plan should consider means to connect with the identified vulnerable communities, as these communities can be marginalized in planning efforts, yet they may bear the brunt of potential impacts. The engagement plan should also be flexible and allow for updates as the needs of the community change or as the breadth of stakeholders increases or decreases over time.

The goal is to help the community and stakeholders envision what a future resilient to SLR could look like, to set goals and priorities to guide adaptation decisions, and to develop adaptation pathways. These aim to avoid negative impacts and instead provide active co-benefits for the community.

Having a robust community engagement plan will help:

- raise awareness of existing flood hazards and vulnerabilities;
- educate stakeholders on how these hazards and vulnerabilities may change with SLR;
- identify and resolve potential community issues and concerns;
- solicit meaningful input to inform analyses;
- develop creative solutions; and
- gain support for the planning process and the implementation of solutions.

Engaging with the community and stakeholders too late can create community resistance and slow down critical planning decisions to protect the community. This concern was raised with respect to this example application of the Guidance because potential actions and strategies are identified and presented for the Suisun City focus area, although no community engagement has occurred. It cannot be stressed enough that this test application of the Guidance was completed quickly (i.e., within approximately 30 days from

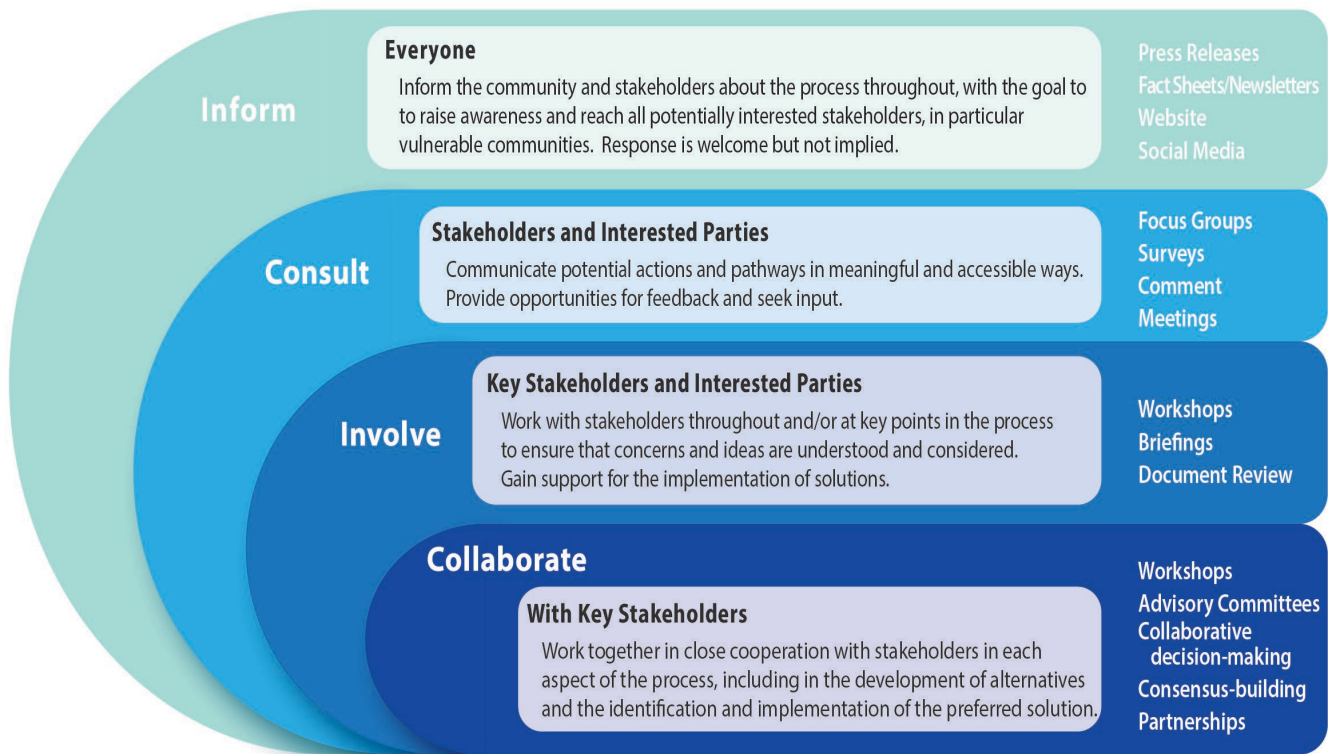


start to finish) and relies substantially on the professional judgement and prior experience of the study team. In practice, following the 8-Step Guidance would take 18 months or more, and the length of the process may be largely driven by the community and stakeholder engagement needs.

### 3.1 Engagement Options

The International Association of Public Participation (IAP2) developed a spectrum of engagement to help clarify public participation and expectations for the public (or community or other stakeholders) in planning and decision making (IAP2 2018). The spectrum identifies five levels of community and stakeholder engagement, with each level having an increasing level of participation and influence. For this report, the first four levels of engagement (e.g., Inform, Consult, Involve, and Collaborate) were used to map potential stakeholders to appropriate level(s) of participation and related engagement tools (see Figure 3.1). The fifth level of engagement in the IPA2 spectrum, Empower, was not included. Stakeholders mapped to the Empower level have decision making ability, and this level of engagement should be assigned by Suisun City.

When identifying stakeholders, it can be helpful to identify the most useful level of engagement for each stakeholder or stakeholder group. A stakeholder that is mapped to “Inform” will have a different role in the planning process relative to a stakeholder that is mapped to “Collaborate”. The draft stakeholder list developed for this report suggests the level of engagement that could be appropriate for each stakeholder or stakeholder group (see Table 3.1). It should be noted that some stakeholders may move between different roles depending on the Step in the planning process and the needs of the community or project.



Source: Adapted from the International Association for Public Participation (IAP2 2018)

Figure 3.1 Spectrum of Engagement

## 3.2 Timing of Engagement

The Guidance was developed in a manner that allows for meaningful input at each step of the process, with a focus on Steps 3 thru 8 (after the identification of the relevant stakeholders and implementing partners, see Figure 1.1).

Stakeholders mapped to an “Inform” role should be provided with continuous information to keep them engaged and informed throughout the process. Stakeholders mapped to a “Consult” role should be provided with opportunities to review materials and provide feedback early in the development and selection of potential actions. They will likely have limited engagement in Steps 3 and 4 but can provide more substantive input in Steps 5 and 6. Stakeholders mapped to an Involve role should be engaged in Steps 3 thru 8. These stakeholders may have direct local technical knowledge and information that can inform discussions on opportunities and constraints, barriers to implementation, adjacent planning efforts, etc. These stakeholders will likely have the highest degree of engagement within the planning process.

Stakeholders mapped to a “Collaborate” role could have substantive involvement in Steps 4, 5, 6, and 7. These stakeholders will likely have greater familiarity with the planning process, and may include landowners, agencies, and organizations that have a stake in helping to identify actions, strategies, and evaluating the strategies to develop a potential preferred solutions. Some ‘Collaborators’ may also be potential Implementing Partners (see Section 4).

The draft stakeholder list developed for this report also suggests when each stakeholder or stakeholder group should be engaged in the planning process (see Table 3.1) based on their potential role.

## 3.3 Potential Stakeholders

A list of potential stakeholders and community organizations was drafted using readily available resources (see Table 3.1). The list includes key stakeholders, such as the city governments, federal and state agencies, community-based organizations (CBOs)/community groups, major landowners in and adjacent to the study area, etc. Table 3.1 represents a suggested stakeholder list only. The list will need to be vetted and revised using local knowledge and information at the outset of the planning process. The level of engagement of the entities listed and their respective stake/interest in the process should also be confirmed and the engagement plan adjusted accordingly.

**Table 3.1 Potential Stakeholders and Community Organizations**

Stakeholder Group	Who	Relationship in Adaptation Planning Process/ Stake/ Interest	When	Level of Engagement
Federal Agencies	US Fish and Wildlife Service (USFWS)	Stakeholder, Permit Agency, compliance with Endangered species Act (ESA)	At inception or before	Consult <sup>1</sup>

<sup>1</sup> “Consult” here is not meant to imply formal consultation with permitting agencies.

Stakeholder Group	Who	Relationship in Adaptation Planning Process/ Stake/ Interest	When	Level of Engagement
	Federal Emergency Management Agency (FEMA)	Stakeholder, compliance with National Flood Insurance Program (NFIP)	At inception or before	Consult <sup>1</sup>
	NOAA Fisheries/ US National Marine Fisheries Service (NMFS)	Stakeholder, Permit Agency, compliance with Endangered species Act (ESA)	At inception or before	Consult <sup>1</sup> <small>Error! Bookmark not defined.</small>
	U.S. Environmental Protection Agency (EPA)	Stakeholder, Permit Agency, potential funding partner	At inception or before	Consult <sup>1</sup>
	US Army Corps of Engineers (USACE)	Stakeholder, Permit Agency for waterways, levees	At inception or before	Involve/Consult <sup>1</sup>
	U.S. Department of Interior, Bureau of Reclamation (Reclamation)	Key regional stakeholder (BLM lands nearby, <i>need to confirm if also in Focus area, if yes, elevate level of engagement to involve/collaborate</i> )	First round of meetings	Consult
	Travis Airforce Base	Jet Fuel Pipeline ( <i>depending on status of pipeline</i> )	Inception	Consult
State Agencies	Bay Conservation and Development Commission (BCDC)	Stakeholder, Permit Agency for Baylands and Bayfill	At inception or before	Collaborate/Consult <sup>1</sup>
	California Department of Water Resources (DWR)	Stakeholder	At inception or before	Collaborate
	California Department of Fish and Wildlife (CDFW)	CDFW owns the Peytonia Slough Ecological Reserve directly south of Suisun City; landowner, Hill Slough Restoration project directly east of Whispering Bay includes construction of berm along eastern bank of existing Whispering Bay channel, and wetland creation in	At inception or before	Collaborate

Stakeholder Group	Who	Relationship in Adaptation Planning Process/ Stake/ Interest	When	Level of Engagement
		Pond 1/Pond 2 next to the proposed berm. Project will also include new access trails to Suisun Marsh, and elevation of Grizzly Island Road.		
	State Lands Commission (SLC)	The SLC manages tide and submerged lands and the beds of navigable rivers, streams, lakes, bays, estuaries, inlets, and straits and issues leases for use or development, providing public access, resolving boundaries between public and private lands, and implementing regulatory programs to protect state waters from oil spills and invasive species introductions. These lands include the Sacramento and San Joaquin rivers and affiliated portions of the Delta. Through its actions, the Commission secures and safeguards the public's access rights to navigable waterways and the coastline and preserves irreplaceable natural habitats for wildlife, vegetation, and biological communities. The Commission has been developing an Environmental Justice Policy and Implementation Plan in 2018.	At inception or before	Collaborate
	California Department of Transportation (Caltrans)	State Route 12, a state highway goes through the focus area and is projected to be affected	At inception or before	Collaborate
	Capitol Corridor Joint Powers Authority (CCJPA)	Key stakeholder, Suisun-Fairfield Train Station and Capitol Corridor rail line is also projected to be affected, may be able to provide insights from Alviso	At inception or before	Collaborate

Stakeholder Group	Who	Relationship in Adaptation Planning Process/ Stake/ Interest	When	Level of Engagement
		Wetland Railroad Adaptation Alternatives Study		
Regional Agencies	San Francisco Regional Water Quality Control Board	Stakeholder. The San Francisco Regional Water Quality Control Board has jurisdiction over the geographical areas in and surrounding Benicia, Fairfield, Suisun City, and Vallejo, oversees Underground Storage Tank System Closure/ Removal Program.	At inception or before	Consult
	Delta Stewardship Council	Integration with the Delta Plan and ongoing planning efforts.	At inception or before	Consult
County and City Government	Suisun City (City Government, Planning, Public Works, Department of Recreation, Parks & Marina)	Landowner for many of the parcels in the focus area, key stakeholder and governmental entity for Suisun City, including Marina with 160 rental berthing slips along with a 300 ft guest dock and boat launch ramps.	Before Inception	Collaborate
	City of Fairfield	City of Fairfield has vulnerable communities and critical assets within the 108" SLR scenario.	Before Inception	Collaborate
	Solano County (Board of Supervisors)	Stakeholder for issues of regional importance.	At inception or before	Consult
	Solano County Transportation Authority (STA)	Stakeholder regarding roads and transit options (Rio Vista Delta Breeze, Fairfield and Suisun Transit (FAST)), facilitator on County level for Climate Mitigation Actions,	At inception or before	Involve
	Solano County Department of Public Works (DPW)	Manages infrastructure improvements in the focus area, key stakeholder	At inception or before	Involve
	Solano Water Agency	Water infrastructure	At inception or before	Consult

Stakeholder Group	Who	Relationship in Adaptation Planning Process/ Stake/ Interest	When	Level of Engagement
Community Based Organizations (CBOs)	Natural Resources Group (Wings Landing Duck Club)	Owners of Wings Landing restoration site. Breaching of perimeter levees and restoration of tidal wetlands south of Peytonia Ecological Reserve	Public Engagement Process	Consult
	Suisun Marsh Natural History Association (SMNHA)	Owner of Suisun Wildlife Center and Parcels	At inception or before	Collaborate
	California Wildlife Foundation	California Wildlife Foundation collaborates with partner organizations to protect the state's rich diversity of wildlife species by acquiring, restoring, and managing habitat to sustain healthy populations over time.	Public Engagement Process	Consult
	Suisun Resource Conservation District (SRCD)	Suisun Resource Conservation District (SRCD) was established in 1963 as a Special District of the State of California. SRCD represents private landowners in the Suisun Marsh on a variety of conservation issues at federal, state, and local levels.	Public Engagement Process	Collaborate
	Homeowner associations and neighborhoods	Green Valley Lakes, Summerwood, Marina Village Residential District, Cordelia Gateway, Whispering Bay Waterfront, Downtown Core, Harbor Village, Victorian Harbor Neighborhood	Public Engagement Process	Consult/Involve/ Collaborate
	Fairfield-Suisun Unified School District	Crystal Middle School and associated Athletic fields potentially impacted	Public Engagement Process	Consult/Involve/ Collaborate
Private Stakeholders	Kinder Morgan Energy Partners	Long-distance fuel transmission line along train tracks	Public Engagement Process	Consult/Involve
	PG&E	Natural Gas Pipelines within Suisun City	Public Engagement Process	Consult

Stakeholder Group	Who	Relationship in Adaptation Planning Process/ Stake/ Interest	When	Level of Engagement
Public	General Public	All residents of Suisun City	Public Engagement Process	Inform/Consult/Involve
Media	News Media	Daily Republic, Suisun City Patch, broadcasting stations (ABC 7 news), radio (KCBS), etc.	Public Engagement Process	Inform

## 4 Identify Appropriate Implementing Partners

Building city-wide resilience will require collective actions and coordination amongst a wide range of stakeholders, some of which may have planning, regulatory, land ownership, management, financing, and/or other interests in the decision-making process. The stakeholders that are assigned an engagement level of “Collaborate” in Table 3.1 are likely contenders for partnerships to address large-scale shoreline or governance changes. This approach recognizes that collaborating and working closely with potential implementing partners can help facilitate more inclusive, integrative solutions that have multiple benefits to more than one entity, sector, or jurisdiction.

Additionally, coordinating with partners and developing multi-benefit adaptation solutions can increase the range of potential funding sources for both project planning and implementation. For example, Proposition 68 authorizes \$4 billion in general obligation bonds for state and local parks, environmental protection project, water infrastructure projects, and flood protection projects. The State Coastal Conservancy has been allocated \$55 million to assign to San Francisco Bay Area projects over the next 5 years. Measure AA funds, distributed by the San Francisco Bay Restoration Authority, can also be used for flood protection projects that are part of an overall habitat restoration project. Eligible project locations and habitat types should be consistent with the Baylands Ecosystem Habitat Goals Science Update (Goals Project 2015). Additional grant and funding options for multi-benefit resilience and climate adaptation efforts are available in the Finance Guide produced for the Resilience By Design Bay Area Challenge (NHA Advisors and Urban Economics 2018).

## 5 Establish Planning Assumptions

Advancing the SLR adaptation planning process requires setting reasonable planning parameters such as defining the area to be assessed, identifying physical planning units that can help set the scale of potential adaptation actions, and establishing the planning horizon. This section provides the assumptions used within the Suisun City focus area for:

- identifying physical planning units – defining the scale of shoreline and communities impacted by SLR to be addressed; and
- establishing a planning horizon – defining SLR scenarios to guide adaptation strategies.

### 5.1 Identified Physical Planning Units

The Suisun City focus area includes portions of vacant land just north of Highway 12 between the Amtrak/Capitol Corridor station (Amtrak Suisun-Fairfield) and Marina Boulevard, extending south between the Amtrak/Capitol Corridor railway and Suisun Slough to the east (see Figure 1.5). The Suisun City communities at risk of SLR inundation within this century are located between Suisun Slough and Highway 12, with minimal buffer between the slough and the developed edge.

The extent of the focus area was defined after reviewing the existing site geography, including the following: location of transportation infrastructure, existing waterways and prominent land features, key assets identified in the ART Bay Area Suisun City OLU Profile, and the PDAs. These were overlain with the inundation extents for the 10 ART SLR and extreme tide scenarios (Vandever et al. 2017). The scenarios span from 12 inches to 108 inches, where the 108-inch scenario can represent 66 inches of SLR coupled with a 100-year extreme tide, or 108 inches of SLR (used as a proxy for the more extreme H++ scenario, 122 inches, presented in the current State Guidance (Griggs et al. 2017, CCC 2018) that considers more rapid ice sheet melting in the latter half of the century). Because each SLR scenario can represent multiple combinations of SLR and extreme tides, the scenarios are often referred to as total water levels (TWL), such as 12-inch TWL and 108-inch TWL (Vandever et al. 2017).

The shoreline of the focus area was subdivided into reaches that consider the shoreline type, areas of initial overtopping, areas of future overtopping at higher water levels, inland development, and the surrounding landscape including proximity to waterways, marsh areas, marinas, and boat access. Figure 5.1 presents the shoreline reaches defined for this report, and Table 5.1 provides additional information on the shoreline type, where the shoreline is first overtopped, and the areas and assets that are inundated as a result of shoreline overtopping.



Table 5.1 Shoreline Reach / Total Water Level Matrix

Reach	Shoreline Type	Total Water Level (TWL)										
		12 TWL	24 TWL	36 TWL	48 TWL	52 TWL	66 TWL	72 TWL	84 TWL	96 TWL	108 TWL	
A	Marsh Edge	-	Y, entire shoreline is overtopped. Cordelia Gateway, Historic Suisun, Downtown Core are flooded at 24 TWL, with flood depths > 4 feet at 36 TWL.									
B	Boat Ramp	M	M	Y, Boat Ramp, Ecological Reserve, Grizzly Waters Kayaking are impacted.								
C	Marina	-	-	-	M	M	Y, shoreline is overtopped (2 to 4 ft at 66 TWL), with impacts to Downtown Core, Historic Suisun, and Cordelia Gateway.					
D	Hardened	-	-	M	Y, overtopping at low-lying stretch of eastern hardened shore in Suisun Channel at 36 TWL and entire shoreline is overtopped (0.5 to 1ft) at 48 TWL. Flooding occurs in Downtown Core, Suisun-Fairfield Train Station, Historic Suisun homes and businesses, Civic Center, and Harbor Village/Victorian Harbor neighborhood.							
E	Embankment	-	-	-	Y, entire hardened shoreline is overtopped (0.5 ft at 36 TWL) with flooding at Civic Center Drive.							
F	Marina	-	-	M	Y, Suisun City Government Parking Lot, Solano Yacht Club, and Marina are impacted.							
G	Marsh	-	Y, entirety of shoreline is overtopped. Flooding occurs in all neighborhoods up to Highway 12. Sea Breeze mobile home park floods. Embankment is overtopped at Harbor Village/Victorian Harbor flooding the neighborhoods, Crystal Middle School, Amtrak parking lot, and station to Highway 12.									
H	Marina	-	M	Y, shoreline is overtopped and Harbor Village/Victorian Harbor neighborhood flooded.								
J	Marsh	-	-	M	Y, field and marsh adjacent to Hill Slough are inundated to Highway 12 at 48 TWL.							

