

# Resilient Bay Area Challenge Site Ideas

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# ALAMEDA COUNTY

## Bay Bridge Landing

**County:** Alameda

**Risks:** sea level rise, storm surge and tidal flooding, high-liquefaction potential in soils, environmental toxicity in soils from historic uses

The Bay Bridge Landing is the touchdown point at the eastern part of the Bay Bridge, which connects the City of San Francisco to the East San Francisco Bay. Located between Interstate 80 and the Port of Oakland, the site will be unique in the Bay Area as a place that celebrates the dynamic regional spirit. The site presents an opportunity to work with the immediate community, to provide a series of portal experiences. Example experiences could highlight the Bay's natural environment, the multi-layered history of transportation, and the powerful economic engine of the Port and its adjacent redevelopment. Site designs could provide access to a new, unparalleled visual experience of the region from the bridge itself.

The low-lying land that is being conveyed to the East Bay Regional Park District to mitigate public access impacts not only protects critical transportation and wastewater infrastructure, but also can be used to implement natural infrastructure solutions that would protect important habitats and species. The Bay Bridge Landing site presents an opportunity to restore a natural beach and marsh upland while creating a resilient park in the face of rising sea level by re-envisioning the shoreline edge. The site borders a low-income, community of color and an important economic hub for the Bay Area, a world-class port. The site also can serve as a multi-modal transportation hub as it has historically for the key system and a node for the Bay Trail and future bikeway on the West Span of the San Francisco-Oakland Bay Bridge.

# West Oakland Waterfront

**County:** Alameda

**Risks:** sea level rise, storm surge and tidal flooding, high-liquefaction potential in soils, poverty, crime/violence, structural racism, economic inequality, lack of investment, shifting macroeconomic trends

The Oakland Waterfront includes Howard Terminal, Middle Shoreline Park (an existing restored wetland), Jack London Square (a thriving waterfront district impacted during king tides and heavy storm events), and the Bay Bridge connection. A study identified nine key areas of vulnerability within the Gateway Regional Shoreline Park area. These areas can be grouped into three categories – shoreline inundation areas, critical inundation pathway, and inland inundation areas. Additionally, extreme tides (50-year or greater) already threaten assets immediately adjacent to the shoreline under existing conditions. These stressors could impact assets such as critical transportation that support the region. If no action is taken, sea level rise will continue to diminish the level of flood protection afforded by the existing shore protection infrastructure up until the point where the shoreline and inland areas are subject to daily tidal inundation and coupled with rising groundwater tables from rainfall, rising water levels will inhibit infiltration and sub-surface storage of runoff. Over the long term, a large-scale integrated flood protection strategy for the area will be required to prevent extensive flooding during extreme tides. Natural and/or engineered shoreline protection will be an essential part of the proposed construction of the Gateway Regional Shoreline Park, such as integrating within the existing wetland and beach habitats located on the north side of the touchdown using an engineered berm with habitat enhancements. The shoreline could incorporate high marsh and riparian habitat features that readily accommodate flooding by extreme tides and storm surge. Landscape terracing and raising existing structures are also possible strategies to increase the resilience and protection provided by the future park, which could be a highly visible model for coastal resilience.

West Oakland has a lack of investment in public amenities and low-income communities of color, although it is increasingly being inhabited by residents of higher incomes. In the 1930s, African-Americans from the South began settling at a disproportionately high rate in West Oakland due to discriminatory housing covenants. Civil unrest of the 1960s, decrease in jobs, and an increase in crime and poverty has led to high rates of violence. Social vulnerabilities to address could focus on arrest rates, crime incidence, food stamp participation rates, youth incarceration and probation rates, rates of violent suspensions, and chronic student absences.

# Arrowhead Marsh/Edgewater/Lower San Leandro Creek District

**County:** Alameda

**Risks:** sea level rise, storm surge and tidal flooding, high-liquefaction potential in soils, poverty, non-English speakers

The Arrowhead Marsh is a large critical wetland at the outfall of the San Leandro Creek that also forms the boundary of the Edgewater Industrial park, the Hegenberger Rd./Airport Area Commercial corridor and the key impacted neighborhoods of Columbia gardens, Brookfield Village and Sobrante Park. This district in Deep East Oakland lies within the projected 1-2m sea-level rise zone and is also part of a critical economic engine for the city, with many development opportunities, and also provides a vital opportunity for habitat restoration and green space connectivity for the Edgewater workers and the mostly low-income residents in the surrounding neighborhoods. The Air District has worked in this area to attract State Climate investment funding for green infrastructure (San Leandro Creek Greenway) as well as directly engaging community residents around air quality (and stormwater) mitigation projects such as the vegetative buffer at Brookfield Elementary School. One critical development site in this district is the 11-acre parcel at 276 Hegenberger Rd. adjacent to the marsh and creek which the City, property owners and stakeholders including Merritt Community College have sought to plan an innovative green mixed-use project that preserves water recharge and open space uses.

This district and site are at a critical and vulnerable urban environmental and development confluence. This is an opportunity to realize many co-benefits in a pilot planning design effort that can illustrate resiliency approaches, climate adaptation and mitigation and interventions that build off and integrate local culture, place-knowledge and include deep community engagement. Furthermore, this area contains the most disadvantaged census tracts (per CES 3.0) in the Bay Area and is also part of the Air District's CARE communities.