Y= Flooded, M= Minor Flooding / Impact (e.g., the shoreline is overtopped, but the impacts to inland infrastructure and assets is minimal)



Figure 5.1 Physical Planning Units

## 5.2 Establish Planning Horizon

Suisun City has a general plan that discusses long-term actions based on guiding principles specific to Suisun City (City of Suisun City 2015b); however, there is no discussion of SLR or a clear planning horizon discussed that governs the lifespan of existing critical assets within the region or the lifespan for planned assets and development. The City’s Local Hazard Mitigation Plan lists flooding as a high risk priority hazard, and recommends continued dredging of the canals to mitigate this risk (City of Suisun City 2017). Most of the city is within the Federal Emergency Management Agency’s (FEMA) 1-percent annual chance special flood hazard area, with flooding sources related to precipitation and coastal storm surge from San Francisco

Bay (see Figure 5.2). The city is also at risk of flooding due to embankment failures within the old ‘levee system’ present in some Solano County marshlands that were originally constructed to reclaim marshland and create additional land for grazing and growing crops (City of Suisun City 2017). These embankments were constructed from Bay mud and weak soils excavated from adjacent waterways, and they are prone to erosion and failure, although the risk of failure in any given year or during storm events is difficult to approximate.



Source: FEMA National Flood Hazard Layer, Effective 8/3/2016

Figure 5.2 FEMA Special Flood Hazard Area

A planning horizon for adaptation is generally selected by evaluating the current and future flood risks, other relevant hazards, as well as evaluating the remaining functional lifespan<sup>2</sup> of critical assets, the community’s risk tolerance for flooding, and other political, economic or socio-economic factors. Selecting a planning horizon generally requires coordination between City staff, key asset-owning City departments, and select stakeholders. Planning horizons may also be influenced by current State Guidance (CCC 2018). For this report, in the absence of any coordination with Suisun City, a long-term planning horizon of 2100 was selected. However, the selection of adaptation actions considered near-term (i.e., 24-inch TWL), mid-term (i.e., 52-inch TWL), and long-term (i.e., 108-inch TWL) scenarios. These scenarios were selected based on the timing of overtopping along the shoreline (see Figure 5.1 and Table 5.1), and the thresholds for asset inundation presented in Section 5.4.

<sup>2</sup> The functional lifespan refers to the time a structure may realistically be in use, including routine repair and maintenance cycles.



Figure 5.3 Near-term Potential Inundation with 24 inch Total Water Level

- Near-term = 24-inch TWL (or existing flooding with a 50-year extreme tide); this is the first scenario where impacts to Suisun City are expected from flooding. Considering the time needed for planning, design, and implementation of strategies to protect against this TWL, this scenario was selected as a near-time planning horizon. This TWL could occur temporarily today, or before mid-century for permanent flooding by SLR). Planning for these strategies should begin soon (within 0 to 10 years).



Figure 5.4 Near-term Potential Inundation with 52 inch Total Water Level

- Mid-term = 52-inch TWL (12 inches of SLR coupled with a 100-year extreme tide); this is the first scenario where regional transportation routes (e.g., Amtrak/Capitol Corridor and Highway 12) are impacted. This mid-term planning horizon considers the additional time needed for planning, design, and implementation of more substantial adaptation strategies. This scenario is expected to occur during a mid-century timeline.



Figure 5.5 Near-term Potential Inundation with 108 inch Total Water Level

- Long-term = 108-inch TWL (66 inches of SLR coupled with a 100-year extreme tide); this planning horizon supports strategies that consider the longer lifecycle and use of infrastructure and facilities until an end of century (i.e., 2100) time horizon.

## 5.3 Local and Regional Opportunities and Constraints

Opportunities and constraints that could influence the selection of adaptation actions were evaluated in the Suisun City focus area by reviewing readily available reports, aerial imagery, conducting limited technical analyses, and using best professional judgement based on similar adaptation and restoration planning efforts in the Bay Area. The list of opportunities and constraints is by no means considered complete and will require conversations with City staff and key stakeholders, including adjacent landowners, permitting agencies, biologists, ecologists, and urban planners with local knowledge of the Suisun City area.

### 5.3.1 Opportunities

- Timing is right for adaptation planning: beginning this process now would allow enough time to develop a range of actions that meet the combined goals of the City, stakeholders, and the community; and develop, update, or modify plans and policies to support climate resilience and the implementation of adaptation actions. Near-term actions could be implemented before the potential impacts become a reality. Delays could result in flooding, damage, and costly recovery efforts. Asset losses (to the community and individual landowners) and adaptation costs will increase over time. Developing far-sighted plans now will be cost-effective in the long run and may help protect assets and property values.
- Nature-based solutions: the proximity of Suisun City to marsh areas provides opportunities to coordinate with adjacent restoration efforts and landowners to develop multi-benefit solutions that provide habitat and flood production. Nature-based solutions that included ecotones (i.e., broad higher elevation land that transitions into tidal or managed wetland habitat) and high tide refugia could be constructed that transition into the surrounding marsh areas. Beneficial use of local dredge material (if of acceptable quality), for example from Suisun Slough and waterways within Suisun City, could be used to create the ecotones or could be directly applied to wetlands in thin layers ('sediment seeding') to help adjacent marshlands keep pace with SLR. The use of nature-based solutions can also provide opportunities for public access, improve water quality, and enhance the cultural resources available to the community.
- Available vacant lands: Suisun City has existing vacant land that can provide the space/footprint needed for the implementation of nature-based flood protection structures or more traditional engineered flood management actions (e.g., floodwalls, levees). The vacant land along the shoreline could also be transformed to provide migration space for wetlands to respond to SLR, if flood protection is provided for inland developed areas. Alternatively, the vacant lands could be used to relocate people or businesses out of harm's way (assuming the vacant land has a lower flood risk or can more easily be protected with lower cost solutions). The use of vacant lands to support flood management actions or relocation may require new policies, re-zoning, or updates to existing land use plans. Relocation is a challenging concept for many communities to accept; however, the ability to relocate residents and businesses to a nearby location within the same community can reduce social impacts (as opposed to relocating residents and businesses to another city or region that may require changing schools, longer commutes, loss of employment, or removing important social connections to local resources, friends, family, community groups, churches, etc.).

- Control of the shoreline: a defining characteristic of Suisun City is that it is surrounded by water. The flooding that could occur with Suisun City is due to overtopping along shorelines that are primarily within Suisun City's control. This is not the case for the city of Fairfield. The flooding within Suisun City could lead to flooding within the city of Fairfield, and the most cost-effective flood protection for Fairfield could be to partner with Suisun City on shoreline improvements. Suisun residents currently have immediate waterfront access to the sloughs, marinas, Suisun Marsh, and San Francisco Bay. Suisun City could develop and implement adaptation actions that optimize co-benefits, such as maintaining or improving public access to the waterfront and marsh habitats.
- Coordination with adjacent landowners: Although coordination with adjacent landowners and jurisdictions can be a constraint (see Section 5.3.2), it can also create opportunities for more collaborative multi-benefit solutions and more diverse funding options for both planning and implementation. Many of the adjacent marsh areas have restoration plans in place or in progress (USFWS et al. 2010, 2014, Moyle et al. 2014). Coordination with these landowners on nature-based solutions or green-grey hybrid solutions (i.e., flood protection actions that combine nature-based solutions with engineered strategies) could provide opportunities for cost-sharing. Coordination with the city of Fairfield could provide additional cost-sharing benefits.

### 5.3.2 Constraints

- Limited SLR-related policies in the General Plan: Suisun City's 2035 General Plan does not consider SLR (City of Suisun City 2016a), although the General Plan recommends completing a SLR vulnerability assessment. The General Plan defines the city's long-term vision for growth and development, and serves as a guide for developers, agencies, and the community for achieving the 2035 goals. Development projects are required by state law to be consistent with the City's General Plan. The General Plan also defines areas for preservation and natural resource conservation, economic development, transportation, safety, public facilities and services, and housing. Updating the General Plan to include SLR-related policies could improve the resilience of future development. Local public officials and City leaders may require education on SLR and flooding concerns in Suisun City, as well as information on potential climate change policies and guidance documents available from regional, state, and federal agencies.
- Lack of SLR mitigation actions in the Local Hazard Mitigation Plan: the City updated their Local Hazard Mitigation Plan in 2017 without consideration of SLR and coastal flooding (City of Suisun City 2017). Local jurisdictions are responsible to prepare and adopt a jurisdiction-wide natural hazard mitigation plan, in accordance with the Stafford Act and Title 44 Code of Federal Regulations (CFR) §201.6; and at a minimum, most review and update the plan every 5 years. Updating the Local Hazard Mitigation Plan to include SLR and future coastal flooding hazards, along with potential mitigation actions, could expand the City's eligibility to apply for FEMA Hazard Mitigation Assistance grants to fund SLR adaptation and flood protection projects.
- Existing development plans: Suisun City completed the Waterfront District Specific Plan in 2016 without consideration of SLR and future flood hazards (City of Suisun City 2016a). The Waterfront District Specific Plan is aligned with the General Plan, with actions that include: strategically developing vacant, underutilized, and infill land throughout the city; developing and transforming

the downtown neighborhood to promote economic activities; increasing mobility between core economic areas with transportation links; and promoting efficient motorized and non-motorized mobility in the downtown area. Because the available land area around Suisun City is constrained by the adjacent sloughs and surrounding marshes, flood protection, adaptation, and relocation options are more limited if the Waterfront District Specific Plan is implemented in its entirety.

- Existing Priority Development Area: In 2008, the Association of Bay Area Governments (ABAG) approved Suisun City's PDA under the PDA grant program administered by the Metropolitan Transportation Commission (MTC), ABAG, and other regional agencies (City of Suisun City 2015a). PDAs are existing neighborhoods that are served by public transit and have been identified by the local community as appropriate for additional, compact development, including additional housing and job growth. The Waterfront District Specific Plan is consistent with the PDA designation, which could pose a constraint on modifying the plan to accommodate SLR.
- Existing flood hazards: Most of Suisun City is located within the FEMA Special Flood Hazard Area (see Figure 5.2). New development, re-development, and substantial improvements of existing structures require compliance with National Flood Insurance Program (NFIP) regulations, such as elevating structures above the base flood elevation to reduce flood risks and potential property damage. Suisun City's floodplain ordinance requires that structures in FEMA flood zones elevate the lowest floor (including basements) to 0.5 feet above the base flood elevation (City of Suisun City 2019). The FEMA base flood elevation in Suisun City is approximately 10 feet NAVD88, and the topographic elevations in Suisun City primarily vary between 5 feet and 10 feet NAVD88. Compliance with the City's floodplain ordinance requires the lowest floor elevation of all new or substantially improved residential structures be located at or above 10.5 feet NAVD88. Non-residential structures require floodproofing of all areas located at or below 10 feet NAVD88. Implementation of the Waterfront District Specific Plan could require raising grades above 10.5 feet NAVD88 to achieve NFIP compliance. Alternatively, accredited flood protection structures could be constructed along the shoreline to remove inland areas from the FEMA Special Flood Hazard Area. The Public Works Director is the designated floodplain administrator and is responsible for maintaining NFIP compliance, including reviewing permits for development in FEMA floodplains.
- Constrained land and water area for adaptation actions: Many areas along the Suisun City shoreline are highly developed with minimal land area available for physical adaptation actions. The city is also surrounded by narrow sloughs, which may also limit the footprint available for physical adaptation actions (as opposed to cities with open Bayfront access). Relocation or slough re-alignments may be required in some areas to create enough space for implementation. However, either option could face regulatory, permitting, and/or re-zoning hurdles. Relocation will require additional planning, incentives, and community coordination to reduce or mitigate social equity issues and other concerns.
- Land acquisition challenges: Some area highlighted as vacant in the Waterfront District Specific Plan appear to include structures, such as the Suisun Pacific Marina and Storage facility in the Whispering Bay Waterfront area (City of Suisun City 2016a, Google 2019). Re-purposing the vacant lands for wetland and habitat migration, nature-based or traditional flood protection structures, or new development may require relocating existing residents and businesses. Land acquisition can

be challenging and cost prohibitive, and a full risk assessment that considers the costs, benefits, and tradeoffs of land use options should be considered.

- Building and maintaining community support: If there is broad community support for the Waterfront District Specific Plan (with residents and business leaders), confusion may occur if a new planning process is initiated to develop a SLR adaptation plan that is inconsistent with the Waterfront District Specific Plan. Conversations and agreement at the city leadership level will be essential to develop clear messaging so the community does not feel misled or confused.
- Addressing and maintaining social equity: Suisun City has some of the highest social vulnerability in the region (ACS 2018). Although these communities are at risk of flooding today (see Figure 5.2), the flood risk will increase over time if no actions are taken. Vulnerable communities are often located in areas with the greatest risk of flooding and environmental hazards, and across the nation vulnerable communities are anticipated to be impacted first and the worst by climate change (Hayhoe et al. 2018). Adaptation actions should consider multi-benefit solutions that provide new connections to transportation corridors; access to community centers, recreational trails, green space, and the waterfront; and maintaining or supporting societal and cultural cohesion.
- Rising groundwater levels: As sea level rise, the shallow groundwater layer may also rise (Plane et al. 2017, 2019). Groundwater levels have been noted as a potential issue in Solano County (Solano County Water Agency 2015); however, the report does not include monitoring well information in the Suisun City focus area. Local monitoring well data for the shallow, unconstrained groundwater layer near Suisun City was reviewed at a high level for this report, and the shallow groundwater level is located at or near the ground surface during heavy precipitation events (Plane et al. 2017, CAWRCB 2019). Physical adaptation efforts that address SLR may be insufficient to address rising groundwater levels; therefore, the shallow groundwater layer must be considered when planning adaptation actions.

## 5.4 Triggers and Thresholds

The timing of the potential impacts from SLR was identified using the ART sea level rise and extreme tide scenarios (Vandever et al. 2017), the physical shoreline planning units (see Figure 5.1 and Table 5.1), and the vulnerable assets identified in the Suisun Slough OLU Profile Sheet. Table 5.2 presents the inundation thresholds for the transportation assets, and Table 5.3 presents the inundation thresholds for the vulnerable communities, including those located in the city of Fairfield to the north of Highway 12. The vulnerable communities in Fairfield can be protected by appropriate adaptation solutions implemented in Suisun City. Table 5.4 presents the inundation thresholds for the critical facilities in Suisun City and the city of Fairfield.



Table 5.2 Transportation Assets

			Total Water Level (TWL)									
			12 TWL	24 TWL	36 TWL	48 TWL	52 TWL	66 TWL	77 TWL	84 TWL	96 TWL	108 TWL
Transportation Assets Vulnerability to Flooding	High-way	I-680	-	-	Y	Y	Y	Y	Y	Y	Y	Y
		Highway-12	-	-	-	-	M	Y	Y	Y	Y	Y
	Passenger Rail Line	Parking Lot	-	M	Y	Y	Y	Y	Y	Y	Y	Y
		Station	-	-	Y	Y	Y	Y	Y	Y	Y	Y
		Rail	-	-	-	-	-	Y	Y	Y	Y	Y
		Freight Rail	-	-	-	-	-	Y	Y	Y	Y	Y
		Local Roads	-	Y	Y	Y	Y	Y	Y	Y	Y	Y

Y = Flooded, M = Minor Flooding / Impact (e.g., the shoreline is overtopped, but the impacts to inland infrastructure and assets is minimal)

Table 5.3 Vulnerable Communities

			Total Water Level (TWL)									
			12 TWL	24 TWL	36 TWL	48 TWL	52 TWL	66 TWL	77 TWL	84 TWL	96 TWL	108 TWL
Priority Development Area (PDA)	Suisun City	Socially Vulnerable Block Groups	-	Y	Y	Y	Y	Y	Y	Y	Y	Y
		Block Groups Vulnerable to Contamination	-	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Fairfield	Socially Vulnerable Block Groups	-	-	-	-	-	Y	Y	Y	Y	Y
		Block Groups Vulnerable to Contamination	-	-	-	-	-	Y	Y	Y	Y	Y

Y = Flooded, M = Minor Flooding / Impact (e.g., the shoreline is overtopped, but the impacts to inland infrastructure and assets is minimal)

Table 5.4 Critical Assets

			Total Water Level (TWL)									
			12 TWL	24 TWL	36 TWL	48 TWL	52 TWL	66 TWL	77 TWL	84 TWL	96 TWL	108 TWL
Critical Facilities	Suisun City	Crystal Middle School	-	Y	Y	Y	Y	Y	Y	Y	Y	Y
		Suisun City Government	-	-	A	A	A	Y	Y	Y	Y	Y
		Greater Purpose Church	-	Y	Y	Y	Y	Y	Y	Y	Y	Y
		Mount Cavalry Baptist Church	-	Y	Y	Y	Y	Y	Y	Y	Y	Y
		Sea Breeze Mobil Home Park	-	Y	Y	Y	Y	Y	Y	Y	Y	Y
	Fairfield	Solano Cogeneration Plant	-	-	-	-	-	Y	Y	Y	Y	Y
		Armijo High School	-	-	-	-	-	-	-	-	-	Y
		Suisun Fire Station	-	-	-	-	-	-	Y	Y	Y	Y
		PG&E Substation	-	-	-	-	-	Y	Y	Y	Y	Y
		Berean Baptist Church	-	-	-	-	-	-	-	-	-	Y

Y= Flooded, A = Access may be impacted, M = Minor Flooding / Impact (e.g., the shoreline is overtopped, but the impacts to inland infrastructure and assets is minimal)

## 6 Collectively Define Guiding Principles for Resilience

The guiding principles for resilience – or the overall resilience goals for the planning process – would normally be defined by the City and collectively refined in collaboration with the relevant stakeholders. In the absence of community and stakeholder engagement, this example Guidance application has adopted the ART Project Resilience Goals.

### 6.1 ART Bay Area Resilience Goals

The ART resilience goals are designed to support the four sustainability frames of governance, society and equity, economy, and environment.

#### 6.1.1 Governance

Build capacity in local governments to lead work in collaboration with local and regional Bay Area communities, agencies, non-governmental organizations, and private entities to build regional resilience by facilitating and funding innovative participation throughout climate adaptation processes. This broad and ongoing participation should focus on the inclusion of diverse stakeholders (e.g., diverse in income, ethnicity, age, etc.) in the critical processes of scoping, framing, decision-making, program development, project implementation, and integration with parallel community planning efforts, to ensure that participation impacts outcomes.

Improve or create governance structures to build a shared set of priorities based on creating consensus around appropriate and distinct areas of responsibility, funding mechanisms, accountability measures, and opportunities to streamline permitting for regional, state, local, and district-scale jurisdictions.

Build collaboration within the Bay Area by forming coalitions, collaboratives, district-scale organizations, and Joint Powers Authorities (JPAs) among agencies, organizations, and communities. To promote regional planning across jurisdictions that addresses issues such as flood management, environmental restoration and protection, infrastructure improvement, public access to the Bay, public health, displacement, and affordable housing.

### 6.1.2 Society and Equity

Protect and improve all Bay Area communities', and particularly vulnerable communities', ability to access services, affordable and safe housing for all income levels, a healthy environment, diverse jobs, transportation, recreation, education, information, and opportunities for advancement, while avoiding displacement whenever possible and creating structures for equitable relocation when necessary.

Prioritize the empowerment of vulnerable communities subjected to disproportionate environmental and socioeconomic burdens so they can lead efforts to improve resilience in their communities through development of community leaders, community engagement, funding mechanisms, and education forums.

Build on existing community strengths and social capital to increase political power, access to funding, and control in inclusive decision-making processes.

### 6.1.3 Economy

Support vibrant, self-sufficient local and regional economies that are designed to be resilient to changing environmental conditions, are supportive of small and large businesses, provide living wage jobs, tax revenues to cities and counties, protect public health, and provide access to affordable housing for all income levels, goods, infrastructure, and social services.

Focus on enhancing the function of regional job centers and job training, recreation and tourism sectors, ecosystem services, transportation networks, and infrastructure and concentrates new development in more resilient areas.

Maintain robust local and regional linkages in a multi-modal transportation network to deliver people, goods, and services throughout the cities, counties, region, nation, and world, while achieving greenhouse gas reduction targets and encouraging development in more resilient areas.

### 6.1.4 Environment

Promote the long-term vitality and biodiversity of natural areas, including habitat for native and endangered species, wetlands, creeks, headwater ecosystems, wetland-upland transition zones, streams, upland ecosystems, subtidal habitat, habitat migration space, and working lands, through protection and restoration of complete systems, sediment management, and other aligned actions that ensure natural areas remain resilient in a changing climate.

Preserve, enhance, and restore healthy and vibrant ecological systems to provide multiple benefits to human and natural communities, including improved water quality and supply, flood risk management, cultural resources, carbon sequestration, and recreation.

Mitigate environmental risks, such as contaminated lands and hazardous materials, while also supporting co-benefits, including improved air quality and emissions reductions, through development that reduces the effects of future climate change by supporting lower carbon intensity forms of transport and energy.

## 6.2 Guiding Principles for Adaptation

Suisun City's vulnerability communities, core economic areas, historical districts, residential neighborhoods, and transportation corridors are compacted into a small geographical footprint that is also low-lying in elevation, potentially resulting in significant impacts should flooding occur over any part of the shoreline. After reviewing relevant documents (see Section 2) and considering local opportunities and constraints (see 5.3), draft guiding principles that balanced maximizing the resilience of both the built and natural environment were considered:

- Prioritize nature-based solutions that preserve, enhance, and restore vibrant ecological systems that align with the surrounding environs and maximize co-benefits whenever possible
- Preserve or strengthen vulnerable communities by avoiding displacement or providing equitable relocation
- Prioritize strategies that maintain flexibility/avoid lock-in
- Prioritize low-cost strategies until tipping points are reached
- Protect local and regional multi-modal transportation networks
- Preserve maritime access and connections to the waterfront
- Preserve (to the maximum extent possible) the unique culture, economic goals, and development plans already approved or in progress
- Consider the surrounding landscape and adjacent landowners

## 7 Explore Future Outcomes

Future outcomes aim to establish potential visions of the future shoreline that meet the City's resilience goals by bringing together the planning baseline (e.g., existing conditions, vulnerabilities, physical planning units, and opportunities and constraints) with the planning horizon and the guiding principles. This step in the process is designed to be collaborative, through visioning workshops with various stakeholder groups, to gather a wide variety of insights and concerns about the potential future of Suisun City when considering SLR and climate change. In the absence of city, community, and stakeholder engagement, the concepts and ideas outlined in this section are speculative.

### 7.1 Select Vulnerabilities to Address

Using all baseline information, the next step is deciding which vulnerabilities should be addressed as part of the overall adaptation planning process. For Suisun City, most of the shoreline is overtopped by the mid-term 52-inch TWL. If large-scale relocation is not an acceptable strategy, physical adaptation strategies would be needed along the entire shoreline. This report envisions a future where all shoreline vulnerabilities are minimized or eliminated. It may be impossible to eliminate all risk; however, flood risk can likely be minimized using a collection of actions that form a comprehensive strategy.

In practice, it can be helpful to host workshops with key stakeholders and community members where they can identify their priorities for future adaptation. Role playing games that help stakeholders understand the costs, benefits, and trade-offs of different adaptation decisions can be helpful. Suggested role playing

games include the *Game of Floods* developed by Marin County (Marin County 2019) and the *In It Together* game developed for the Resilience by Design Challenge (All Bay Collective 2018).

## 7.2 Identify Strategic Approaches

In general, there are four strategic approaches that can address SLR vulnerabilities: protecting assets or communities in place; retreating from flood prone areas and/or avoiding new development in flood prone areas; adapting to changing conditions and allowing areas to flood; and preparing areas for future changing conditions, including establishing governance mechanisms necessary to protect, retreat/avoid, and adapt in the future. Most communities will use more than one strategic approach, either in tandem or in sequence, to mitigate or reduce potential SLR hazards.

- **Prepare:** This approach includes actions that help to prepare an area for an increased flood risk in the future. This can include monitoring changes in the best available climate projections and local rates of SLR, implementing flood resilient building codes and standards, and increasing awareness of future SLR and coastal flooding hazards. Prepare actions should be designed to support future decision-making, leading to adaptive outcomes in the future that can mitigate or reduce flood risk. Prepare could be the preferred approach for areas that are not anticipated to be exposed to flooding until the longer-term planning horizon. Prepare could also be appropriate for areas if additional community outreach and capacity building is needed before concrete adaptation decisions can be made. Often, Prepare is an early stage of a larger strategic approach, and more active strategic approaches (i.e., Protect, Adapt, Retreat) would be needed before a given threshold TWL is reached.
- **Protect:** This approach aims to protect areas with critical assets from flooding. This can include asset-specific protection or large-scale protection for a neighborhood or city planning area. Actions can include physical barriers that prevent inland flooding, redirecting floodwaters to flood storage basins or areas allowed to flood, or slowing or absorbing potential floodwaters with nature-based solutions. This may be the preferred approach in areas with a high density of existing, high-consequence assets projected to be flooded in the near- or medium-term planning horizons, or where other approaches are infeasible due to cost, societal or environmental impacts, or other constraints identified by the community.
- **Adapt:** This approach would let an area flood without causing disruption to the city or damage to existing assets. This could require retrofits to existing structures to increase their adaptive capacity (i.e., ability to be temporarily flooded without impacts), such as elevating assets above flood thresholds, floodproofing assets, and implementing flood resilient building codes and standards for all new construction. Adapt could be the preferred approach in areas of low or medium density that contain critical assets that cannot be relocated or phased out of service before flooding is anticipated to occur. Adapt could also be an option in areas with some development pressure and where innovative or exploratory approaches (such as floodable streets or floating homes) are acceptable to the community.
- **Retreat or Avoid:** This approach would allow a flood prone area to flood. For areas that are developed, retreating would require removing or relocating existing assets to areas with

reduced flood risk or higher ground. Ideally, relocation will be accomplished within the city boundaries to limit societal and economic impacts. Relocation can be accomplished through buyouts, rerouting critical services to alternate areas, or allowing assets at the end of their useful life to not be replaced. Retreating could be a preferred approach in areas with a low density of assets. For areas that are not currently developed, avoiding flooding would require preventing critical assets and development from occurring now or in the future. This could be achieved through easements, land buyouts, changing allowable uses through zoning, or refocusing development in safer (e.g., less flood prone, higher elevation) areas. Avoid could be a preferred approach in flood prone areas where the cost of flood protection exceeds the benefits of development, or in areas where existing undeveloped land can provide the footprint needed for adaptation actions that protect already developed areas.

In practice, selecting potential strategic approaches for each physical planning unit (see Section 5.1, Step 3) and city planning area will require collaboration with stakeholders and the community. This can be accomplished in tandem with the workshops proposed for Section 7.2 (Step 5), as role playing games can be helpful when identifying areas to protect, retreat/avoid, adapt, or prepare. It can be helpful to brainstorm multiple potential future visions for the city, without constraining the visioning exercise to existing land use, zoning, development plans, or the feasibility of different adaptation actions. In most cases, multiple actions can accomplish the same or similar future visions.

### 7.3 Define Future Visions

This step articulates desired future outcomes for Suisun City and the surrounding areas. In practice, the results and feedback from the workshops would be synthesized by City staff and used to inform one or more potential futures. This step could include refining or modifying the resilience goals defined in Section 6 (Step 4) to better present the community goals uncovered during the workshops.

For this report, three future visions were explored. All three visions address the complex shoreline vulnerabilities; however, each vision emphasizes a different over-arching goal: 1) prioritizing natural solutions and balanced growth, 2) protecting in place and maximizing growth, and 3) protecting in place while balancing natural solutions. It should be noted that the visions have interchangeable features (i.e., solutions for each physical planning unit can be extracted and combined in multiple ways). All three visions will require continued community outreach and education to build support for a unified vision, funding and financing mechanisms, and governance and policy changes (e.g., updated General Plan, zoning changes, etc.). Although relocation of residents and businesses may be necessary over time to reduce flood risks and construct flood protection infrastructure, the preparation for relocation will include substantive community involvement to reduce stress and create new neighborhood(s) that are responsive and sensitive to community needs. The goal of relocation is to create a situation where all residents, businesses, and stakeholders are provided with improved conditions that retain Suisun City's unique cultural identity. For all three visions, all new structures are constructed using updated building codes and design standards that promote resilient, floodproof, or floodable infrastructure.

- Vision 1: Prioritize Natural Solutions and Balanced Growth: Over time, Suisun City uses some currently vacant land use to support nature-based adaptation actions. Nature-based solutions provide multiple co-benefits for the city and surrounding areas, including increased greenspace

and habitat enhancement, shoreline access, public recreation, and flood protection. The flood protection offered by nature-based adaptation actions will protect inland communities, including critical city facilities and transportation routes. Some shorelines transition from hardened shorelines with direct waterfront access to natural shorelines with habitat areas, public access trails, and new mobility networks; and some shorelines remain hardened with additional engineered flood protection improvements. The existing vacant areas along the shoreline are prioritized for nature-based solutions that transition seamlessly to the surrounding marsh habitats, rather than supporting new development. In the longer-term, some residents and businesses along the shoreline are strategically relocated to an area with reduced flood risks, such as north of Highway 12. The exact location would be determined collaboratively with the residents and businesses being relocated.

- Vision 2: Protect in Place and Maximize Growth: Suisun City is protected in place using engineered flood protection and hardened infrastructure along the shoreline that can increase in height over time to adapt to increasing Bay and slough water levels. This vision supports the development goals outlined in the Waterfront District Specific Plan (City of Suisun City 2015a, 2016a). The existing vacant areas along the shoreline are prioritized for new development. Existing grades in vacant area are increased using imported fill to reduce flood risks. Waterfront access and maritime facilities are maintained and optimized to support rising sea levels.

Vision 3: Protect in Place while Balancing Growth and the Environment: Suisun City achieves a future that both accommodates sea level rise in some areas and protects shorelines and facilities in place in other areas. This blend of nature-based solutions and hardened shorelines protects existing communities and minimizes changes to the Waterfront District Specific Plan (City of Suisun City 2016a). The existing vacant areas along the shoreline are optimized to provide the footprint needed for nature-based solutions or hybrid green-grey solutions<sup>3</sup> in higher flood risk areas along the shoreline, and for new development in lower-flood risk and protected areas. Existing waterfront access and maritime activities are preserved in the near to mid-term planning horizons, but in the long-term waterfront areas selected for nature-based or green-grey solutions transition to habitat areas with public access trails. In the longer-term, some residents and businesses along the shoreline are strategically relocated within the city boundaries (location(s) to be determined by revisiting the Waterfront District Specific Plan).

## 8 Select Actions and Create Strategies

The visions described in Section 7.3 (Step 5) can be achieved through combinations of actions that create a strategy. Actions could include physical (i.e., constructed, built) solutions along the shoreline; changes in policies, procedures, or operations; increasing capacity for decision-making or action; increasing community awareness existing and/or future flood hazards; or the formation of new entities, programs, or collaboratives that bring people together to find shared multi-benefit solutions. Ultimately each vision

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<sup>3</sup> Hybrid green-grey solutions combine nature-based solutions and more traditional engineered solutions to offer the co-benefits of nature-based solutions while increasing the level of flood protection that can be provided.

requires multiple actions, either simultaneously or in sequence, to create a comprehensive strategy for Suisun City. Actions are categorized into the following categories:

- Capacity Building: actions that increase the city's or community's ability to problem solve and implement actions, such as education, community engagement, formal or informal partnerships, relationship-building, and streamlining or creation of new organizational structures.
- Plans and Policies: actions to update, revise, or develop new plans, policies, and guidelines to address sea level rise. These plans and policies may alter how governance, zoning, building code, design, or permitting decisions are made within a jurisdiction.
- Programs and Operations: actions that enhance or create programs, procedures, or management activities within a jurisdiction to address climate change, such as tax incentive programs, financial programs, land acquisition or banking, adaptive management procedures, or disincentive programs.
- Built Projects: physical actions that are appropriate for the shoreline, surrounding areas, inland community, and existing and future flood risks. Built projects include (but are not limited to) nature-based solutions, grey infrastructure, hybrid green-grey solutions, retrofits, or adaptive designs.
- Funding and Financing Mechanisms: actions that support or provide funding for planning and implementing actions and/or strategies, including regional resources, state, federal, or local grants, and financial tools such as taxes, assessments, private funding, or fees.

## 8.1 Select Actions

Several resources are readily available that provide summaries, catalogs, and information for a wide array of actions that reduce flood risk or increase resilience to coastal flooding from sea level rise, including:

- San Francisco Bay Shoreline Adaptation Atlas (SFEI and SPUR 2019)
- BCDC's Adaptation Action Catalog (BCDC 2019)
- Climate Resiliency Design Guidelines (NYC 2019)
- Sea Level Rise Policy Guidance (CCC 2018)
- Climate-Resilient Infrastructure, Adaptive Design and Risk Management (ASCE 2018)
- Protecting Building Utility Systems from Flood Damage. Principles and Practices for the Design and Constructions of Flood Resistant Building Utility Systems (FEMA 2017)
- Use of Natural and Nature-Based Features for Coastal Resilience (Bridges et al. 2015)
- Climate Change and Extreme Weather Adaptation Options for Transportation Assets in the Bay Area Pilot Project (MTC et al. 2014)
- Floodproofing Non-Residential Buildings (FEMA 2013)
- Engineering Principles and Practices for Retrofitting Flood-Prone Residential Structures (FEMA 2012)



- Adaptation Tool Kit: Sea Level Rise and Coastal Land Use. How Governments can use Land-Use Practices to Adapt to Sea Level Rise (Grannis 2011)
- Strategies for Managing Sea Level Rise (SPUR 2009)

This following section describes the actions selected to support the three visions.

### 8.1.1 Prepare

The first action(s) to implement in Suisun City should include ‘Capacity Building’ actions, such as those listed below. Additional capacity building actions should be developed by the City using their knowledge and insight of the types of actions that work best within their unique communities.

- Train government staff in adaptation and resiliency. An adaptation point-person is formalized with supporting champions identified from all City agencies and departments. Staff have consistent and reliable access to resources, tools, and trainings to build their expertise on adaptation strategies and measures.
- Create a climate change and SLR public awareness campaign to build support for local City-led SLR adaptation efforts, educate residents and business owners on the actions they can take to increase the resilience of structures under their control, and create opportunities for community members to partner with city staff throughout the adaptation planning process.
- Create a cooperative program, such as a shoreline management program, that helps identify strategies for shared decision-making and funding to reduce current and future flood risks in a manner that benefits and balances issues of equity, economy, and environment.
- Establish or enhance relationships with other Bay Area communities that are farther along in their adaptation planning process, such as San Mateo County (SMC and SCC 2018), Marin County (BVB 2017), city of Alameda (City of Alameda 2019), and others.
- Participate in groups supporting regional SLR and climate change coordination.
  - BCDC’s Adapting to Rising Tides (ART) Program has released SLR and coastal flooding inundation layers for the entire Bay Area and developed a portfolio of planning guidance, tools, engagement exercises, and information to support climate change assessments and adaptation. As cities, counties, agencies or localized areas complete assessments using the ART approach, the assessments are posted on the ART website to foster lessons learned and transparency across the region. BCDC also hosts Regional Working Groups to encourage regional conversations on adaptation planning and implementation.
  - Bay Area Climate Adaptation Network (BayCAN) is a collaborative network of local government staff and partners to help the Bay Area region respond effectively and equitably to the impacts of climate change on human health, infrastructure, and natural systems. BayCAN covers the 9-county San Francisco Bay Area and primarily exists to facilitate connections, information sharing, and best practices development among local governments, develop opportunities for multi-jurisdictional collaboration

and program implementation, and help secure greater levels of adaptation funding and resources.

- San Francisco Bay Regional Coastal Hazards Adaptation Resiliency Group (CHARG) is an organization of flood control managers and scientists responsible for reducing flood risk in the Bay Area. As a strategic initiative of the Bay Area Flood Protection Agencies Association, CHARG's goal is to advance the technical, scientific, and engineering analyses needed for the region to implement adaptation projects and build resilience to SLR and climate change. CHARG hosts regional workshops, meetings, and presentations to share their findings and encourage collaboration.

Several opportunities exist for Suisun City to update 'Plans and Policies' to prepare the city for adaptation and increase the resilience of existing and future development.

- Create guidelines to incorporate sea level rise guidance into Suisun City's planning processes. Guidelines or informational material can be messaged to increase public or government understanding of sea level rise hazards and present best practices for adaptation planning (e.g., using nature-based actions) and development in the floodplain.
- Update the General Plan and Zoning Ordinance concurrently to provide design guidelines and regulations for new development in areas with SLR and flooding hazards and develop resilience strategies for existing developments within these areas.
- Update the Local Hazard Mitigation Plan to include SLR and coastal flooding hazards and include potential mitigation strategies for these hazards.
- Update Building Codes and Design Guidelines to support sustainable development and substantial improvements to existing structures that consider SLR and climate change. The updates should consider floodproofing, flood resistant building materials, floodable designs, and freeboard/elevation requirements.
- Update the local Floodplain Management Ordinance to go beyond existing NFIP regulations:
  - Adding additional freeboard to the current base flood elevation (BFE) requirement. Current freeboard requirements add 0.5 feet to the FEMA BFE. Adding additional freeboard (2 feet plus) could increase the resilience of new and substantially improved structures.
  - Suisun City can examine the potential of lowering their Community Rating System (CRS) designation. This helps achieve two goals: lowering NFIP policy premiums and building more resilient structures and communities.

Opportunities also exist for developing or updating 'Programs and Operations' and 'Funding and Financing Mechanisms' to prepare the city for adaptation.

- Monitoring rising sea levels is required to better identify when target flood elevations are reached, and to identify when adaptation plans should be revisited with respect to the timing of when adaptation actions need to be place. Monitoring sea level rise and other climate change considerations could be included in the City's operational procedures.

- Green Bonds may provide a more feasible funding option for adaptation implementation than typical municipal bonds. Repayment of debt could come from taxes (e.g., parcel taxes).
- Grant programs are available to help fund adaptation planning and implementation, and additional grant programs are likely to be created to support coastal resiliency and adaptation efforts. Current grant programs are supported locally by Proposition 68 and Measure AA. FEMA provides grant funding through their Hazard Mitigation Grant Program, and NOAA provides funding through their Coastal Resilience Grants Program. Most grants do not cover the full suite of project costs and matching funds may be required.