Social vulnerabilities include risk of displacement, local health impacts due to cumulative air pollution sources (mobile and stationary), high levels of poverty and lack of access to resources, and a high population of immigrants and non-English speakers.

## Emeryville Crescent Marsh

**County:** Alameda

**Risks:** sea level rise, storm surge and tidal flooding, liquefaction, aging infrastructure, earthquake

The Emeryville Crescent Marsh is about 2 miles long north-south from the north end of the Emeryville Peninsula and 64th Street to the Outer Harbor Terminal and freight rail station in Oakland, and 1.5 miles wide east-west from the Bay Bridge toll plaza and west end of the peninsula to the Emeryville Amtrak station and Mandela Parkway. The area is bordered by the intersection of the I-80 and I-580 freeways at the eastern touchdown of the Bay Bridge in Emeryville and northwest Oakland as well as the Bay Trail, Radio Island wildlife habitat, and the Bay Bridge Bicycle and Pedestrian Path.

This site includes sensitive wildlife habitat, major regional and state transportation infrastructure (freeways, ramps, railroad tracks, freight yard, Amtrak station, Bay Trail, bridge path, and ferry), affordable housing, senior housing, employment centers, recreational open space, and a wastewater treatment plant near a low-income industrial and residential community. Storm surges would inundate the marsh area at high tide and could eventually flood areas further inland. Protecting and raising the marsh could help protect the inland infrastructure and land uses, such as protecting the nearly three-quarters of a million vehicles that cross the Bay Bridge every day. Solutions could convey and treat stormwater overland via bio-swales, protect and gradually raise the marsh, preserve connections between existing land uses, and create a pedestrian and bicycle connection between inland areas and shoreline parks. If the solution includes pedestrian-bicycle access to the Bay Bridge, it could connect the lower income community on Treasure Island with jobs in Emeryville.

The area is within the Bay Area Air Quality Management District's Community Air Risk Evaluation (CARE) area, where populations are most vulnerable to air pollution. Furthermore, flooding of the wastewater treatment plant could threaten the Bay and poses a public health risk as a flooded wastewater plant could result in sewer backups and overflows throughout the service area and thus impacting hundreds of thousands of residents and businesses.

# Hayward Regional Shoreline

**County:** Alameda

**Risks:** sea level rise, storm surge and tidal flooding, liquefaction, aging infrastructure, earthquake

The Hayward Regional Shoreline refers to Alameda County's shoreline from the San Leandro Marina to the Alameda/Santa Clara County line in Fremont. It encompasses the cities of San Leandro, Hayward, Fremont, and Union City. The exact limits of the site will be delineated as part of the proposed resiliency solutions, and may encompass some or all of this shoreline. As identified in the San Francisco Bay Conservation and Development Commission's Alameda County Adapting to Rising Tides project, the Hayward shoreline is one of the most vulnerable stretches of Alameda County shoreline. The San Leandro/Hayward/Fremont ("Hayward") Shoreline site offers the opportunity for creativity and ingenuity in addressing a wide variety of types of land use, ecosystems, communities, and infrastructure, including: environmentally sensitive wetlands areas (Eden Landing Ecological Reserve, Don Edwards San Francisco Bay National Wildlife Refuge, Cogswell Marsh, Hayward Marsh, and wetlands in the Coyote Hills Regional Parks), critical infrastructure (San Mateo-Hayward Bridge (SR 92) eastern approach, Dumbarton Bridge (SR 84) eastern approach, East Bay Dischargers Authority's sanitary sewer outfall, and Calpine Russell City Energy Center).

Sea level rise currently threatens the ecological integrity of the invaluable wetlands areas along the Hayward Shoreline. If not protected, these wetlands will be submerged, eliminating vital habitat for many species and eliminate recreational opportunities. Flooding of near-shore housing, business, and industrial areas will have large economic implications. The subsurface conditions below the site generally include soft clay deposits. Ground shaking could cause damage to dikes, levees, and man-made structures. It could also cause liquefaction of sand layers, leading to collapse of the ground and any overlying structures.

Many of the neighborhoods are currently at elevation 12 or 13 above MHHW, and are thus highly vulnerable to sea level rise. Disruptions caused by flooding would cause major social implications to the Bay Area's transportation network. Adapting to threats would help the light manufacturing and industrial facilities along this stretch of shoreline offer jobs to people and support the economic vitality of the East Bay and Bay Area, as well as preserve the area for recreational purposes.

# Albany Bulb

**County:** Alameda

**Risks:** sea level rise, storm surge and tidal flooding, high-liquefaction potential in soils.

The area where the 'Albany Bulb' is located is part of the Albany State Marine Reserve and its surrounding environments. The 'Albany Bulb' is a landfill site that is transitioning to a regional park, and will one day become part of the Eastshore State Park. Other areas include Albany Beach, a vestige of native shoreline and parking lots and facilities associated with Golden Gate Fields Racetrack, where horse racing has taken place since the 1940's. The racetrack itself, its infield, parking lots and horse stables are all approximately 8' above sea level. The Turf Club and grandstands are located on Fleming Point, a natural hill that once housed a dynamite plant but has now had its top removed to fill in the surrounding area.