### 8.1.2 Protect

This section describes physical actions selected to support the three visions. The following physical actions fall under “Built Projects”:

- Nature-based solution / ecotone habitat levee: physical landscape features that are created and evolve over time through the actions of environmental processes operating in nature (or features that mimic characteristics of natural features but are created by human design, engineering, and construction in concert with natural processes) to provide coastal protection and other ecosystem services (SFEI and SPUR 2019). This solution evolved from traditional engineered levee designs and concepts, but in addition to providing flood protection, an ecotone habitat levee provides co-benefits such as habitat creation, water quality improvements, and public access and recreation. Engineered levees typically have a water-wide slope of 2:1, whereas an ecotone habitat levee has a shallower water-wide slope closer to 20:1, requiring a larger footprint for implementation. The Oro Loma Sanitary District constructed an ecotone habitat levee (a.k.a., horizontal levee) as a pilot project to test the concept in the Bay Area (OLSD et al. 2015).
- Grey solution / floodwall: conventional flood protection infrastructure, often engineered for compliance with FEMA’s National Flood Insurance Program, U.S. Code of Federal Regulations, Title 44 §65.10 (CFR 1986). A floodwall is a vertical levee built to provide flood protection, with limited to no provisions for ecosystem services or other co-benefits. A floodwall uses a minimal footprint; therefore, this action can be used along developed/urbanized shorelines with limited space for alternative options. Floodwalls may limit shoreline access and can also limit the views from adjacent or nearby buildings. Floodwalls have limited options for adaptation in the future; however, a floodwall can be constructed with an oversized foundation to support a future increase in height to accommodate higher rates of SLR.
- Hybrid green-grey solution / ecotone with floodwall: hybrid action that combines the benefits of both solutions. The desired level of flood protection can be achieved using a narrower ecotone habitat levee (i.e., smaller footprint, fewer habitat and public access co-benefits) combined with a shorter floodwall (i.e., the ecotone habitat levee provides wave dissipation so the floodwall height can be reduced in comparison to the height needed for a standalone floodwall). This hybrid action can be strategically phased over time by first constructing an ecotone levee with an oversized floodwall foundation on the landward edge. The floodwall can be increased in

height in the future as SLR increases; however, this could limit public access and recreation opportunities along the shoreline.

- Hybrid green-grey solution / elevate existing grades: raising existing ground elevations can reduce flood risks. This can be accomplished by elevating individual trails or roadways, or by elevating the grade of existing land parcels or vacant land areas:
  - Existing shoreline trails (e.g., the San Francisco Bay Trail) can be elevated on a berm, levee, or on the inland edge of an ecotone habitat levee to maintain or increase public access and provide flood protection.
  - Existing land parcels or vacant lands can be elevated by importing fill to raise grades to the desired elevation. This action is best suited for areas with limited existing structures, as structures would also need to be raised to or above the desired elevation. Elevating lands along the shoreline can provide opportunities to integrate habitat corridors, ecotone habitat, and other co-benefits.
  - Existing roadways can also be raised to provide flood protection for inland areas. Although habitat corridors can be located along raised roadways, these corridors may provide more water quality benefits (e.g., improving the water quality of roadway runoff) than habitat benefits given the proximity to motor vehicles.
  - Existing rail infrastructure can also be elevated to protect the railway from inundation and to provide flood protection for inland areas. This may require more grey infrastructure solutions as opposed to green solutions to maintain the integrity of the railway. Anecdotal evidence has noted past subsidence along many of the railways constructed through Suisun Marsh, including along the Amtrak / Capitol Corridor. The geotechnical conditions may govern the options available for raising or elevating the railway.

### 8.1.3 Adapt

The following physical actions generally fall under 'Built Projects':

- Channel realignment / widening: Existing streams and tributaries can be realigned or widened where space and environmental conditions allow. Modifications can help reduce flood risk, maintain or increase flood conveyance, and enhance habitat corridors. Channel realignment can also increase the footprint available for implementing physical actions that protect communities and assets.

Floodproofing and flood resilient infrastructure: Existing structures can be modified to reduce the impacts from temporary flooding, and new structures can be built to allow for temporary flooding with limited impacts. Floodproofing allows floodwaters to temporarily enter a structure without significant damage, shields the outside of a structure from floodwater damage, and/or raises sensitive components (e.g., electrical equipment) above projected flood elevations. Floodproofing can also include raising the structure above the flood elevation. Floodproofing measures can be used in tandem with nature-based or traditional flood protection actions along

the shoreline to provide redundancy. Floodproofing actions should be supported by updates to Building Codes and Design Guidelines (see Prepare, Section 8.1.1).

#### 8.1.4 Retreat / Avoid

The following actions fall under the category of 'Programs and Operations':

- Migration space preparation: identify area(s) with limited or no development that can be preserved for landward migration of natural areas or future nature-based adaptation solutions and prevent new development. This action should be supported by other plans and policies and programs and operations, such as buyout programs (if existing development is within migration areas), land acquisitions (if the land is not owned by the City), and/or updates to land use and zoning ordinances.
- Managed retreat: identify area(s) where the relocation of people and assets out of harm's way provides a greater overall benefit for the city than attempting to protect the area(s) in place. Retreat is often seen as a last resort, a failure to adapt, or a one-time emergency action in the aftermath of an extreme storm event (Siders et al. 2019). However, relocating at-risk communities before a future extreme event occurs can reduce property damage, loss of life, and displacement uncertainties associated with recovery efforts. If strategic retreat is integrated into planning for economic, social, and environmental goals, and part of a larger transparent community conservation, it may be achievable (Bronen 2015). Relocation must be sensitive to social inequities and human rights concerns, and destination sites that are safe from multiple hazards should be identified so that one hazard is not being substituted for another (Siders et al. 2019). Relocation can be facilitated with bans on rebuilding after an extreme event and land-use restrictions including setbacks and property acquisition (either voluntarily or through eminent domain). As relocation for climate-related concerns becomes more common, additional tools will likely be created to support smooth transitions for the affected communities.

## 8.2 Create Strategies

Creating a comprehensive strategy for Suisun City includes selecting actions that can be bundled together to meet the goals of each future vision defined in Section 7.3. The process of selecting appropriate actions draws on all the elements within this planning process: the physical planning units, triggers and thresholds, planning horizons, guiding principles, opportunities and constraints, and the visions articulated for Suisun City. The strategy descriptions refer to neighborhoods described in the Waterfront District Specific Plan, see Figure 8.1.



Source: Adapted from City of Suisun City (2016a)

**Figure 8.1 Neighborhoods and Planning Districts**

### 8.2.1 Prioritize Natural Solutions and Balanced Growth (Strategy 1)

In this strategy Suisun City embraces a nature-based approach to flood resilience. In the vacant areas along the shoreline, development is limited to allow these areas to transform into nature-based solutions that provide flood protection for communities and infrastructure. The physical actions selected to achieve this vision include ecotone levees that can be adapted to higher amounts of sea level rise, elevating existing trails to provide additional flood protection, and realigning Suisun Slough to provide space for nature-based solutions along the Suisun City shoreline. It also includes managed retreat (i.e., relocating communities to areas with a reduced flood risk) from high hazard coastal areas to provide the footprints needed for nature-based solutions.

The progression of the selected actions across the planning horizons is presented in Figure 8.2 thru Figure 8.4 and described below.

- Near-term 24-inch Total Water Level (Figure 8.2)
  - Elevate: fill is used to block the flood pathways on the southern edge of the Cordelia Gateway and Southern Waterfront, which could allow floodwaters to reach developed areas.
  - Ecotone habitat levees: the shoreline edge along the Whispering Bay Waterfront is transformed with ecotone habitat levees that provide flood protection, public access, and habitat co-benefits.
  - Plans and Policies (see Section 8.1.1) are updated in the near-term to limit development of waterfront areas and support future adaptation actions.
- Mid-term 52-inch Total Water Level (Figure 8.3)
  - Channel realignment: Suisun Slough adjacent to the Harbor Village/Victorian Harbor Neighborhood is realigned in collaboration with the Hill Slough Tidal Marsh Restoration Project. The new alignment will continue to provide flood conveyance and habitat value. Realigning the slough provides more opportunities for nature-based solutions along the complex, developed shoreline. Many of the existing residential structures extend over the shoreline and into the existing slough, with docks and direct boat access to the slough. Realigning the slough prevents direct boat access via private docks; however, there could be opportunities to create pedestrian access to a new (small) marina adjacent to the realigned slough to support continued boating and water-based recreation for the residents along this shoreline. Construction of a marina would be contingent upon coordination with adjacent landowners and the Hill Slough Tidal Marsh Restoration Project.
  - Ecotone habitat levees: most of Suisun City's shorelines are transformed into ecotone habitat levees to increase flood protection. The ecotone habitat levees constructed in the near-term planning horizon are expanded to increase the level of flood protection.
  - Floodwalls: the hardened shorelines adjacent to the Downtown Core (Waterfront Promenade) are upgraded to support floodwalls. The floodwall foundations are over-sized to support future increases in height in the longer-term planning horizon.
  - Maritime access: connections to the existing marinas within Suisun Slough are maintained with pedestrian walkways. The existing docks may need retrofits that allow them to adjust to higher water levels. The retrofits should consider the longer-term water levels. Maintaining a boat ramp in this area while also providing flood protection to inland areas may be challenging. A fixed gantry crane may be required to launch and remove boats from the water near the marina.
  - Elevate the Bay Trail: the existing Bay Trail (Grizzly Island Trail) along the Harbor Village/Victorian Harbor Neighborhood is elevated and extended to provide flood protection

for the inland communities and Highway 12. The extended trail also increases mobility and public access and recreation.

- Elevate the railway: a segment of the Amtrak / Capitol Corridor railway is elevated to prevent potential overtopping along the westside of the railway.
  - Mitigation space preparation: waterfront areas that are needed for longer-term flood protection are designated and prepared. Early community education, outreach, and planning is required if any residents or businesses are designated for relocation in the longer-term.
  - Programs and operations: a community program that plans, researches, and supports future relocation efforts may be needed. The program should be community-centered to help the community understand why relocation may be necessary, provide potential relocation incentives, and help identify potential relocation areas and develop plans for a new neighborhood that meets the cultural and social identity and needs of the community.
  - Plans and policies (see Section 8.1.1) may require additional updates in the mid-term to limit development of waterfront areas and support future adaptation actions.
- Long-term 108-inch Total Water Level (Figure 8.4)
    - Ecotone habitat levees: ecotone habitat levees constructed in the mid-term planning horizon are raised in elevation and width to provide greater flood protection for inland communities. New ecotone habitat levees are constructed adjacent to the Amtrak / Capitol Corridor rail line to protect a greater distance of rail line.
    - Elevate floodwalls: the floodwalls adjacent to the Downtown Core (Waterfront Promenade) along Suisun Slough are increased to the maximum height supported by the foundations constructed in the mid-term.
    - Elevate trails: the trails elevated in the mid-term are elevated further to provide additional flood protection for inland communities.
    - Elevate low-lying areas: the Highway 12 and Amtrak / Capitol Corridor crossing is modified to prevent floodwaters from extending north of Highway 12.
    - Managed retreat: some residents and/or businesses may require relocation away from high-hazard waterfront areas to provide the footprints required for the ecotone habitat levees. The relocation location would be determined collaboratively with those being relocated.



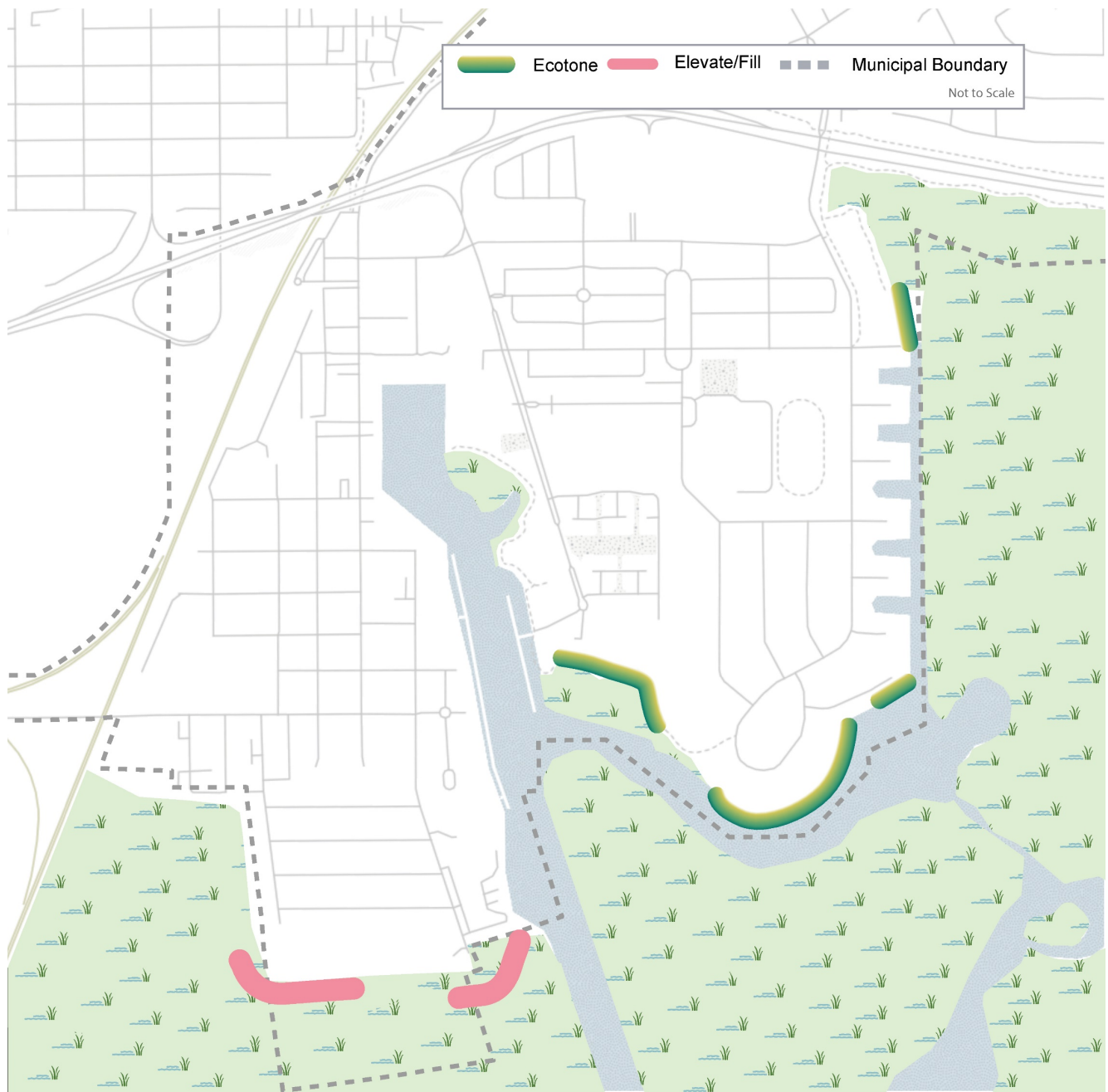


Figure 8.2 Strategy 1 Near-term Adaptation Concept



Figure 8.3 Strategy 1 Mid-term Adaptation Concept



Figure 8.4 Strategy 1 Long-term Adaptation Concept

## 8.2.2 Protect in Place and Maximize Growth (Strategy 2)

In this strategy, Suisun City maximizes the development potential outlined in the Waterfront District Specific Plan (City of Suisun City 2016a). The physical actions selected to achieve this vision include floodwalls and traditional engineered flood protection actions. Flood protection foundations are over-sized to support future increases in height as sea levels continue to rise. Managed retreat is avoided, and the city is protected in place through the long-term planning horizon.

The progression of the selected actions across the planning horizons is presented in Figure 8.5 thru Figure 8.7 and described below.

- Near-term 24-inch Total Water Level (Figure 8.5)
  - The near-term actions for Strategy 2 are identical to those described for Strategy 1.
  - Elevate low-lying areas: Before developing the vacant areas along the shoreline (e.g., Whispering Bay Waterfront), consider raising grades above the mid-term or long-term flood elevation to minimize the cost of future flood protection elements.
- Mid-term 52-inch Total Water Level (Figure 8.6)
  - Hybrid ecotone-floodwalls: the shoreline edge along the Cordelia Gateway neighborhood is transformed into a hybrid ecotone habitat levee coupled with a floodwall foundation along the inland edge. The hybrid structure is adaptable in the future to provide flood protection for higher rates of SLR. The hybrid structure integrates well with the surrounding marsh and the Peytonia Ecological Reserve, without requiring additional encroachment into the reserve in the longer-term planning horizon.
  - Ecotone habitat levees: the northern edge of the Harbor Village/Victorian Harbor Neighborhood is protected with an ecotone habitat levee integrated with the elevated Bay Trail.
  - Floodwalls: the hardened shorelines adjacent to the Downtown Core (Waterfront Promenade), Civic Center, Whispering Bay Waterfront, and the Victorian Harbor Keys are upgraded to support floodwalls that provide inland flood protection. The floodwall foundations are over-sized to support future increases in height in the longer-term planning horizon. The floodwalls require a minimal footprint and can help maximize the developable area along the shoreline with minimal encroachment into the slough. Construction of the floodwall along the Victorian Harbor Keys neighborhood is challenging, as many residential structures extend over the water (beyond the existing shoreline) with private docks. The construction of the floodwall may require removal of private docks, extending the shoreline into the slough (beyond the existing residential structures), and placing fill behind the floodwall.
  - Maritime access: connections to the existing marinas within Suisun Slough are maintained with pedestrian walkways. The existing docks may need retrofits that allow them to adjust to higher water levels. The retrofits should consider the longer-term water levels. Maintaining a boat ramp in this area while also providing flood protection to inland areas

may be challenging. A fixed gantry crane may be required to launch and remove boats from the water near the marina.

- Elevate the Bay Trail: the existing Bay Trail (Grizzly Island Trail) along the northern edge of the Harbor Village/Victorian Harbor Neighborhood is elevated and integrated into the ecotone habitat levee to provide flood protection for the inland communities and Highway 12.
  - Elevate the railway: a segment of the Amtrak / Capitol Corridor railway is elevated to prevent potential overtopping along the westside of the railway.
  - Elevate the shoreline: the shoreline along the Southern Waterfront is elevated with an earthen berm to provide inland flood protection.
  - Plans and policies (see Section 8.1.1) may require additional updates in the mid-term to limit development of waterfront areas and support future adaptation actions.
- Long-term 108-inch Total Water Level (Figure 8.7)
    - Hybrid ecotone-floodwalls: a floodwall is constructed on the floodwall foundation integrated within the ecotone habitat levee along the southern edge of the Cordelia Gateway neighborhood to provide flood protection through the long-term.
    - Floodwalls: the floodwalls adjacent to the Downtown Core (Waterfront Promenade), Civic Center, Whispering Bay Waterfront, and the Victorian Harbor Keys are increased to the maximum height supported by the foundations constructed in the mid-term.
    - Widen channel: Suisun Slough adjacent to the Victorian Harbor Keys is widened to accommodate the larger floodwall needed for long-term flood protection.
    - Maritime access: a new marina is constructed in Suisun Slough adjacent to the Victorian Harbor Keys to provide replacement boat slips for the residents that will lose private boat docks and water access due to construction of the floodwall.
    - Elevate trails: the trails elevated in the mid-term are elevated further to provide additional flood protection for inland communities.
    - Elevate low-lying areas: low-lying areas are raised to preserve waterfront access along the Southern Waterfront. The Amtrak / Capitol Corridor railway that spans from Highway 12 to Cordelia Street is raised above long-term flood elevations. The Highway 12 and Amtrak / Capitol Corridor crossing is also modified to prevent floodwaters from extended north of Highway 12.



Figure 8.5 Strategy 2 Near-term Adaptation Concept

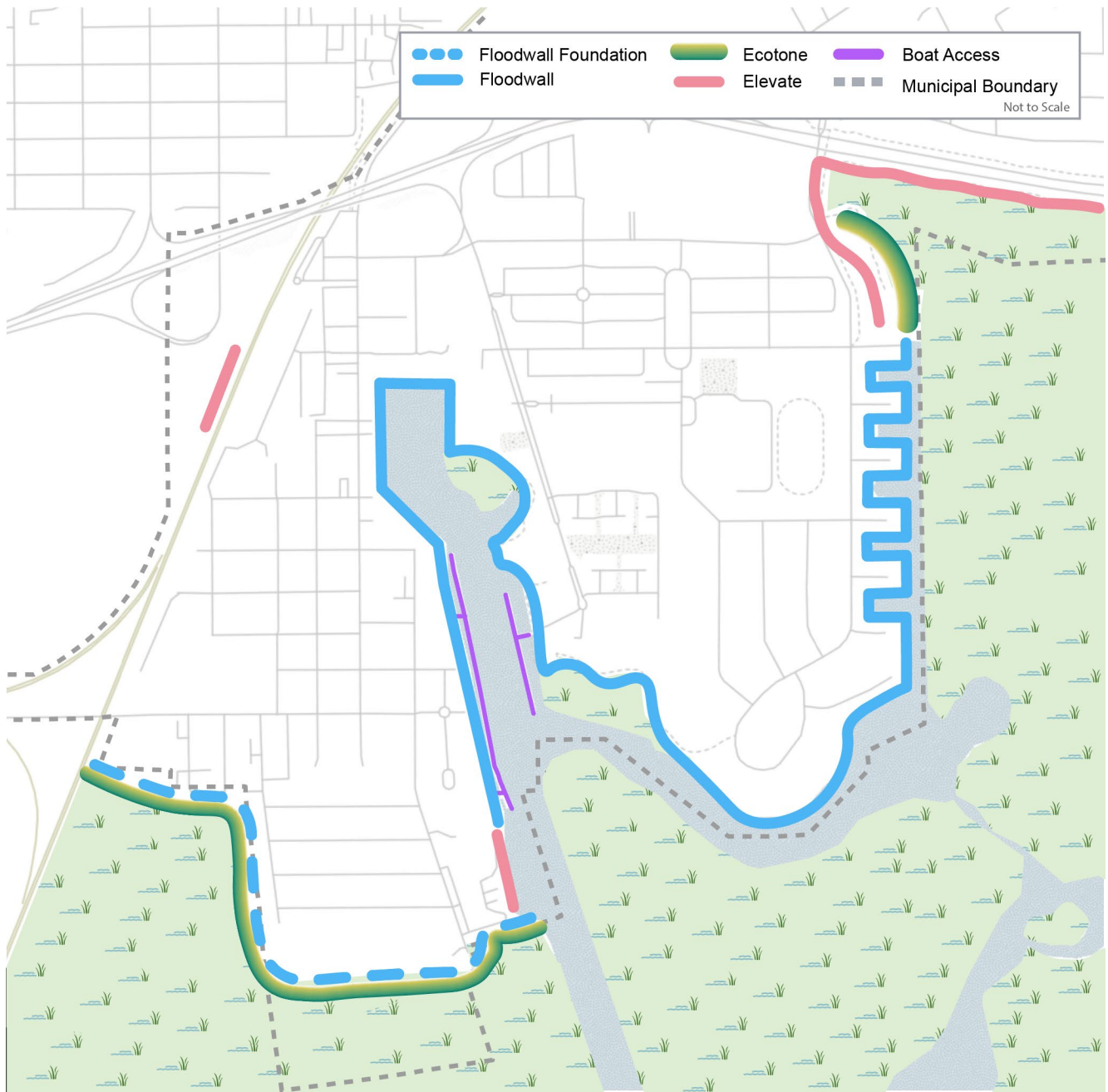


Figure 8.6 Strategy 2 Mid-term Adaptation Concept

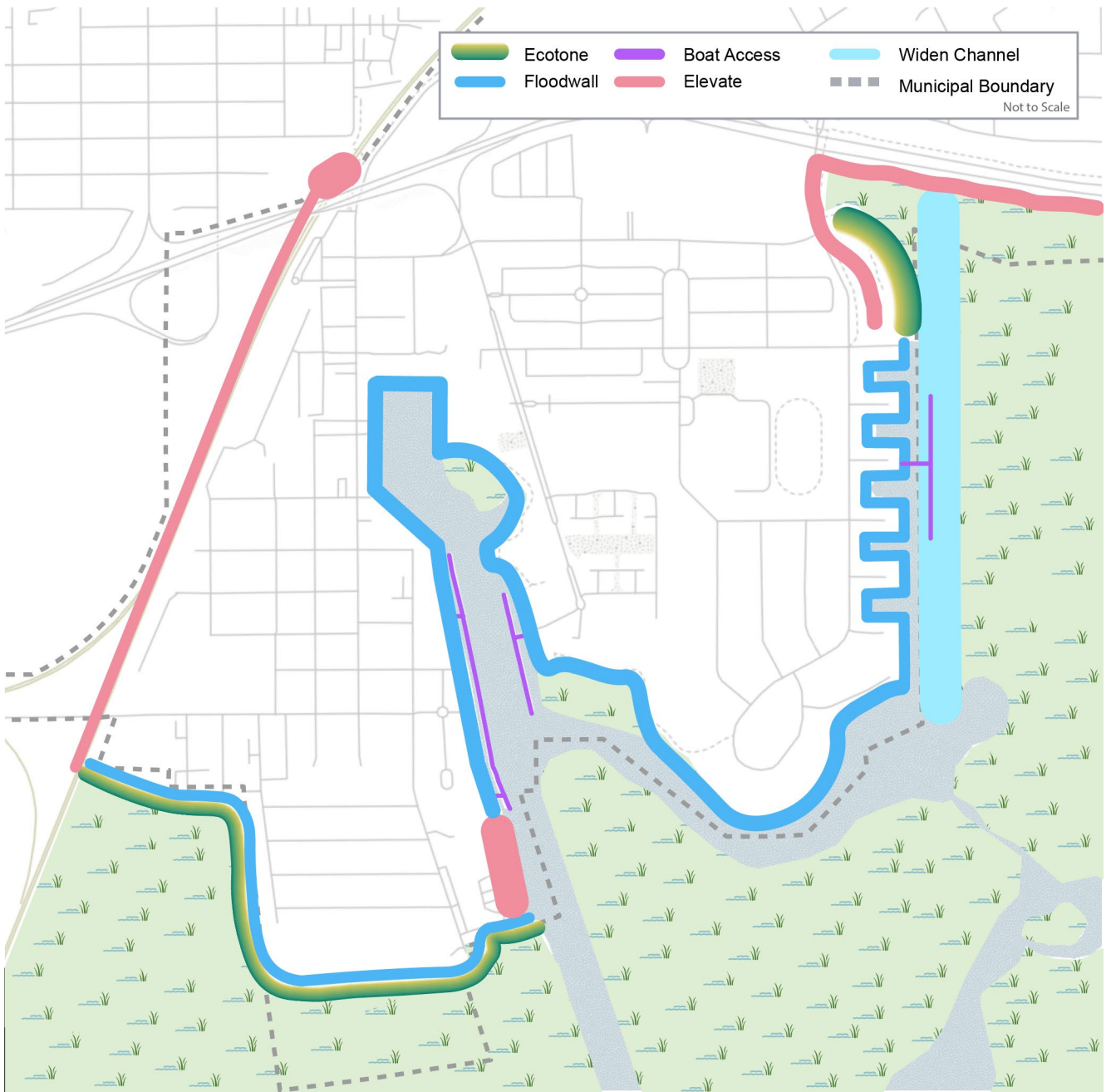


Figure 8.7 Strategy 2 Long-term Adaptation Concept



### 8.2.3 Protect in Place and Balance Growth and the Environment (Strategy 3)

In this strategy, Suisun City combines elements of Strategy 1 and Strategy 2 to achieve a plan that can protect some areas in place and support continued growth, while accommodating sea level rise and implementing nature-based solutions in other areas. Strategy 1 relies primarily on green infrastructure (nature-based solutions) while Strategy 2 relies primarily on grey infrastructure, and Strategy 3 aims to incorporate elements of both. Where feasible, hybrid green-grey actions consisting of ecotone habitat levees combined with floodwalls are implemented. Managed retreat (i.e., relocating communities to areas with a reduced flood risk) from high hazard coastal areas may be required to provide the footprints needed for nature-based solutions.

The progression of the selected actions across the planning horizons is presented in Figure 8.8 thru Figure 8.10 and described below.

- Near-term 24-inch Total Water Level (Figure 8.8)
  - The near-term actions for Strategy 3 are identical to those described for Strategy 1.
  - Elevate low-lying areas: Before developing the vacant areas along the shoreline (e.g., Whispering Bay Waterfront), consider raising grades above the mid-term or long-term flood elevation to minimize the cost of future flood protection elements.
- Mid-term 52-inch Total Water Level (Figure 8.9)
  - Hybrid ecotone-floodwalls: the shoreline edge along the Cordelia Gateway neighborhood is transformed into a hybrid ecotone habitat levee coupled with a floodwall foundation along the inland edge. The hybrid structure is adaptable in the future to provide flood protection for higher rates of SLR. The hybrid structure integrates well with the surrounding marsh and the Peytonia Ecological Reserve, without requiring additional encroachment into the reserve in the longer-term planning horizon. The shoreline edges along the Civic Center and Whispering Bay Waterfront neighborhoods are also transformed into a hybrid ecotone habitat levee coupled with a floodwall foundation along the inland edge.
  - Floodwalls: the shorelines along to the Downtown Core (Waterfront Promenade) and the Harbor Village/Victorian Harbor Neighborhood are upgraded to support floodwalls that provide inland flood protection. The floodwall foundations are over-sized to support future increases in height in the longer-term planning horizon. The floodwalls require a minimal footprint and can help maximize the developable area along the shoreline with minimal encroachment into the slough. Construction of a floodwall along the Victorian Harbor Keys neighborhood is challenging, as many residential structures extend over the water (beyond the existing shoreline) with private docks. In this strategy, a straight floodwall is constructed rather than following the existing shoreline edge of the Victorian Harbor Keys. The construction of the floodwall will require removal of all private docks, extending the shoreline into the slough (beyond the existing residential structures), and placing fill behind the floodwall, including within the keys. This filled area is transformed into open space and park areas for the residents of the Victorian Harbor Keys.

- Widen channel: Suisun Slough adjacent to the Victorian Harbor Keys is widened to accommodate the larger floodwall needed for long-term flood protection.
  - Maritime access: a new marina is constructed in Suisun Slough adjacent to the Victorian Harbor Keys to provide replacement boat slips for the residents that will lose private boat docks and water access due to construction of the floodwall/seawall. No launching facilities or boat ramps are available at the new marina. The connections to the existing marinas within Suisun Slough are maintained with pedestrian walkways. The existing docks may need retrofits that allow them to adjust to higher water levels. The retrofits should consider the longer-term water levels. Maintaining a boat ramp in this area while also providing flood protection to inland areas may be challenging. A fixed gantry crane may be required to launch and remove boats from the water near the marina.
  - Elevate the Bay Trail: the existing Bay Trail (Grizzly Island Trail) along the northern edge of the Harbor Village/Victorian Harbor Neighborhood is elevated and integrated into the ecotone habitat levee to provide flood protection for the inland communities and Highway 12.
  - Elevate neighborhood: the Southern Waterfront area is raised to an elevation above the long-term flood elevation to preserve waterfront access and provide inland flood protection to inland low-lying communities.
  - Mitigation space preparation: some waterfront areas are prepared for landward migration of natural areas.
  - Plans and policies (see Section 8.1.1) may require additional updates in the mid-term to limit development of waterfront areas and support future adaptation actions.
- Long Term 108-inch Total Water Level (Figure 8.10)
    - Ecotone habitat levees: a new ecotone habitat levee is constructed at the Suisun Slough edge along a portion of the Downtown Core shoreline to provide additional public greenspace, and a separate ecotone habitat levee is constructed along the Amtrak / Capitol Corridor railway to protect the railway from long-term flooding.
    - Hybrid ecotone-floodwalls: a floodwall is constructed on the floodwall foundation integrated within the ecotone habitat levee along the southern edge of the Cordelia Gateway neighborhood and along the Civic Center / Whispering Bay Waterfront.
    - Floodwalls: the floodwalls adjacent to the Downtown Core (Waterfront Promenade) and the Victorian Harbor Keys are increased to the maximum height supported by the foundations constructed in the mid-term.
    - Maritime access: the marina along the western edge of Suisun Slough is removed to accommodate construction of an ecotone habitat levee. The marina constructed at the northern edge of the Victorian Harbor Keys transitions to a public marina to accommodate the loss of boat slips adjacent to the Downtown Core.

- Elevate low-lying areas: the Highway 12 and Amtrak / Capitol Corridor crossing is modified to prevent floodwaters from extended north of Highway 12.
- Managed retreat: some residents and/or businesses may require relocation away from high-hazard waterfront areas to provide the footprints required for the ecotone habitat levees.