Located directly opposite the Golden Gate Bridge, the overall Albany Waterfront Site is grossly underutilized relative to its world class position in the Bay and adjacency to East Bay communities. Golden Gate Fields has been an excellent land bank but may not be the highest and best use of the land. Much of the site is roughly 6' to 8' above sea level, with many features (the Beach, the Jettys, portions of the racetrack infield and Codornices Creek adjacent I-80) at lower and more vulnerable elevations.

Rising sea levels will alter the shoreline may threaten the integrity of the beach and the parking lots. There will likely be substantial erosion at the beach that could migrate into the parking area, though nothing of value is currently threatened.

# City of Alameda

## County: Alameda

**Risks:** flooding (groundwater, stormwater, tidal sources), sea-level rise, liquefaction, earthquake/earthquake fires, lack of investment, insecure municipal funds, fire, aging infrastructure.

The Island of Alameda is the San Francisco Bay's largest island and home to most of the city's 75,000 residents. The island is very flat, rising only 30 feet above sea level at its center. It was originally a low-lying, marshy peninsula connected to the southern portion of Oakland, however development and dredging of the San Leandro Channel in 1902 converted it into an island. It is now accessible to Oakland via three bridges on the eastern end of the island and one split vehicular tunnel on the western end of the island. A fourth bridge connects it to Bay Farm Island, part of the City of Alameda, to the southeast.

Large portions of the island are manmade, resulting from development built on fill dredged over time from San Francisco Bay. Most of the original tidelands were filled, which doubled the size of the island. These filled areas include Alameda Point (home of the former Naval Air Station) and the Southshore area. A saltwater-fed lagoon system currently separates the Southshore area from the original island, and the north shore of this lagoon system is the former shoreline. As the Bay Area's largest island both by geography and population, sea level rise (SLR) is a unique challenge here. Estimates project flooding inundating the island approximately one-half mile, along the east and south shore, during extreme storm events at mid-century. SLR will inundate the man made beach at Crown Beach Memorial State Park, the residential areas on the perimeter of the island, the Elsie Roemer Bird Sanctuary marshland, and the former Naval Air Station runways.

Because Alameda is very flat, especially in areas of made-ground, backup within the stormwater system is frequent due to tidal and rainstorm event influences. During high tide, many stormwater outfalls are currently underwater and subject to chronic mud deposition, clogging, and upstream backup within the system. The City owns and operates nine stormwater pump stations, which can help overcome these setbacks at a few key locations by pumping stormwater out under pressure when outfalls are below high tide. However, many of these stations and their outfalls are well past their useful life or require additional capacity, and none are close to sufficient to deal with realities of sea level rise. Community vulnerabilities include potential displacement of lower-income communities, insecure municipal finances, health concerns from contaminated floodwaters, and lack of investment.

## Bay Farm Island/Oakland Airport

**County:** Alameda

**Risks:** flooding (groundwater, stormwater, tidal sources), sea-level rise, liquefaction, earthquake/earthquake fires, aging infrastructure,

Bay Farm Island (BFI) is approximately 2.4-square miles in size and is situated on the east side of San Francisco Bay. Although part of the City of Alameda, it is separated from the main island by the San Leandro Channel. BFI is now a peninsula six times larger than its original area, and is connected to the City of Oakland. Due to marshland reclamation, it is below sea level in some places, yet up to 16 feet high around the edges. Doolittle Landfill, the highest point on BFI, is 56 feet high. The Port of Oakland owns and operates Oakland International Airport, adjacent to BFI and separated from it by Harbor Bay Parkway. The airport serves more than 11 million passengers per year and is a hub of the regional economy.

With an additional two feet of SLR predicted for BFI, this area will be inundated nearly in its entirety. 100-year floodwaters can currently overtop the existing ground at various locations along the OAK shoreline and roadways, Chuck Corica Golf Course, and surrounding homes. These floodwaters could then potentially block all emergency and recovery egress routes, rendering Bay Farm Island completely isolated, cut off from Oakland as well as the Island of Alameda.

The 100 ft long section of seawall along the north shore of BFI, between the north end of the lagoon system and the San Leandro Channel, which FEMA mapped below the 100-year base flood, could potentially be breached during an earthquake or extreme high tide event. This would flood approximately 300 residential buildings, 6 commercial buildings, and the lagoons themselves. Other risks include landfill leaching (rising groundwater levels overcoming current leachate containment), and shoreline street and trail damage.

Social risks include residential and commercial displacement, reduced access to open space, loss of regional airport, loss of circulation for emergency vehicles, lack of access to hospitals and functional schools/education, loss of industry and commerce including the Harbor Bay Business Park, and health concerns from potential contaminated floodwaters.

# Alameda Point

**County:** Alameda

**Risks:** sea level rise, storm surge and tidal flooding, high-liquefaction potential in soils, aging infrastructure, financial economic crisis, insecure municipal finances, lack of affordable housing

Alameda Point is the westernmost edge of Alameda Island and the site of the former Alameda Naval Air Station, one of the Bay Area's major hubs during World War II. It extends for the western tip to Main Street which is a major north/south connector and mirrors the location of the former railroad tracks that once connected the island to Oakland mainland. The area was originally marsh land and was filled in over time, but the base was closed in 1974 and no physical improvements have occurred since then on this end of the island. Currently, Alameda Point has been master planned as a new, walkable transit-oriented community, a new commercial and industrial district, a marina, a future VA hospital and an extensive public open space and wildlife refuge for endangered species. Because Alameda is an island, it is vulnerable to flooding from all sides. Resiliency strategies are a priority for the Point beginning with SITE A - a 68 acre redevelopment site currently underway that involves coordination with the City of Alameda and BCDC to incorporate sea level rise strategies in its design framework.

Currently, the Point is made up of a mix of commercial and industrial uses and is inhabited by a primarily low-income community. It is important to note that the area, including the proposed Site A redevelopment, is vulnerable to sea level rise. Because the area has great redevelopment potential, it is primed for the incorporation of sea level strategies in its redevelopment process. The current Site A redevelopment project, a 68 acre mix of residential, commercial, open spaces, streetscapes, transit, and a ferry terminal, along with its 10 acre Waterfront Park will be a crucial piece of this development as it has the potential to act as both Site A and the Point's first line of defense against rising tides and can furthermore set the stage for strategies that can be harnessed for the whole island.

The City of Alameda has adopted a plan for a sea wall strategy as its baseline approach to protect the entire island community from rising seas. Much of Site A is at sea level and requires grade elevation increases for all new developments. Transportation lines, businesses, cultural landscape architecture (hangars), sewer, stormwater and utility infrastructure and trail connectivity along the shoreline are all vulnerable. Because the 1974 base closure affected the economic growth of the City, a seawall is not a cost effective option for the entire Site A area nor for the entire island. Based off of these conditions, at least four feasible options exist for the Waterfront Park: Design for Inundation, Sea Wall, Levee, and Floodable Wetland.

# Berkeley Marina

**County:** Alameda

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, homelessness, crime/violence

The Berkeley Marina is an epicenter of the San Francisco Bay located at the foot of University Ave in Berkeley and is essentially the first point of contact on the East Bay from waters flowing west to east. The site area could include all of Cesar Chavez Park, McLaughlin Eastshore State Park State Seashore, the Marina and Aquatic Park, and the I-80/580 up to the 4th St Commercial Corridor - projected to have 6 feet of sea level rise by 2050. The site context includes the watersheds from the Berkeley Hills especially the Strawberry Creek Watershed and the beach front south to Emeryville, and north to Richmond. This is the extent of the historic Berkeley Beach, otherwise known as The Bite.

The site has great potential to serve as an alternative transportation hub due to its proximity to the ferry and the I-80. The marina has an incredible amount of open space, now suffering from years of drought, deferred maintenance and general wear and tear, drastically in need of a major overhaul. If designed with great vision, in coordination the Emeryville marina, this open space could serve as large 'barrier island' for the East Bay with ecological amenities such as a high marsh.

Wave erosion and inundation are an eminent threat and flooding along I-80 is already constantly occurring. The stormwater system that is a culmination of Schoolhouse, Strawberry and Potter Creek all exit at this site and these storm drains are repeatedly filling with sediment and are unable to drain. Other vulnerable infrastructure include a high-pressure jet fuel line, a large diameter sanitary force main located between I-80 and Aquatic Park, and a large landfill and a methane plant with leachates and other toxins.

The site is home to many transient people and the pressures on the site are formidable, especially on facilities. There are not enough public restrooms, the unisex-accessible showers for the marina are a draw, and keys are stolen or users are stalked and harassed while entering shower facilities. The Berkeley Marina and Pier have been a site for many cultural festivities including Berkeley Kite Festival, 4th of July and Berkeley Bay Festival. This cultural communal landscape is also a place of learning and activities for many of the bay areas at risk youth. Furthermore, the site was also discovered to be a burial site for the Ohlone tribe. Programming that happens in this area serves as a positive and unique learning experience for various populations, a place of learning and enjoyment for the entire Bay Area.

# Gateway Park

**County:** Alameda

**Risks:** sea level rise, storm surge and tidal flooding, liquefaction, aging infrastructure

Gateway Park is the proposed name of a 170 acre linear park on a long, narrow spit of land that juts into San Francisco Bay on Oakland's northwestern waterfront and was, in pre-Bay-Bridge days, home to the Key Route pier and ferry terminal. The area is also known as the eastern touchdown of the San Francisco-Oakland Bay Bridge.

Gateway Park would span near the touchdown of the new East Span to Mandela Parkway in West Oakland, and on both sides of the Bay Bridge approach and toll plaza. A restored and protected expanse of wetlands stretches north and east from Radio Beach, along the northern side of the peninsula toward the Emeryville Crescent. In contrast, a mosaic of port, industrial, commercial and other urban uses dominate the south side of the peninsula. On three sides, the peninsula is surrounded by San Francisco Bay and may be publicly accessible in the future.

Sea level rise threatens not only the ecological integrity of the site's existing wetlands, but also the future park and the critical infrastructure at the site's midline, specifically the Bay Bridge toll plaza and approach to the bridge. The peninsula is relatively flat, elevated approximately 6 to 10 feet above the mean high water, and surrounded by the San Francisco Bay on the north, west, and south sides. Both the future park and the toll plaza are vulnerable to flooding during extreme high tides and storms. In addition, seismic-induced liquefaction would render the Bay Bridge inaccessible to populations in the East Bay. There is also a need to protect into the future critical components of onsite East Bay Municipal Utility District (EBMUD) wastewater infrastructure. The surrounding Key Peninsula site could envelop and protect the toll plaza with berms, seawalls, wetlands and other features that provide flood protection and seismic stability and also be a unique opportunity to inform visitors of the site's vulnerabilities.