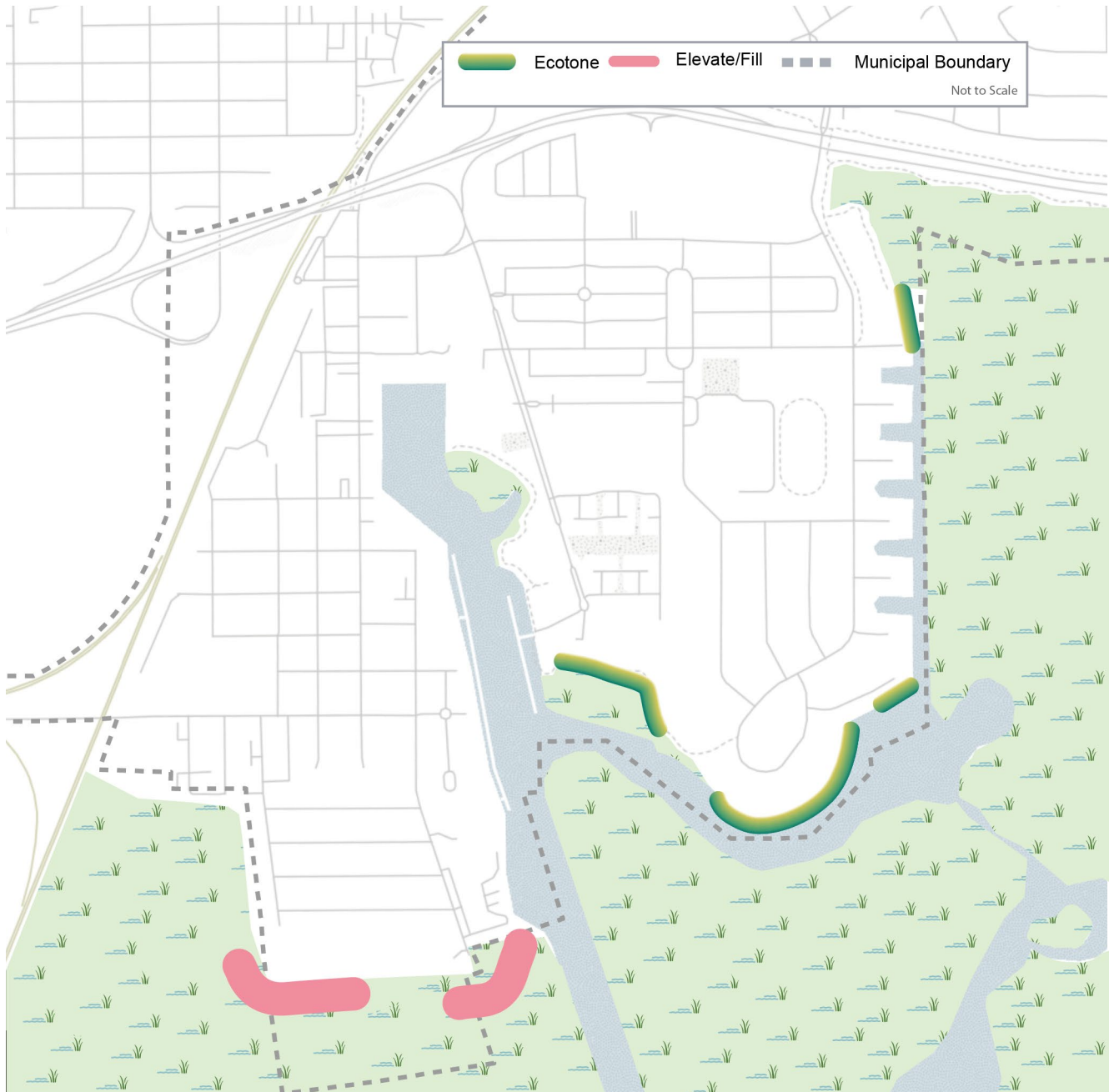


Figure 8.8 Strategy 3 Near-term Adaptation Concept

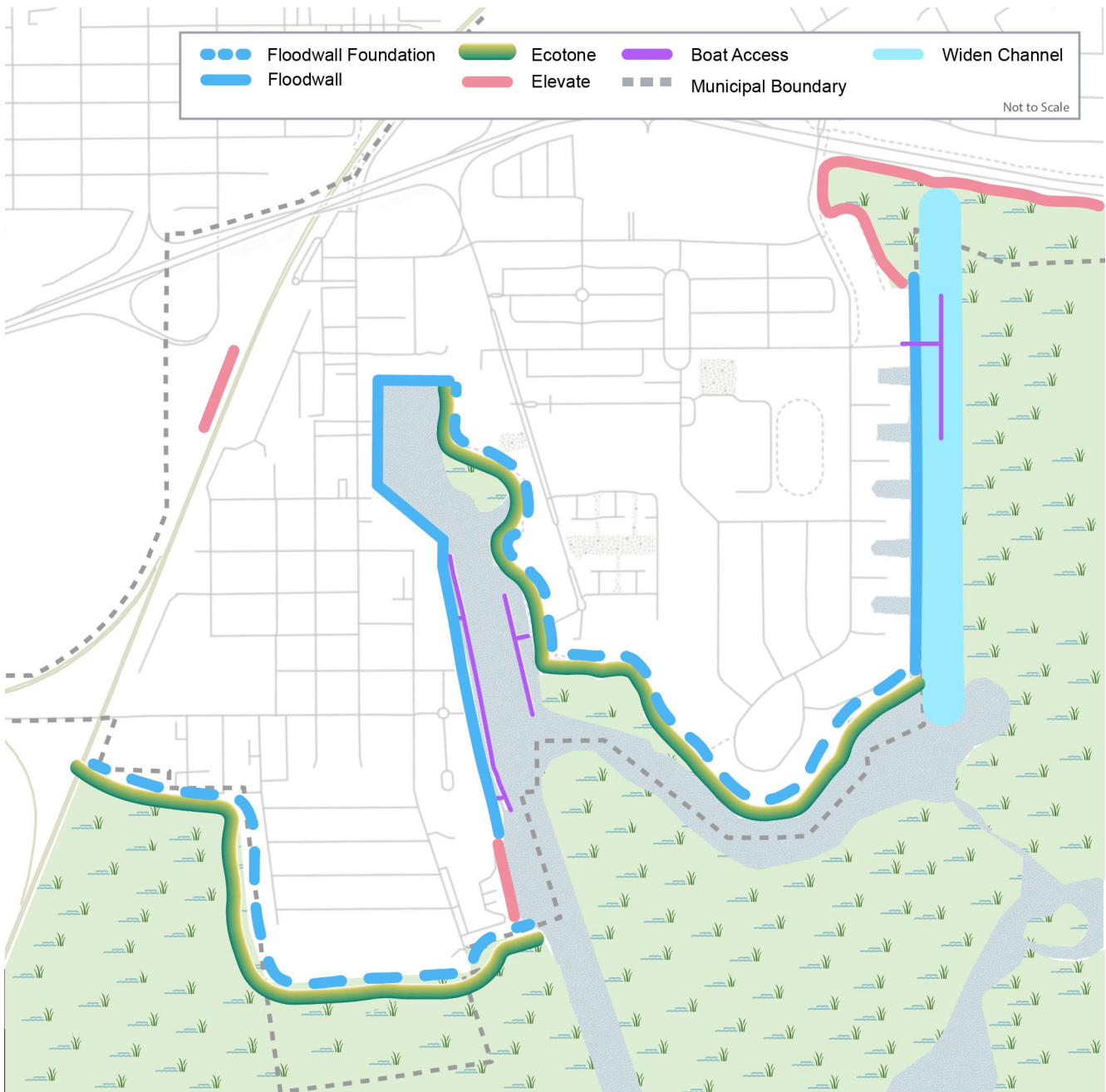


Figure 8.9 Strategy 3 Mid-term Adaptation Concept

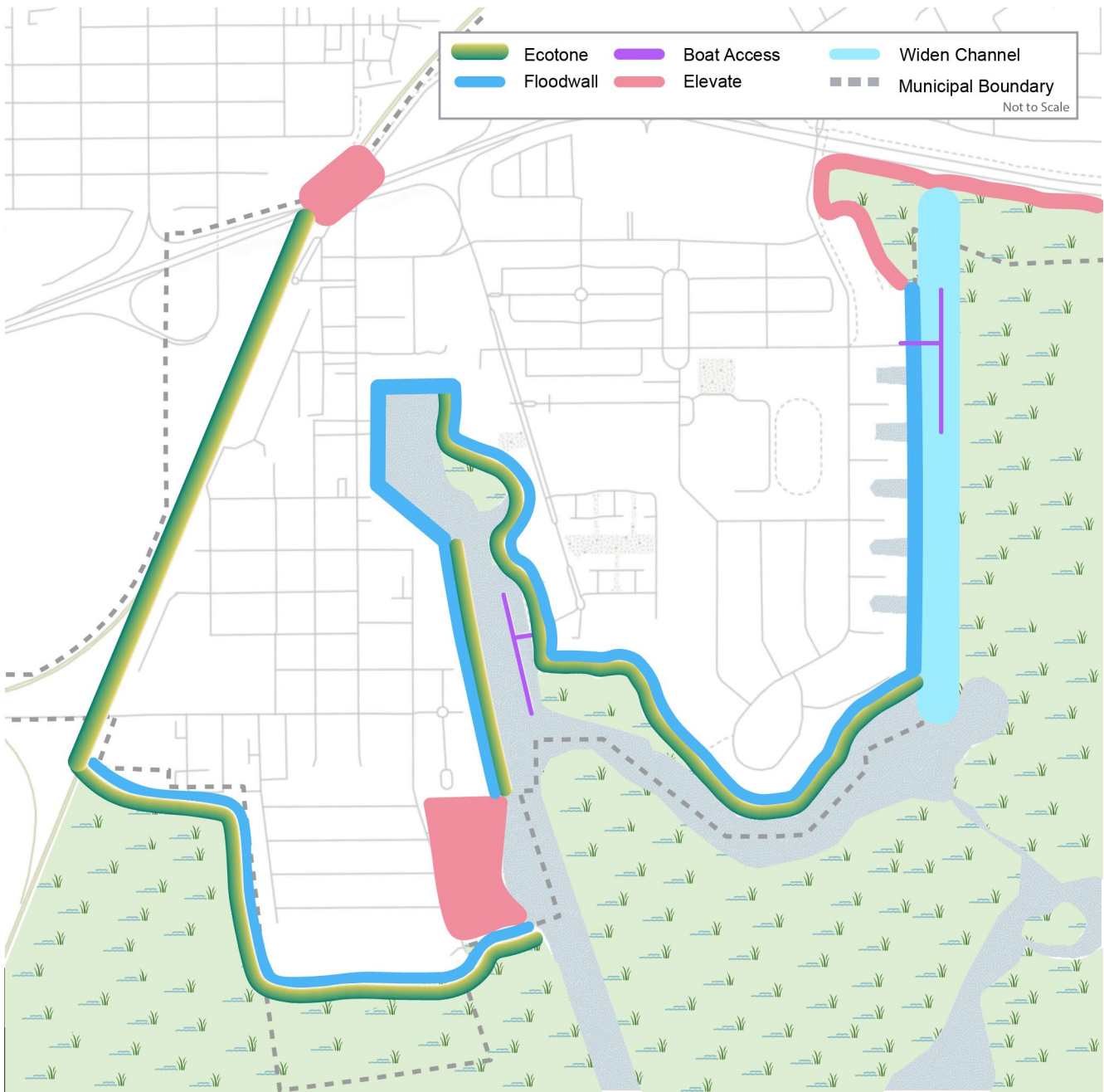


Figure 8.10 Strategy 3 Long-term Adaptation Concept

## 9 Evaluate Strategies

Evaluating the strategies using city- and stakeholder-defined evaluation criteria allows for a qualitative assessment of how well the strategies perform against the resilience goals. Evaluation criteria help identify areas in which a strategy or strategies do not address or meet goals and help identify ways to improve strategies. Evaluation criteria can also be used to compare multiple possible strategies and facilitate in-depth conversations with stakeholders about how actions can balance the needs of several groups and create buy-in from potential partners.

Suisun City-specific evaluation criteria were not developed for this report. A successful evaluation process requires coordination with project stakeholders and the community, including co-developing evaluating criteria that meet the unique needs of Suisun City. In the absence of this co-development process, potential evaluation criteria are presented along with a discussion of how the criteria could be applied to the three strategies presented in Section 8.2.

### 9.1 Evaluation Criteria

Based on the city's resilience goals (which for this report were based on the ART Bay Area resilience goals), evaluation criteria developed for the ART program can provide a starting place for developing community specific criteria (BCDC 2016, BCDC et al. 2020). These evaluation criteria involve the following categories:

- **Feasibility:** including cost, financing, administrative processes, political support, community support, and legality.
- **Social Benefits:** including positive, negative, or neutral impacts on access to transportation, housing, jobs or services, life safety, contaminants, vulnerable residents, housing or transit cost burden, community function, social capacity, recreation, displacement, or other aspects.
- **Economic Benefits:** including positive, negative, or neutral impacts on jobs, local tax base, local affordability, commuter movement, goods movement, service networks, infrastructure, protecting assets, new development, and vulnerable communities.
- **Environmental Improvements:** including positive, negative, or neutral impacts on habitats and biodiversity, water quality, nature-based solutions, and greenhouse gas emissions.
- **Governance:** including positive, negative, or neutral impacts on decision-making, partnerships, regulations, and community participation.
- **Disaster Lifecycle:** including positive, negative, or neutral impacts on disaster preparedness, mitigating risk, disaster response, and disaster recovery.
- **Regional Impacts:** including positive, negative, or neutral impacts on regional transportation systems, regional habitat systems, nearby neighbors, and regional housing markets.

In practice, a draft set of evaluation criteria across all the above categories is developed while considering the resilience goals and guiding principles (see Section 6). The draft list is then vetted with stakeholders through workshops and facilitated discussions and refined to address the feedback received. Evaluation criteria are likely added and deleted throughout this process as the evaluation criteria are refined. Although

quantitative evaluation criteria can be proposed (i.e., criteria that can be measured with quantitative numbers, such as acres of wetlands created, or conceptual cost of an action), most criteria will be qualitative in nature (i.e., general rankings such as: High-Medium-Low-Unknown or Positive-Neutral-Negative-Undetermined are suitable).

Once a refined list of evaluation criteria is developed, multiple city staff and stakeholders should score the strategies against the criteria, and the results can be compiled, analyzed, and discussed. Scores will generally reflect the different values, priorities and expertise of each person completing the assessment. Consensus among the stakeholders is not anticipated, rather, this process helps identify perceived strengths or weaknesses of the strategy or strategies and provides valuable insight into how they could be improved and where communication and messaging could be strengthened.

As a preliminary exercise, the following sections present potentially relevant evaluation criteria for Suisun City (organized by type), along with draft scores. The draft scores presented are not intended as guidance towards a preferred strategy. The selection and evaluation of a preferred strategy cannot be completed without substantive community involvement.

### 9.1.1 Feasibility

**Table 9.1 Feasibility Evaluation Criteria**

Evaluation Criteria	Definition/Question	Strategy 1	Strategy 2	Strategy 3
Cost	Does this action have a reasonable cost compared to other actions?	◆	◆	◆
Financing	Can the action be accomplished with existing or expected financing sources?	◆	◆	◆
Administrative	Can the action be accomplished with existing or operations or procedures?	○	●	○
Political support	What is the likelihood of political support?	○	●	○
Community support	Is the action supported by a strong advocate or local champion?	◆	◆	◆
Legal	Can the action be accomplished with existing authorities or policies?	○	○	○

● = positive; ○ = neutral; ⊙ = negative; ◆ = undetermined or additional analysis required

- Cost: To assess a ‘reasonable cost’, conceptual level cost estimates can be compared for the three strategies. A conceptual level cost estimate for the No Action<sup>4</sup> scenario can also help assess reasonable costs for the strategies. Costs should be estimated for all planning horizons. Although the cost of the three strategies will vary, at the current level of conceptual planning, no difference in cost can be assessed.

<sup>4</sup> The No Action scenario could assume no flood protection or adaptation strategies are implemented and the city floods as sea levels rise. A conceptual level cost estimate could consider the resulting property and infrastructure damage; service disruptions for water, sewer, power; economic losses to businesses; recovery costs, etc.

- Financing: Funding and financing mechanisms have not been explored in enough detail to assess a difference between the strategies.
- Administrative: Suisun City’s existing plans and policies, and programs and operations, will require updates for all three strategies. Strategy 2 may require fewer updates as it does not include managed retreat and it limits encroachment into adjacent landowner’s properties.
- Political support: Strategy 2 aligns best with the existing General Plan and the Waterfront District Specific Plan; therefore, it may have a higher likelihood of political support today. However, nature-based solutions could gain support if the city and stakeholders shift towards a more environmentally focused future. Retaining waterfront access, maximizing real estate values, and supporting continued economic growth will likely continue to be priorities for Suisun City. Actions such as managed retreat and equitable relocation are more challenging for gaining political support.
- Community support: Strong advocates and local champion(s) are required for all three strategies. Community outreach and stakeholder engagement were not completed as part of this example application of the Guidance; therefore, the likelihood of community support across the three strategies cannot be assessed.
- Legality: Existing authorities or policies have gaps with respect to the legal instruments for sea level rise preparedness and adaptation. The existing flood management ordinance supports floodproofing of individual structures 0.5 feet above minimum NFIP requirements but does not contain additional freeboard language that accounts for current projected rates of sea level rise (City of Suisun City 2019). The General Plan does not currently promote sea level rise planning (City of Suisun City 2015b).

### 9.1.2 Social Benefits

**Table 9.2 Social Benefits Evaluation Criteria**

Evaluation Criteria	Definition/Question	Strategy 1	Strategy 2	Strategy 3
Access	Will the action protect access to transportation (car, public transit, bike or pedestrian), housing, jobs, or services?	●	●	●
Life safety	Will the action protect and/or improve public health and safety, especially vulnerable communities?	●	●	●
Contaminants	Will the action prevent the mobilization of contaminants from hazardous sites?	◆	◆	◆
Vulnerable residents	Will the action help protect vulnerable communities and/or help address chronic issues faced by vulnerable communities?	●	●	●
Cost burden	Will the action protect against increased housing or transit cost burdens?	◆	◆	◆
Community	Will the action preserve community function, and/or advances other community objectives?	◆	◆	◆



Evaluation Criteria	Definition/Question	Strategy 1	Strategy 2	Strategy 3
Social capacity	Will the action help build social networks, community capacity, and internal community leadership?	●	●	●
Recreation	Will the action create or maintain recreational, educational, and/or shoreline access opportunities?	●	⊙	●
Displacement	Will the action help avoid displacement of vulnerable communities?	⊙	●	⊙
Co-benefits	Will the action help support or create co-benefits?	●	⊙	●

● = positive; ○ = neutral; ⊙ = negative; ◆ = undetermined or additional analysis required

- Access: All three adaptation strategies seek to protect and maintain existing access for the community across mobility networks and maintain maritime access. Strategy 1 provides additional mobility connections by adding new waterfront access trails.
- Life safety: All three strategies prioritize life safety by providing flood protection for all residents and businesses.
- Contaminants: Rising shallow groundwater elevations are likely in Suisun City, and emergent groundwater can mobilize contaminants to the surface resulting in potential health hazards. Although this was identified as a constraint (see Section 5.3.2), this remains a data gap that requires additional analysis. Nature-based solutions may provide the most benefits for limiting contaminant exposure, as natural solutions can filter contaminants, and vegetation can assist in reducing shallow groundwater levels to some degree, but these benefits were not quantified.
- Vulnerable residents: The three strategies protect vulnerable community members. Strategies 1 and 3 include managed retreat with relocation of residents and businesses. Equitable relocation options are suggested but will need substantive outreach and co-development of relocation plans to ensure positive long-term benefits for relocated residents.
- Cost burden: All three strategies aim to protect existing mobility networks and residential housing. However, the impact of the strategies on transit and housing cost burdens requires additional analysis.
- Community: The three strategies aim to preserve community function but achieve this through different actions. Community involvement is required to adequately score this criterion.
- Social capacity: Advancing any of the strategies requires increasing social awareness of sea level rise and climate-related hazards; building social capacity and networks; and forming collaborative working groups. Many of the initial Prepare actions (see Section 8.1.1) improve Suisun City's overall social capacity.
- Recreation: The three strategies aim to maintain shoreline access, maritime access, and recreational opportunities. Maintaining waterfront access was identified as a Guiding Principle for Adaptation for Suisun City (see Section 6.2). Although maritime access is maintained under Strategy 2, the construction of floodwalls around the city in the long-term may disconnect the

community from the waterfront (e.g., high concrete walls may obscure viewpoints and separate the community from the vibrant ecosystems surrounding the city).

- Displacement: Strategies 1 and 3 require managed retreat to provide the footprints needed for constructing nature-based solutions. This may require relocation of existing residents and businesses. Although equitable relocation is one of the Guiding Principles of Adaptation used in this assessment (see Section 6.2), this process requires community engagement to co-develop a relocation plan to ensure positive long-term benefits for relocated residents. Strategy 2 aims to protect the community in place to minimize the need for displacement and relocation.
- Co-benefits: Strategies 1 and 3 create recreation and ecological co-benefits. Strategy 2 focuses on flood protection and protecting the city in place. In the long-term, Strategy 2 may negatively impact existing recreation and ecological benefits.

### 9.1.3 Economic Benefits

Table 9.3 Economic Benefits Evaluation Criteria

Evaluation Criteria	Definition/Question	Strategy 1	Strategy 2	Strategy 3
Jobs	Will the action create or retain jobs?	○	●	○
Tax base	Will the action help maintain or create revenues from taxes, rates or fees?	○	●	○
Affordability	Will the action help maintain tax rate and/or ratepayer affordability (for example, for utility services)?	◆	◆	◆
Commuter movement	Will the action help maintain or enhance commuter movement?	●	●	●
Goods movement	Will the action help maintain the movement of goods (e.g. by rail, ship or highway)?	●	●	●
Service and networks	Will the action help reduce service or network disruptions of infrastructure (e.g. telecom, water, electricity, roads, drainage, etc.)?	◆	◆	◆
Infrastructure	Will the action help protect infrastructure investments (e.g. roads, highways, rail, water treatment facilities, substations, etc.) and/or address the current need for upgrades to our infrastructure?	●	●	●
Protect assets	Will the action help reduce damage to assets (e.g. buildings, community facilities, parks, historic landmarks, infrastructure, etc.)?	●	●	●
Development	Does the action help focus new development in more resilient areas and/or help protect existing development?	●	○	○
Vulnerable communities	Does the action help protect community services, homes, and businesses of vulnerable communities?	●	●	●

● = positive; ○ = neutral; ⊙ = negative; ◆ = undetermined or additional analysis required

- Jobs: All strategies aim to protect and maintain current jobs. Strategies 1 and 3 may relocate existing businesses, potential causing temporary job disruption. Strategy 2 maximizes job growth.
- Tax base: Strategy 2 is most likely to increase tax revenues through economic growth. Strategies 1 and 3 may require new programs or incentives to increase the tax base.
- Affordability: Additional analysis is required to assess the impacts to tax rates and ratepayer affordability. This will require identifying the most viable funding and financing mechanisms, which could include increases to tax rates.
- Commuter movement: One of the Guiding Principles for Adaptation is to protect local and regional multi-modal transportation networks. All three strategies protect Highway 12 and the Amtrak / Capitol Corridor railway as regional links between communities. Strategy 1 provides additional non-motorized routes (e.g., trails) for local commuter movement, allowing for increased movement across neighborhoods.
- Goods movement: All three strategies protect the Capitol Corridor railway and Highway 12, which are important regional links for goods movement.
- Service and networks: All three strategies protect critical infrastructure services. Interior drainage issues have not been assessed and will require additional analysis.
- Infrastructure: All three strategies protect critical infrastructure, including Highway 12, the Amtrak / Capitol Corridor railway, major local roadways, and other infrastructure within Suisun City. Connections to regional distribution infrastructure (e.g., power, gas, water) were not assessed. Upgrades to existing infrastructure are not included within the three strategies.
- Protect assets: All three strategies provide flood protection on a city-wide scale. Non-physical strategies, including floodproofing, would further reduce flood risk to individual assets.
- Development: Strategy 1 uses existing vacant space along the shoreline for nature-based flood solutions and focuses new growth and development in areas with reduced flood risk. Strategy 2 uses all existing vacant space for new growth and development. Although flood protection strategies will protect these areas; some level of flood risk will remain, particularly in the areas closest to the shoreline. Strategy 3 provides a balanced use of vacant space for both nature-based solutions and new development.
- Vulnerable communities: All three strategies protect existing community services, homes, businesses, and vulnerable communities. Strategies 1 and 3 may relocate vulnerable populations to areas with a reduced flood risk. The relocation plan needs to be co-developed with those being relocated to ensure positive long-term benefits for relocated residents.

### 9.1.4 Environmental Improvements

Table 9.4 Environmental Improvements Evaluation Criteria

Evaluation Criteria	Definition/Question	Strategy 1	Strategy 2	Strategy 3
Habitats and biodiversity	Will the action help create or maintain biodiversity and resilient habitat (e.g. does habitat drown with projected sea level rise)?	●	⊙	●
Water quality	Will the action help maintain or improve water quality (e.g. through green infrastructure, such as wetlands or vegetated swales)?	●	○	●
Nature-based	Will the action promote nature-based solutions (e.g. wetlands, reefs, beaches, etc.), as opposed to traditional grey/hard infrastructure (e.g. pipes, pumps, sea walls, etc.)?	●	⊙	●
Greenhouse gases / energy use	Will the action help reduce greenhouse gases (GHGs), add carbon sequestration, and/or reduce energy use?	◆	◆	◆

● = positive; ○ = neutral; ⊙ = negative; ◆ = undetermined or additional analysis required

- Habitats and biodiversity: Strategies 1 and 3 promote habitat creation, maintaining and/or enhancing biodiversity, and improving connectivity with the surrounding marshes. Strategy 2 provides limited habitat benefits, and the floodwalls serve as barriers to habitat and wetland migration.
- Water quality: Strategies 1 and 3 have the greatest potential to improve water quality within the adjacent sloughs with the nature-based solutions located between developed areas and the sloughs and existing marshes. Strategies to improve urban water quality concerns were not assessed.
- Nature-based: Strategies 1 and 3 promote nature-based solutions, while Strategy 2 focuses on traditional grey/hard engineered solutions.
- Greenhouse Gases/energy use: Additional analysis is required to estimate the greenhouse gas creation, mitigation, and sequestration provided by the three strategies.