Vulnerabilities like severe shoreline erosion, flooding, inundation, wave overtopping, and loss of critical infrastructure—particularly the outflow from the EBMUD wastewater plant could result in loss of access to the Bay Bridge, a "lifeline structure" designed to remain functional after a major seismic event. Furthermore, the Key Peninsula will be the backbone of a bicycle/pedestrian path and future park for residents of both West and North Oakland and the entire East Bay bicycle and walking community. Allowing and preserving public shoreline access creates an opportunity to reconnect people to the Bayfront and thereby to re-envision and reset our relationship to both our cities and our shoreline.

# San Leandro Water Pollution Control Plant and Waste Management/Davis Street Transfer Station

**County:** Alameda

**Risks:** sea level rise, storm surge and tidal flooding, liquefaction, unemployment

This approximately 39 acre site sits on the northern portion of the San Leandro Shoreline near the Oakland International Airport and was developed with the San Leandro Water Pollution Control Plant (WPCP). The WPCP is surrounded by tidal flats and mudflats with the adjacent area being mostly industrial land uses, notably the Waste Management Davis Street Transfer Station, as well as public access open space and bay trails at the Oyster Bay Regional Park.

According to 2009 FEMA flood maps, there is a one percent chance of flooding of the area in any given year. Long-term, a 36-inch flood as soon as 2050 could reach the San Leandro Water Pollution Control Plant and Waste Management's Davis Street Transfer Station as well as the adjoining Oyster Bay Regional Park. These assets could be temporarily inundated by five-year recurrence interval storm by mid-century and will potentially be permanently inundated by the end of the century. Although the Port of Oakland plans to raise levees by 1 to 2 feet along the southern border of the airport lands, some of the plant will remain exposed to rising sea levels. Once sea level rise reaches 48 inches, sanitary sewer assets are exposed as well, including the San Leandro Effluent Pump Station. Sewer overflow and incapacitation of water treatment could also pose threats to public health and economic vitality in San Leandro and flooding of the Davis Street Transfer Station would threaten a region-wide waste processing facility.

The existence of a regional waste collection and transfer station and a regional park makes this site a good choice for a location that serves both community and region-wide needs. The Water Pollution Control Plant and Davis Street Transfer Station both employ employee union labor and professionals from communities throughout the Bay Area. Permanent closure of those facilities from flooding could threaten hundreds of good jobs. In addition, San Leandro neighborhoods to the east and southeast of the site are considered disadvantaged communities according to CalEnviroScreen. San Leandro is committed to ensuring that Resilience Design incorporate environmental justice and equity concerns.

# Berkeley Waterfront

**County:** Alameda

**Risks:** sea level rise, coastal erosion, storm surge and tidal flooding, aging infrastructure

The Berkeley Waterfront, particularly the University Avenue shoreline, is located on the southern side of University Avenue, west of I-80, from West Frontage Road to Marina Blvd. North of the shoreline, the Bay Trail Extension multi-use bicycle path brings visitors and ferry commuters to the marina at the Berkeley Waterfront. Above the Bay Trail, University Ave serves as the sole connector road and emergency access for the entire Berkeley Waterfront, which includes the marina area, McLaughlin Eastshore State Park, and Cesar Chavez Park. In addition, University Ave contains all of the utility lines that serve the Berkeley Waterfront: electric, gas, sanitary, and telecom.

North of University Ave, the Berkeley Meadow is the single largest established conservation habitat in Eastshore State Park and is home to a wide variety of birds and other wildlife that have protected status. This shoreline was initially constructed as part of the buildout of the marina at the Berkeley Waterfront on bay fill in the 1960s and continues to be lined with construction debris/concrete from the original construction. The shoreline has experienced severe erosion that creates serious vulnerabilities to the viability of the Bay Trail, University Ave, and the Berkeley Meadow Wetlands in times of storm surge and sea level rise. By 2050, especially during a storm event, the area could be inundated with 3 feet of water and the currently low-lying shoreline would no longer provide its protective function. The Berkeley Waterfront could become inaccessible to regional commuters, recreational users, and emergency response teams, and the ecological integrity of the Berkeley Meadow could be severely impacted. Interpretative opportunities on resilience to climate change can easily be accommodated via info panels along the existing Bay Trail, and at the Shoreline Park Nature Center in the marina area.

The Berkeley Waterfront is a well-known recreational destination for people of all socioeconomic backgrounds from throughout the entire Bay Area. The City is currently funding an engineering study to convert the existing eastbound roadway along University Ave to an open space in order to protect against sea level rise. The potential physical vulnerabilities that threaten this site include the impact of flooding, sea level rise, and storm surge at the eroded section of the University Ave shoreline to the existing critical roadway and utility infrastructure along University Avenue, and to the sensitive Berkeley Meadows Wetland habitat at Eastshore State Park.

## West Alameda

**County:** Alameda

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, unemployment, lack of affordable housing

West Alameda is located at the East Bay on the island of Alameda and connected to Oakland by a pair of tunnels. This site is mainly occupied by low-density residential housing and many new businesses such as high-tech companies like Wind River and Wrightspeed. Historically, West Alameda was home to a Naval Air Station, a major employer during WWII. There are several development projects undergoing; however, some developable sites are unused and they provide potential design opportunities.

As an island, Alameda faces the challenge of addressing sea level rise that especially threatens its transportation infrastructure. There are only 3 operable bridges, located on the eastern side of the island connecting Alameda and Fruitvale/I-880 freeway and a pair of tunnels on the western side connecting Alameda to Oakland and adjacent cities in the East Bay. Although there are 2 ferry terminals that provide ferry service between Alameda and SF, the lack of direct freeway and railway connections makes access challenging.

Alameda's Measure A, approved in 1973, limits the development projects in the city by setting the maximum density for any residential development within the City of Alameda to be 1 housing unit per 2000 square feet of land. While the major original aim was to stop developers from demolishing historic homes and putting up large apartment complexes, community members now leverage the measure to mitigate traffic congestion and crime.

The closure of the naval air station has led to the loss of many jobs and increasing demand for housing among Alameda is now one of the key issues. Furthermore, the community is struggling to find a balance between development and preservation and city-scale master planned development projects have failed twice in the past 2 decades. This dilemma will be a key issue to tackle in future efforts.

# CONTRA COSTA COUNTY

## Richmond Field Station

**County:** Contra Costa

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, earthquake, liquefaction, poverty, lack of investment, unemployment

The Richmond Field Station is an academic teaching and research off-site facility located 6 miles northwest of the UC Berkeley Central Campus on the San Francisco Bay that has been used primarily for large-scale engineering research since 1950. The 170-acre property consists of 100-acres of uplands with the remainder being marsh or bay lands. The open areas of the Field Station are also prized for their research and habitat value. The site contains one of the largest and best preserved remaining areas of native coastal grasslands that were once prevalent throughout the Bay Area. The adjacent stands of eucalyptus provide a home for wintering monarch butterflies and nesting raptors. The bay marsh and mudflats provide additional habitat for a variety of flora and fauna, including the endangered California Clapper Rail, as well as an opportunity for the Berkeley campus to use these areas for teaching and research. A resiliency project at this location fits into the CA Measure AA narrative: the Bay Area has, for the first time ever, a unified funding and implementation mechanism for a regional tidal restoration and habitat protection, including learning how to live/develop sustainably in the transition zones that will be affected by sea level rise.

The City of Richmond has a long, heavily polluted history with 20 active EPA hazardous cleanup sites mostly on the Richmond coastline sprinkled with complicated and convoluted remediation efforts. The Zeneca site adjacent to the Richmond Field Station in particular has an extensive history of toxic dumping. Sea level rise, flooding, storm surges, and ocean acidification will affect freeways, roads, housing, water and energy infrastructure already under stress due existing inefficiencies and poverty in the area.

The Richmond community is vulnerable to toxic industrial behavior and climate change events. Pollution presents public health threats to an already vulnerable community that already faces infrastructure inefficiencies and limited money flows in the area. Richmond residents have lower than average education levels and median incomes, and a higher than average percentage of ethnic minorities, immigrants and low-income individuals. Finally, the Bay Area's ongoing gentrification poses a risk of displacement for local community members who have already voiced their concerns about potential development ideas to UC Berkeley directly.

## Point San Pablo

**County:** Contra Costa

**Risks:** sea level rise, storm surge and tidal flooding, liquefaction, earthquake, shifting macroeconomic trends

Point San Pablo is a regional landmark. With Point San Pedro in Marin County, Point San Pablo defines the San Pablo Straits separating San Francisco and San Pablo Bays.

Originally, Point San Pablo was home to Terminal 4 in Richmond in the 20th century, the last operating whaling station in the United States before it shut down in 1971. Its closure was followed by closure of Pacific Molasses operations and Paktank's vegetable oil and petrochemical product business. No longer viable economically as a marine terminal, most of the old tanks located in the upland hills have been dismantled.

Four major land use plans have been developed for the entire Point San Pablo Peninsula in addition to the Reuse Plan adopted by the Richmond City Council for the former Naval Fuel Depot at Point Molate. All of them call for completion of the San Francisco Bay Trail, which would allow access to the shoreline and adjacent open spaces for local residents including disadvantaged communities living near refineries and other heavy industrial sites. In the upland areas, the plans call for a combination of park and recreational spaces, mixed-use development, and open space and restoration areas.

Access to the area's several miles of shoreline will also be improved with the construction of a bike/ped lane on the Richmond-San Rafael Bridge in 2018. These improvements have the potential to generate economic activity in a disadvantaged area. Other potential improvements could include using harbor dredging to create living shorelines and super levees. Overall, sea level rise, storm surge, earthquake and liquefaction, and potential refinery disaster threaten Point San Pablo. Addressing these challenges is essential to preserving housing and increasing access to open space and jobs.