### 9.1.5 Governance

Table 9.5 Governance Evaluation Criteria

Evaluation Criteria	Definition/Question	Strategy 1	Strategy 2	Strategy 3
Decision-making	Will the action help support or create transparent decision-making in collaboration with community groups and stakeholders?	●	●	●
Partnerships	Does the action encourage broad public and/or private sector partnerships?	●	●	●
Regulation	Will the action help streamline regulatory processes when possible?	◆	◆	◆

Evaluation Criteria	Definition/Question	Strategy 1	Strategy 2	Strategy 3
Communities	Will the action help facilitate and fund participation with diverse stakeholders, including vulnerable communities?	○	○	○

● = positive; ○ = neutral; ⊙ = negative; ◆ = undetermined or additional analysis required

- Decision-making: All three strategies recommend collaborative planning and decision-making, including substantive and meaningful engagement with the community and stakeholders.
- Partnerships: All three strategies recommend establishing partnerships within the community, and with key stakeholders, adjacent landowners, potential implementing partners, and regional groups that are farther along in adaptation planning and implementation.
- Regulation: Additional analysis on regulatory hurdles, constraints, permitting issues and other considerations is required, to assess if streamlining regulatory processes is possible.
- Communities: All three strategies recommend collaborative planning and meaningful engagement with the community; however, funding for vulnerable community participation has not been identified as part of this example application of the Guidance.

### 9.1.6 Disaster Lifecycle

Table 9.6 Disaster Lifecycle Evaluation Criteria

Evaluation Criteria	Definition/Question	Strategy 1	Strategy 2	Strategy 3
Preparedness	Does the action help build or enhance disaster preparedness?	●	●	●
Risk	Does the action help mitigate risk?	●	●	●
Response	Does the action improve disaster response?	○	○	○
Recovery	Does the action encourage resilient recovery?	○	○	○

● = positive; ○ = neutral; ⊙ = negative; ◆ = undetermined or additional analysis required

- Preparedness: All three strategies recommend the same Prepare actions (see Section 8.1.1). Actions include training city staff on sea level rise and climate risks, resilience building effort, and adaptation. The actions also include a public awareness campaign to educate the community about existing and future flooding risks. These actions will have a positive benefit on increasing disaster preparedness.
- Risk: All three strategies include physical and non-physical actions that will mitigate existing and future flood risks within the near-term, mid-term, and long-term planning horizons.
- Response: The three strategies do not include actions focused on improving disaster response.
- Recovery: The three strategies do not include actions focused on improving recovery.

## 9.1.7 Regional Impacts

Table 9.7 Regional Impacts Evaluation Criteria

Evaluation Criteria	Definition/Question	Strategy 1	Strategy 2	Strategy 3
Regional transportation	Will the action help maintain regional services from airports, ports, highways, rail systems and/or major transportation hub services?	●	●	●
Regional habitat	Does the action help achieve regional habitat goals (for example, Baylands Ecosystem Habitat Goals Project)?	●	⊙	●
Neighbors	Does the action have a positive or neutral impact on neighboring jurisdictions (e.g. doesn't cause flooding to worsen)?	◆	◆	◆
Housing	Does the action increase the availability of housing and help relieve the housing crisis?	◆	◆	◆

● = positive; ○ = neutral; ⊙ = negative; ◆ = undetermined or additional analysis required

- Regional transportation: The three strategies aim to protect regional transportation routes and hubs.
- Regional habitat: Strategy 1 provides the greatest regional habitat benefits, including integrating the ecotone habitat levees with the neighboring marsh restoration projects. Short-term impacts will occur during construction, but long-term habitat co-benefits will be realized with Strategy 1. Strategy 3 provides the same benefits as Strategy 1, although the total acreage of habitat created with the ecotone habitat levees will be smaller. Strategy 2 may negatively affect regional habitat over time.
- Neighboring Jurisdictions: The three strategies will provide flood protection for portions of the city of Fairfield. Some encroachment into the adjacent marsh areas and the ecological preserve may be required to construct all three strategies. Additional analysis supported with conceptual designs is required to assess the net benefit for the neighboring jurisdictions.
- Housing: All three strategies will provide protection for existing housing, but the impact on the housing market and the housing crisis is unknown at this time. Additional analysis is required to assess the overall impacts to housing availability and affordability over the near-, mid-, and long-term planning horizons.

## 10 Create Adaptation Pathway

The final step in the Plan Step Guidance brings together the pieces identified in the previous steps to develop adaptation pathways as visual representations of the implementation of the Strategies over time. Adaptation pathways are a sequence of linked strategies that are triggered by a change in environmental conditions (e.g., reaching a TWL threshold), with initial actions that have low regrets and preserve options for the future (Barnett et al. 2014). Triggers that are tied to social impacts (e.g., inland flooding, disruption, and damage) may resonate most with the community. Co-developing the adaptation pathways with stakeholders and the community can help build consensus among diverse groups and interests (Barnett et al. 2014). Although many approaches exist for developing adaptation pathways (Haasnoot et al. 2013,

Fazey et al. 2015, Aerts et al. 2018), the approach generally requires modification to fit the local communication needs and the complexity of the local strategies.

## 10.1 Considerations

Key considerations for constructing adaptation pathways include:

- Sequencing of actions to reach desired outcome: some strategies may require multiple actions implemented in a specific sequence to meet projects goals and objectives. For example, to build a floodwall, it may be necessary to update the City’s Local Hazard Mitigation Plan to make the project eligible for FEMA funding, followed by coordination with regulators to assess permitting constraints, as well as coordination with existing and adjacent landowners, if the project is not wholly contained within the city-owned lands. In parallel, a public engagement campaign would be essential to increase awareness, vet alternatives, and create buy-in. Additional actions would also be required to identify funding financing mechanisms for implementation and future adaptation (if the project will be adapted in the future as sea level rise increases).
- Timeline: for each action or sequence of actions that act together, the timeline for implementation is considered, including potential lead time. Questions to address include: When does the action need to be implemented by? When will a certain area start flooding or reach a threshold? How much lead-time is needed (how long will planning, design, permitting, and construction take)? Working backwards from the identified implementation date, the sequence of actions and length of time required is identified.
- Simple, complex, and cascading pathways: depending on local priorities, desired outcomes, and many other factors such as funding, political will, or lack of certainty or buy-in, some adaptation pathways may directly lead to a desired end state (e.g., building a floodwall for 108” TWL), while others may sequence multiple approaches (e.g., constructing an ecotone habitat levee with a floodwall foundation for 52” TWL, followed by construction of a floodwall for 84” TWL, followed by a final floodwall height increase for 108” TWL). For these more complex pathways, the length of time that an action will be effective must be evaluated to identify the trigger or decision point for planning the next action along the pathway.
- Diverging or alternative pathways: some pathways may have decision points that allow for divergence from one strategy to another strategy. This can occur if multiple strategies are under consideration, and a preferred strategy is not yet identified. If the early actions for both strategies are the same, the selection of the preferred strategy could be delayed to a later decision point and re-evaluated based on changing conditions (e.g., how fast sea levels are rising, how the surrounding marsh has adapted/migrated/kept pace with SLR, etc.) and additional information (e.g., new potential flood protection techniques).
- Uncertainty: a strategy may make sense today given current knowledge and assumptions, but in the future, the strategy may no longer achieve the desired outcome (e.g., based on updated climate science, new adaptation techniques, changing community values, etc.). This especially pertains to actions identified in the long-term planning horizon, as there is inherently a greater range of uncertainty in the more distant future. For these actions, changing conditions should

be monitored and the adaptation pathway should integrate points for re-assessing the strategy and related actions to assess if changes are required to best meet the community's resilience goals, needs, and desired objectives. This approach requires understanding factors that may constrain the ability to make adaptive decisions along the way, such as actions that preclude other, future actions, or thresholds past which an action is no longer feasible.

## 10.2 Adaptation Pathways

The three strategies developed for Suisun City consist of multiple physical actions applied along the entire shoreline, including non-physical actions required to implement the physical actions. Developing and illustrating adaptation pathways for an entire strategy is a complex undertaking and exceeds the scope of this example application of the Guidance. The usefulness of developing an adaptation pathway for entire strategy would also be limited, as the city and its stakeholders have not participated in this effort. Therefore, to illustrate the adaptation pathways approach, a single shoreline reach (i.e., a portion of the Whispering Bay Waterfront, Physical Planning Unit G, see Figure 5.1) was selected for illustrate how the adaptation pathways could look, including decision points and action implementation across the near-, mid-, and long-term planning horizons. Adaptation pathways were developed for Strategy 1 and Strategy 2 along this shoreline reach.

The adaptation pathways include the following elements:

- **Actions:** the adaptation pathway includes the physical actions required to provide flood protection across the near-term, mid-term, and long-term planning horizon, as well as the non-physical actions required to support the physical actions and increase community resilience to SLR.
- **Total Water Level (TWL):** the adaptation pathway uses the TWLs (from 0 inches to 108 inches) to illustrate the progression of action implementation through the planning horizons. This approach provides flexibility in pairing the TWLs to different sea level projections (e.g., RCP8.5 or RCP4.5<sup>5</sup>) and the TWLs can readily be paired with updated projections over time.
- **Trigger:** Triggers represent points along the adaptation pathway where planning for a physical or non-physical action should be begin. Trigger points associated with actions are generally tied to a Decision Point (see Decision Point). For example, a decision is made to create flood resilient building codes, and this decision 'triggers' the start of the planning and development time (i.e., the Lead Time) needed to draft, revise, and adopt the codes. A Trigger can also be associated with a specific TWL (Trigger TWL), and once that TWL is reached, it 'triggers' a new decision point along the adaptation pathway. For example, once the TWL equals 42 inches, this could trigger a Decision Point along the pathway for the next set of actions to begin the planning phase.

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<sup>5</sup> A Representative Concentration Pathway (RCP) is a greenhouse gas concentration trajectory adopted by the IPCC for its fifth Assessment Report (AR5) in 2014. Four pathways were selected that describe different climate futures, all of which are considered possible depending on how much greenhouse gases are emitted globally in the years to come. The four RCPs, namely RCP2.6, RCP4.5, RCP6, and RCP8.5, are labelled after a possible range of radiative forcing values in the year 2100 (2.6, 4.5, 6.0, and 8.5 W/m<sup>2</sup>, respectively). Currently, global greenhouse gas concentrations are tracking with RCP8.5, which is considered a 'business as usual' scenario. RCP4.5 assumed substantive reductions in greenhouse gas emissions, resulting in lower greenhouse gas concentrations in the atmosphere.



- **Threshold:** a Threshold is generally a tipping point. In this approach, the Threshold is a TWL that results in overtopping of the shoreline and inland flooding. Actions to mitigate or reduce flooding impacts should be implemented before a Threshold is reached. Thresholds may be associated with the end of the functional lifespan of a previously implemented action. Generally, a lower Trigger TWL is associated with a Threshold TWL, and the Trigger signals the start of planning for the next action so that a new action is in place when the Threshold is reached.
- **Decision Point:** a point along the adaptation pathway where decisions must be made to begin planning for action implementation. If decisions are not made at this point, there may not be adequate time along the pathway for planning, designing, permitting, and implementing the action before a Threshold is reached.
- **Strategy Direction Decision Point:** a critical point along the adaptation pathway where a decision must be made that effects multiple future actions. It can represent a point of no return along a given pathway, or a point where investments along the current strategy are setting long-term plans in motion that cannot be easily modified if a change in direction is desired at a later date. Such a point can lead to a decision to stay on the current adaptation pathway, or to deviate from it by creating a new pathway for an alternate strategy.
- **Lead Time:** the amount of time needed to complete all planning efforts, such as design, permitting, and construction for physical actions, so that the action is implemented before a Threshold TWL is reached. Lead Time is generally associated with a Trigger and includes the planning time required between the Trigger and the Action Implementation (i.e., the location of Trigger point may be defined by the necessary Lead Time). Lead Time is represented as a dashed line to represent uncertainty in the time required to plan for action implementation, particularly the planning time required to plan decades from today. In the future, if policies and programs are in place regionally to support nature-based solutions, shorter lead times may be feasible. In some cases, getting adequate funding and financing mechanisms may govern the lead time.
- **Action Implementation:** shows when (based on TWLs) a specific action should be implemented to achieve the desired future outcomes.
- **End of Action Lifespan:** shows when the Action's useful lifespan is reached. For physical actions, the Action may no longer be effective in meeting its primary design criteria or function. For non-physical actions, such as public outreach or stakeholder engagement, the end of lifespan denotes when the outreach or engagement campaign is complete. This generally coincides with the completion of implementing another Action.

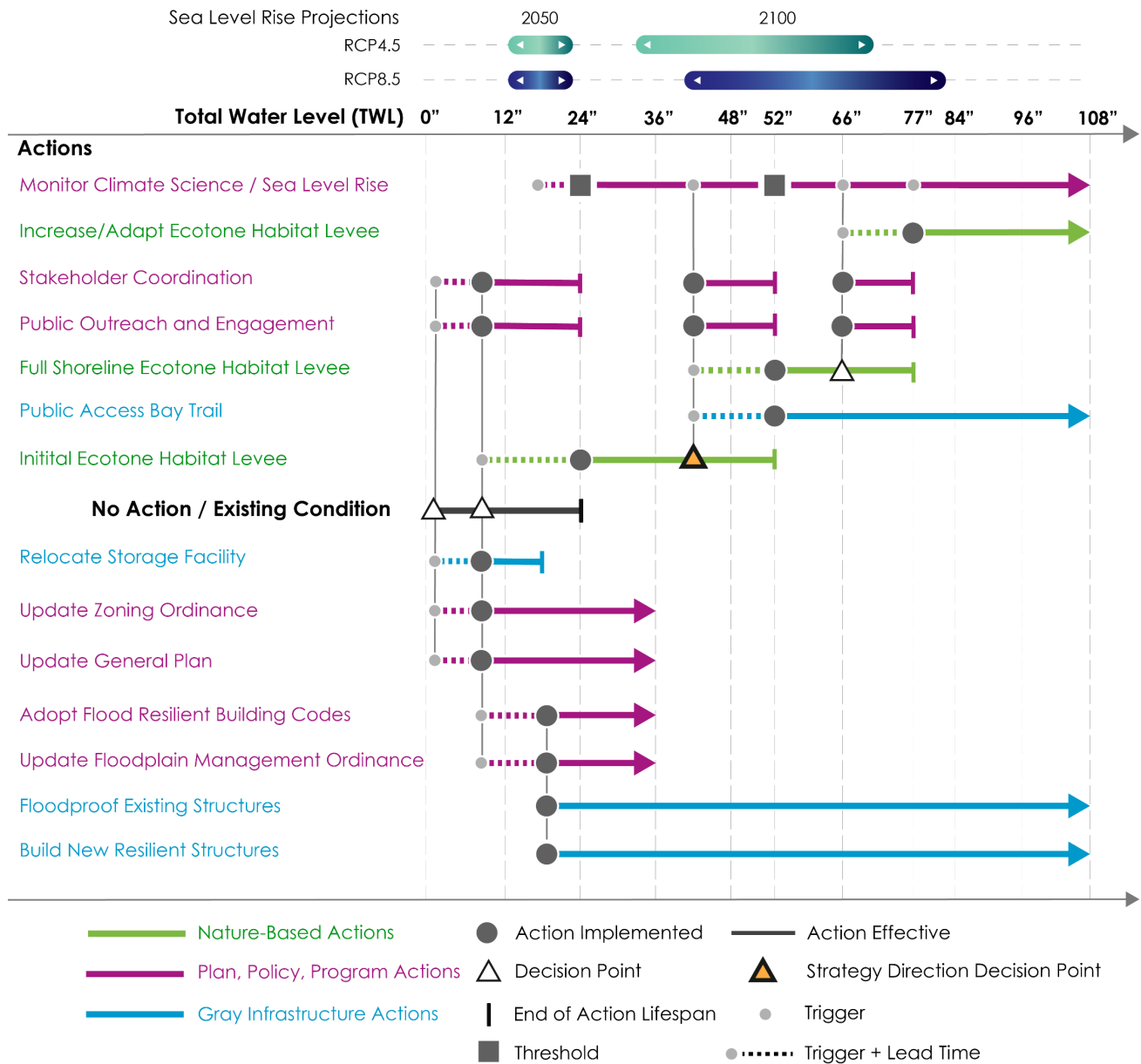


Figure 10.1 Strategy 1 Conceptual Adaptation Pathway for the Whispering Bay Shoreline

The adaptation pathway presented in Figure 10.1 was developed by first identifying the Threshold TWLs and the physical actions (for Strategy 1) that need to be in place before the Threshold is reached. The Lead Times and Trigger TWLs were then identified by working backwards along the pathway and estimating the time required for all planning efforts required for implementation. The non-physical actions required to support the physical actions were also identified, along with the associated lead times for decision making and action implementation. Figure 10.1 highlights that several non-physical actions should be implemented in the near-term to support all future actions, and the planning for the initial physical actions should occur shortly thereafter, before the 24-inch Threshold TWL is reached.

A Strategy Direction Decision Point is identified along the Initial Ecotone Habitat Levee action. At this point, a decision will be required to either continue the adaptation pathway for Strategy 1, or to switch to the pathway for an alternate strategy (e.g., Strategy 2, Strategy 3, or an alternate strategy). Once the second physical action (a full ecotone habitat levee along the entire Whispering Bay shoreline) is implemented, moving from Strategy 1 to Strategy 2 would result in substantial additional costs (i.e., installing a floodwall foundation would require removing or significantly disturbing the full ecotone habitat levee). Figure 10.2 presents the adaptation pathway for Strategy 2. The physical and non-physical actions are the same as those presented on Figure 10.1 between the 0-inch and 36-inch TWL. However, after the Strategy Direction Decision Point, the planning can begin for implementing the floodwall with an oversized foundation to support future adaptation. The pathway assumes that less Lead Time (and therefore less public outreach and stakeholder coordination) is required for this more traditional flood protection pathway; therefore, a second Decision Point is located on the Initial Ecotone Habitat Levee to denote when the planning should begin for the floodwall. Note that several Plan, Policy, and Program actions may be revised or updated over time (after the 36-inch TWL) in response to non-sea level rise related triggers (e.g., adoption of other ordinances or regulations); these actions are not shown on Figure 10.1 or Figure 10.2.

The adaptation pathways shown for Strategy 1 and Strategy 2 are illustrative conceptual examples only, and additional or alternative actions are likely required to achieve the desired future outcomes for Suisun City. However, developing conceptual adaptation pathways for each physical planning unit can help highlight critical decision points, and support prioritization of action implementation in the near term. Over time, the adaptation pathways should be revisited as regulatory, physical, environmental, and societal factors change.

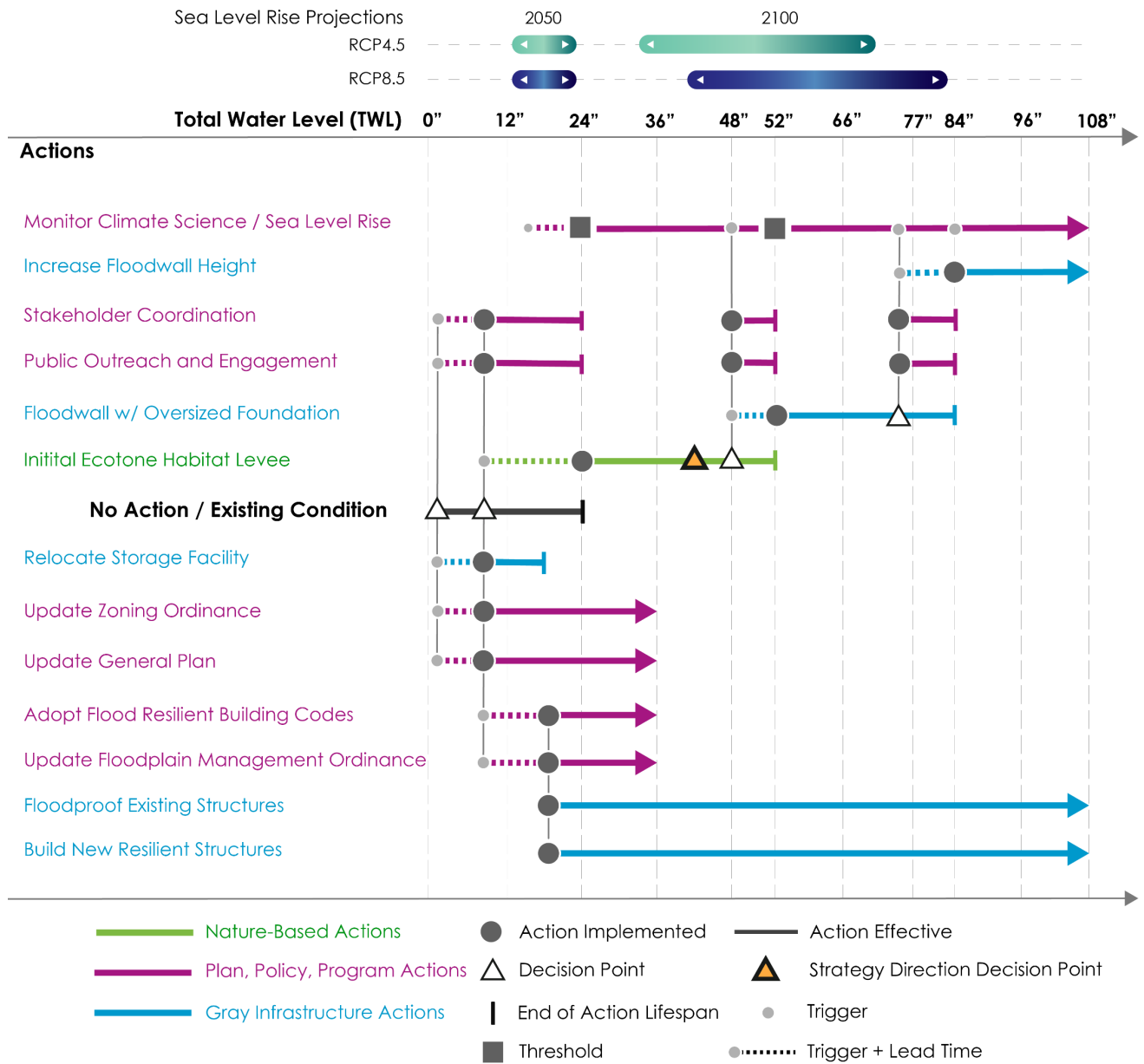


Figure 10.2 Strategy 2 Conceptual Adaptation Pathway for the Whispering Bay Shoreline

## 11 Conclusion

The goal of this planning exercise is to test the Guidance using an actual Bay Area city (Suisun City) with sea level rise vulnerabilities and provide feedback on how the ART tools and resources can be used to support or reinforce each step. The following lists represents the lessons learned throughout this exercise:

- Adaptation planning without coordinating with the City and without community engagement is incredibly challenging. The study team found themselves trying to think like Suisun City decision makers or community members throughout the process, and this role-playing thought exercise was not a suitable replacement for actual engagement.
- The SLR mapping and shoreline overtopping information presented in the ART flood explorer provide a valuable starting place for understanding SLR vulnerabilities and initial Threshold TWLs; however, the study team had to dive deeper into the topography data to understand the initial flood pathways that result in inland flooding. High-resolution aerial and oblique imagery were also important for understanding shoreline type, condition, and unique characteristics that are important when considering adaptation strategies (such as the houses that extend over and beyond the shoreline along the Victorian Harbor Keys).
- Characterizing the opportunities and constraints requires significant place-based and local knowledge, and this task cannot be easily represented in a Guidance document. Although the study team found and reviewed numerous documents for Suisun City and the surrounding landscape to develop the opportunities and constraints outlined in Section 5.3, it is almost certain that several opportunities and constraints were missed. A multi-disciplinary team that includes engineers, ecologists, biologists, geomorphologists, planners, community members, and more should develop and review the opportunities and constraints that will frame the selection of appropriate adaptation options. The importance of this step should not be under-emphasized.
- This exercise relied on a desktop study to define the physical planning units and characterize the opportunities and constraints. In practice, these tasks should also include site visits with local stakeholders to better understand on-the-ground conditions.
- Evaluating the strategies (Section 9) in absence of City involvement and community engagement proved more challenging than developing the potential strategies (Section 8). Strategy evaluation is complex and will ultimately need to balance the needs and concerns of many diverse stakeholders. The study team could not replicate these diverse viewpoints as part of this exercise.
- Although this exercise had its limitations, as expressed above and throughout the report, the study team did find the Guidance to be a useful roadmap for adaptation planning.
- Ideally, the thought processes, concepts, and ideas presented in this report will prove useful for Suisun City as they proceed with their own adaptation planning process.

## 12 References

- ACS. 2018. 2012-2016 American Community Survey 5-year Estimates. Washington, DC.  
<https://www.census.gov/programs-surveys/acs/data.html>
- Aerts, J. C. J. H., P. L. Barnard, W. Botzen, P. Grifman, J. F. Hart, H. De Moel, A. N. Mann, L. T. de Ruig, and N. Sadrpour. 2018. Pathways to resilience: adapting to sea level rise in Los Angeles. *Annals of the New York Academy of Sciences* 1427:1–90. DOI:10.1111/nyas.13917
- All Bay Collective. 2018. The Estuary Commons : People, Place, and a Path Forward. Prepared by the All Bay Collective (California College of the Arts, AECOM, CMG Landscape Architecture, UC Berkeley, Silvestrum Climate Associates, Skeo, modern, IDEO, and David Baker Architects) for the Resilient by Design Challenge, Oakland, CA
- ASCE. 2018. Climate-Resilient Infrastructure, Adaptive Design and Risk Management. Page (B. M. Ayyub, Ed.). American Society of Civil Engineers, Committee on Adaptation to a Changing Climate, Reston, Virginia
- Barnett, J., S. Graham, C. Mortreux, R. Fincher, E. Waters, and A. Hurlimann. 2014. A local coastal adaptation pathway. *Nature Climate Change* 4:1103–1108. DOI:10.1038/nclimate2383
- BCDC. 2016. Developing Adaptation Criteria. ART Supply: How-to-Guide; Designing Your Project Step 7: Evaluate Responses. Prepared by the San Francisco Bay Conservation and Development Commission, San Francisco, CA. [http://www.adaptingtorisingtides.org/wp-content/uploads/2016/02/art-h2g-evaluation-criteria\\_web-aligned\\_v2.pdf](http://www.adaptingtorisingtides.org/wp-content/uploads/2016/02/art-h2g-evaluation-criteria_web-aligned_v2.pdf)
- BCDC. 2017. Hill Slough Tidal Marsh Restoration Project Commission Meeting Notes. Prepared by the San Francisco Bay Conservation and Development Commission, San Francisco, CA
- BCDC. 2019. Draft Adaptation Catalog. Prepared by the San Francisco Bay Conservation and Development Commission, San Francisco, CA
- BCDC, MTC, and BATA. 2019. Adapting to Rising Tides Bay Area, Regional Sea Level Rise Vulnerability Assessment Framework. Prepared by AECOM and Silvestrum Climate Associates for the Metropolitan Transportation Commission, Bay Conservation and Development Commission, Bay Area Regional Collaborative, and Caltrans, San Francisco, CA
- BCDC, MTC, and Caltrans. 2020. Adapting to Rising Tides Bay Area Vulnerability Assessment and Adaptation Guidance. Prepared by the San Francisco Bay Conservation and Development Commission, Metropolitan Transportation Commission, and Caltrans District 4., San Francisco, CA
- Bridges, T. S., P. W. Wagner, K. A. Burks-copes, M. E. Bates, Z. A. Collier, C. J. Fischel, J. Z. Gailani, L. D. Leuck, C. D. Piercy, J. D. Rosati, E. J. Russo, D. J. Shafer, B. C. Suedel, E. A. Vuxton, and T. V Wamsley. 2015. Use of Natural and Nature-Based Features (NNBF) for Coastal Resilience. Page US Army Corps of Engineers - Engineer Research and Development Center. US Army Corps of Engineers Engineer Research and Development Center, Vicksburg, MS
- Bronen, R. 2015. Climate-induced community relocations: using integrated social-ecological assessments to foster adaptation and resilience. *Ecology and Society* 20. DOI:10.5751/ES-07801-200336
- BVB. 2017. Marin Shoreline Sea Level Rise Vulnerability Assessment. Prepared by BVB Consulting LLC for Marin County Department of Public Works, County of Marin, CA.  
<https://www.marincounty.org/main/marin-sea-level-rise>

- CAWRCB. 2019. Geotracker Survey XYZ, Well Data, and Site Map Guidelines & Restrictions. California State Water Resources Control Board, Sacramento, CA. <http://www.geotracker.waterboards.ca.gov/>
- CCC. 2018. Sea Level Rise Policy Guidance Science Update 2018. California Coastal Commission, Sacramento, CA. <https://www.coastal.ca.gov/climate/slrguidance.html>
- CFR. 1986. U.S. Code of Federal Regulations, Title 44, Chapter I, Part 65, Section 65.10: Mapping of areas protected by levee systems. United States of America. [https://www.govregs.com/regulations/title44\\_chapteri\\_part65\\_section65.10](https://www.govregs.com/regulations/title44_chapteri_part65_section65.10)
- City of Alameda. 2019. Alameda Climate Action and Resiliency Plan (CARP). City of Alameda, Alameda, CA
- City of Suisun City. 1981. Suisun City General Plan Component of the Suisun Marsh Local Protection Program. City of Suisun City, Suisun City, CA
- City of Suisun City. 2015a. Downtown Waterfront Priority Development Area Profile and Market Analysis. Applied Development Economics, Suisun City, CA
- City of Suisun City. 2015b. 2035 General Plan. Suisun City, CA. <https://www.suisun.com/departments/development-services/planning/general-plan/>
- City of Suisun City. 2016a. Waterfront District Specific Plan. City of Suisun City, Suisun City, CA
- City of Suisun City. 2016b. Waterfront District Specific Plan Consistency Analysis. City of Suisun City, Suisun City, CA
- City of Suisun City. 2017. Local Hazard Mitigation Plan. City of Suisun City, Suisun City, CA
- City of Suisun City. 2019. Suisun City, California - Code of Ordinances. Title 15 - Buildings and Construction. 15.08 Floodplains and Flood Damage Prevention. [https://library.municode.com/ca/suisun\\_city/codes/code\\_of\\_ordinances?nodeid=tit15buco\\_ch15.08fldapr](https://library.municode.com/ca/suisun_city/codes/code_of_ordinances?nodeid=tit15buco_ch15.08fldapr)
- Doehring, C., J. Beagle, J. Lowe, R. M. Grossinger, M. Salomon, P. Kauhanen, S. Nakata, R. A. Askevold, and S. N. Bezalel. 2016. San Francisco Bay Shore Inventory: Mapping for Sea Level Rise Planning. SFEI Contribution No. 779. San Francisco Estuary Institute, Richmond, CA. <https://www.sfei.org/documents/san-francisco-bay-shore-inventory-mapping-sea-level-rise-planning>
- Fazey, I., R. M. Wise, C. Lyon, C. Câmpeanu, P. Moug, and T. E. Davies. 2015. Past and future adaptation pathways. *Climate and Development*. DOI:10.1080/17565529.2014.989192
- FEMA. 2012. Engineering Principles and Practices for Retrofitting Flood-Prone Residential Structures (Third Edition) (FEMA P-259). Federal Emergency Management Agency, Washington, D.C.
- FEMA. 2013. Floodproofing Non-Residential Buildings (FEMA P-936). Federal Emergency Management Agency, Washington, D.C. <https://www.fema.gov/media-library/assets/documents/34270>
- FEMA. 2017. Protecting Building Utility Systems from Flood Damage. Principles and Practices for the Design and Construction of Flood Resistant Building Utility Systems (Second Edition). Federal Emergency Management Agency, Washington, D.C. <https://www.fema.gov/media-library/assets/documents/3729>
- Goals Project. 2015. The Baylands and Climate Change: What Can We Do. Baylands Ecosystem Habitat Goals Science Update 2015. prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. California State Coastal Conservancy, Oakland, CA
- Google. 2019. Google Earth Pro Aerial Imagery dated September 2018. <http://maps.google.com> Date

Accessed: November 4, 2019

- Grannis, J. 2011. Adaptation Tool Kit: Sea Level Rise and Coastal Land Use. How Governments can use Land-Use Practices to Adapt to Sea Level Rise. Georgetown Climate Center, Washington, D.C.
- Griggs, G., J. Arvai, D. Cayan, D. R. J. Fox, H. A. Fricker, R. E. Kopp, C. Tebaldi, and E. A. Whiteman. 2017. Rising Seas in California: An Update on Sea-Level Rise Science. California Ocean Science Trust, Sacramento, CA
- Haasnoot, M., J. H. Kwakkel, W. E. Walker, and J. ter Maat. 2013. Dynamic adaptive policy pathways: A method for crafting robust decisions for a deeply uncertain world. *Global Environmental Change* 23:485–498. DOI:10.1016/j.gloenvcha.2012.12.006
- Hayhoe, K., D. J. Wuebbles, D. R. Easterling, D. W. Fahey, S. Doherty, J. Kossin, W. Sweet, R. Vose, and M. Wehner. 2018. Our Changing Climate. Pages 72–144 in D. R. Reidmiller, C. W. Avery, D. R. Easterling, K. E. Kunkel, K. L. M. Lewis, T. K. Maycock, and B. C. Stewart, editors. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II. U.S. Global Research Program, Washington D.C. DOI:10.7930/NCA4.2018.CH2
- IAP2. 2018. IAP2 Spectrum of Public Engagement. Developed by the International Association for Public Participation, Australia, Portland, OR
- IEP TWM PWT. 2017. Tidal Wetland Monitoring Framework for the Upper San Francisco Estuary Version 1.0. Prepared by the Interagency Ecological Program Tidal Wetlands Monitoring Project Work Team, Sacramento, CA
- Marin County. 2019. Game of Floods. Created by the Marin County Community Development Agency and the Department of Public Works, Marin County, CA.  
<https://www.marincounty.org/depts/cd/divisions/planning/csmart-sea-level-rise/game-of-floods>
- Moyle, P. B., A. D. Manfree, and P. L. Fiedler. 2014. The Future of Suisun Marsh as Mitigation Habitat. *San Francisco Estuary and Watershed Science*:209–230.  
DOI:10.1525/california/9780520276086.003.0009
- MTC, and ABAG. 2018. Priority Development Areas (current). Prepared by the Metropolitan Transportation Commission and the Association of Bay Area Governments, San Francisco, CA.  
<http://opendata.mtc.ca.gov/datasets/priority-development-areas-current>
- MTC, Caltrans, BCDC, and Bart. 2014. Climate Change and Extreme Weather Adaptation Options for Transportation Assets in the Bay Area Pilot Project. MTC; Caltrans; BCFC; Bart, San Francisco, CA
- NHA Advisors, and Urban Economics. 2018. Finance Guide for Resilient By Design Bay Area Challenge Design Teams Final Version 2.0. Resilient By Design, San Francisco, CA
- NYC. 2019. Climate Resiliency Design Guidelines, version 3.0. New York City, Mayor's Office of Recovery and Resiliency, New York, NY
- OLSD, CVSan, EBDA, SFEP, and Save the Bay. 2015. Oro Loma and Castro Valley Sanitary Districts to Test Experimental Levee. Prepared by Oro Loma Sanitary District, Castro Valley Sanitary District, East Bay Dischargers Authority, California Department of Water Resources, San Francisco Estuary Partnership, the Bay Institute, and Save the Bay, Hayward, CA. <https://oroloma.org/horizontal-levee-project/>
- Plane, E., K. Hill, and C. May. 2019. A Rapid Assessment Method to Identify Potential Groundwater Flooding Hotspots as Driven by Sea Levels Rise in Coastal Cities. *Water* 2228:8–10.  
DOI:10.3390/w11112228 <https://www.mdpi.com/2073-4441/11/11/2228>



- Plane, E., K. Hill, and C. L. May. 2017. Minimum Depth to Groundwater for the Coastal San Francisco Bay Area. DOI:<https://doi.org/10.6078/D1W01Q>  
<https://dash.berkeley.edu/stash/dataset/doi:10.6078/d1w01q>
- SFEI, and SPUR. 2019. San Francisco Bay Shoreline Adaptation Atlas. San Francisco Estuary Institute and the San Francisco Bay Area Planning and Urban Research Organization, San Francisco, CA
- Siders, A. R., M. Hino, and K. J. Mach. 2019. The case for strategic and managed climate retreat. *Science* 365:761–763. DOI:10.1126/science.aax8346
- SMC, and SCC. 2018. County of San Mateo Sea Level Rise Vulnerability Assessment. Prepared by San Mateo County and the State Coastal Conservancy, San Mateo, CA
- Solano County. 2015. Municipal Boundaries (Polygons): Solano County, California GIS Dataset. Vacaville, CA. <http://purl.stanford.edu/sn288qn5252>.
- Solano County Water Agency. 2015. 2013 - 2015 Groundwater Report Groundwater: Conditions In Solano County. Solano County Water Agency, Vacaville, CA
- SPUR. 2009. Strategies for Managing Sea Level Rise. The Urbanist.  
<https://www.spur.org/publications/urbanist-article/2009-11-01/strategies-managing-sea-level-rise>
- USFWS, CDFG, and Reclamation. 2010. Suisun Marsh Habitat Management, Preservation, and Restoration Plan: Final Environmental Impact Statement/ Environmental Impact Report Executive Summary SCH# 2003112039. Page Suisun Marsh Habitat Management, Preservation, and Restoration Plan Final EIS/EIR. Prepared by the California Department of Fish and Wildlife, the United States Fish and Wildlife Service, and the Bureau of Reclamation, Sacramento, CA.  
DOI:ICF:06888.06
- USFWS, CDFG, and Reclamation. 2011. Final Environmental Impact Statement/Environmental Impact Report Volume Ia: Main Report, Executive Summary and Chapters 1-5. Page Suisun Marsh Habitat Management, Preservation, and Restoration Plan Final EIS/EIR. Prepared by the California Department of Fish and Wildlife, the United States Fish and Wildlife Service, and the Bureau of Reclamation, Sacramento, CA. DOI:ICF:06888.06
- USFWS, UDOI, Reclamation, CADFW, CADWR, NMFS, SRCD, and DSC. 2014. Adaptive Management Advisory Team Charter for the Suisun Marsh Habitat Management , Preservation and Restoration Plan. U.S. Fish and Wildlife Service; U.S. Department of Interior, Bureau of Reclamation; California Department of Fish and Wildlife; California Department of Water Resources; National Marine Fisheries Services; and the Suisun Resource Conservation District, Sacramento, CA
- Vandever, J., M. Lightner, S. Kassem, J. Guyenet, M. Mak, and C. Bonham-Carter. 2017. Adapting to Rising Tides Bay Area Sea Level Rise Analysis and Mapping Project. Prepared by AECOM for the San Francisco Bay Conservation and Development Commission, the Metropolitan Transportation Commission, and the Bay Area Toll Authority, San Francisco, CA.  
<http://www.adaptingtorisingtides.org/wp-content/uploads/2016/05/bata-art-slr-analysis-and-mapping-report-final-20170908.pdf>