## Point Molate

**County:** Contra Costa

**Risks:** sea level rise, storm surge and tidal flooding, coastal erosion, aging infrastructure, poverty

Point Molate spans about 300 acres and has a variety of geologic features, including sloping hills and a small beach area with some public amenities. The southernmost beach area, Point Molate Beach Park, is the nexus of an intact natural bay watershed that connects native grassland prairie and coastal scrub via willow drainages to a rare coastal strand beach and offshore eel grass beds. Point Molate began as a shrimp camp in the late 1800s and later became a winery operated by the California Wine Association (CALWA). After CALWA was dissolved, Point Molate was acquired by the U.S. Navy for use as a fuel depot during World War II. The fuel depot operated until 1995, when the property was acquired by the city of Richmond. In 2013, the Beach was reopened due to a community initiative to connect residents directly with the remaining natural shoreline, although the project had minimal funding. The site has been used as a base for outdoor science and ecology education for Richmond students. Recently, the City Council approved housing a boat building workshop and employment training program for underserved youth here; however, the park is in jeopardy as the effects of sea level rise and storm surge are already becoming evident. The unconsolidated fill dirt that was placed by the Navy over the original sloping shoreline grade is now undergoing rapid erosion due to rising tides.

The site has the opportunity to be a community, cultural, economic, and ecological asset for Richmond residents. Projects such as the Richmond Greenway renovation and the Bay Trail extension will increase access to Point Molate by providing safe and attractive opportunities for Richmond families to easily access the site's natural beauty, outdoor recreation, and nature and cultural education opportunities. Artifact evidence of the Chinese shrimp camp along the shoreline is being investigated by the Chair of the U.C. Berkeley Anthropology Department and has stimulated ideas for communicating the area's early shoreline economic and cultural history. Richmond's median household income is lower than the median for Contra Costa County and the State as a whole. The poverty rate, 18 percent, is significantly higher than the poverty rate for the county, 10 percent. According to the county health department, communities with the highest percentage of low-income and non-white residents — San Pablo, Richmond, North Richmond and Pittsburg/Bay Point — experience higher death and disease rates than the county overall for many chronic and communicable diseases, injury, and maternal and child health issues.

## Richmond (Atchison Village)

**County:** Contra Costa

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, poverty, crime and violence

Atchison Village is made up of 450 housing units in the Rosie the Riveter/World War II Home Front National Historical Park of Richmond, CA that was built by the Federal government in the 1940s to house the city's wartime workforce. In 1956, when the residents heard the government was going to shut it down, they incorporated and became one of California's first housing cooperatives. In 2003, it was awarded status on the National Register of Historic Places.

Atchison Village shares a surface storm water drainage system with the adjacent Liberty Village's 100 units of wartime housing. Both villages sit on the Richmond flats at a low elevation of between 8 and 16 feet above sea level. The drainage system frequently backs up when storms and high tides coincide, causing temporary flooding in the area of Curry St. and West Chanslor Ave. The currently affected area is only 5½ feet above the high tide mark and these current problems forebode much worse flooding as sea levels rise. As sea levels rise, the antiquated, inadequate drainage systems currently in place in Atchison Village, Liberty Village and adjacent Iron Triangle neighborhoods leave significant numbers of people vulnerable to losing their homes to flooding. Overall, the site presents significant hydrological and logistical problems that need to be solved in order to save this diverse, vital community.

In addition to storm surges, flooding and sea level rise being significant potential threats, the community is also only a few miles from the Hayward Fault and thus, a major earthquake threatens infrastructure.

Housing insecurity is a vulnerability in the area, especially given Atchison Village's history of housing preservation struggles. The adjacent Liberty Village's affordable units houses many families with few alternatives in today's housing market, and relatively little mobility due to financial constraints. The surrounding Iron Triangle community is largely Black and Hispanic, populations intensely impacted in Richmond by a acute lower income housing shortage. Preserving the homes and neighborhoods of all of these groups is critical, in addition to addressing the area's declining industry and history of violent activity.

## North Richmond Shoreline

**County:** Contra Costa

**Risks:** sea level rise, storm surge and tidal flooding, shifting macroeconomic trends, poverty

The North Richmond Shoreline is located between Point San Pablo and Point Pinole, east of the BNSF/Santa Fe railroad tracks. This area includes communities of the unincorporated County of Richmond and City of Richmond, such as the North Richmond, Parchester Village, and Shields-Reid neighborhoods.

Along the shoreline, the area includes: the Chevron Refinery, Wildcat Creek and Marsh, West County Wastewater District treatment facility - a closed landfill still operating as a solid waste transfer station and refuse collection corporation yard, San Pablo Creek, Rheem Creek, Point Pinole Regional Shoreline Park and the newly restored Dotson Family Marsh. Several critical transportation assets exist along this portion of the shoreline, including rail lines, the Richmond Parkway, and the Bay Trail.

The Richmond City Council recently established a moratorium on industrial development along portions of the shoreline in light of sea level rise. The San Francisco Estuary Partnership (SFEP) is currently leading a community visioning process for North Richmond that integrates sea level rise vulnerability, environmental justice and innovative solutions. Opportunity areas exist for ecological enhancement, restoration and protection as well as “light touch” use overlays, such as biomass utilization, Bay Trail gap closures, recreation centers, and urban gardens. The Bay Conservation and Development Commission (BCDC) “Adapting to Rising Tides: Contra Costa County Vulnerability Study” provides an in-depth analysis of future shoreline conditions under anticipated sea level rise scenarios and the State Coastal Conservancy has been testing climate change adaptation features at marshes as part of its Living Shorelines Program.

North Richmond is identified as a “Severely Disadvantaged Community” - median household income less than 60 percent of California State’s median household income. Neighborhoods within North Richmond are impacted by multiple environmental and socio-economic stressors. Local environmental justice organizing has focused on creating an environmentally sensitive approach to reducing flood risk, protect open space and establish the Bay Trail and Wildcat Creek Trails, and lower exposure and burden associated with adjacent industrial activities. Adjacent communities of the shoreline were settled as segregated housing predominantly for African-Americans who were shut out of housing opportunities elsewhere in Richmond during WWII.

# Pittsburg

**County:** Contra Costa

**Risks:** sea level rise, storm surge and tidal flooding, poverty

Pittsburg, specifically the Bay Point area is a census-designated place with a total population of 21,586. Land uses in Bay Point are primarily residential, with some commercial and industrial uses, parks, and open spaces. Parallel rail lines used by Union Pacific and Burlington Northern Santa Fe are located between the shoreline and the developed portions of Bay Point. North of the rail lines are significant tidal marshes, the McAvoy Yacht Harbor, the Bay Point Regional Shoreline, and a chemical plant. The local area has historically been home to large industrial facilities including refineries, power plants, chemical plants, and factories. On CalEnviroScreen 3.0, Bay Point scores in the 99th highest percentile for asthma, the 94th highest percentile for unemployment, and the 87th highest percentile for both hazardous waste and housing burden. The railroad and nearby tidal marshes currently provide some level of flood risk reduction but may not be able to keep up with sea level rise. Affected areas may include the 150-acre Bay Point Regional Shoreline Park, the harbor, and 5 heavy industrial parcels located on Nichols Road on the bayward side of the Union Pacific and Burlington Northern Santa Fe rail lines. These parcels, owned by General Chemical West as part of the Bay Point Works, are within the current 100-year floodplain and are at risk from one to four feet of sea level rise.

Bay Point is situated in the Northern Waterfront Economic Development Initiative (NWEDI) study area (see below). As part of the NWEDI, Contra Costa County has allocated \$500,000 this year toward a number of economic development and site-specific studies. The passage of Measures AA (Restoration Authority) and WW (East Bay Regional Park District) provide opportunities to leverage state grant funds that favor disadvantaged communities such as Bay Point.

Bay Point has very high poverty rates, with 31.9% of the population at or below 100% of the Federal Poverty Rate; in some census tracts there are as many as 59% of the population under 200% of the Federal Poverty Rate. As of December 2016, 20% of Bay Point residents had no health insurance coverage. Bay Point has a higher rate of population who have not received a high school diploma than the County overall. Despite higher population growth over the last two decades than Contra Costa County overall, Bay Point has very little access to non-governmental social safety net services. A 2012 study by the Federal Reserve Bank showed that for every \$8 in social services available to a low-income person in West Contra Costa County, a low-income person had access to only \$1 in services.

# Rodeo

**County:** Contra Costa

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, lack of investment, crime and violence.

Rodeo is a census-designated place 4.6 square miles in size located in West Contra Costa County, on the shore of San Pablo Bay. The population was 8,679 in the 2010 census. Rodeo is along the Interstate 80 (I-80) corridor, immediately north of Hercules. It is surrounded by major roads, including Cummings Skyway on the northeast, State Route 4 on the southeast, and I-80, which bisects Rodeo from the southwest to the northeast. Rodeo was settled by Europeans in the early 1800s as an original part of the El Rancho del Pinole. Rodeo rebuilt itself after the 1906 earthquake, and became home during World War II to shipyard workers. Today, it is a residential community with bluffs overlooking the Bay. Downtown Rodeo is marked by a number of historic buildings, however the Downtown area is neither visually nor physically connected with the waterfront area, an important visual and economic resource.

The Adapting to Rising Tides study identified a number of challenges for Rodeo with rising sea levels. These include two rail lines running through Rodeo that are not designed as barriers, pipelines that are subject to flooding and groundwater intrusion, location close to the Hayward fault, 55 commercial parcels at risk of current or future flooding clustered in Downtown Rodeo along the major thoroughfares of Parker and San Pablo Avenues. The neighboring Phillips refinery is subject to flooding, as are residential and multi-family buildings in Rodeo and Rodeo Creek. Rodeo Creek receives only 5% of the funding necessary to perform channel maintenance, such as desilting, due to funding restrictions associated with Propositions 13 and 218. Because desilting is both expensive and difficult to permit, the last sediment removal effort was in the mid-1990s. As a result the channel now only conveys approximately the 15- to 20-year riverine flow, and the 2005/2006 New Year's Eve storm events almost caused overbank flooding. Many users of Rodeo's San Pablo Bay Trail are elderly or disabled, and low-income; therefore maintaining unobstructed access to the trail in the face of severe erosion is critical. The area includes neglected private property that has drawn graffiti and crime to the area, making park management difficult. Rodeo has 15% senior residents and 18% of the population is 14 years and under. Approximately 17% of residents do not have a high school degree, and 23% of the population has a Bachelor's degree or higher. 40% of Rodeo residents, both renters and owners, are housing cost burdened. Additionally, the majority of northwest Rodeo has greater than 30% of households that are very low income, housing cost burdened, and transportation cost burdened. Many of the lowest income individuals live in public housing in closest proximity to the neighboring refinery.

# MARIN COUNTY

## Santa Venetia/San Rafael

**County:** Marin

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, lack of affordable housing

The Santa Venetia neighborhood of San Rafael is in Marin County, wedged between the Gallinas Creek estuary and the scenic uplands of San Pedro Mountain and China Camp State Park. Its 1,600 households were built on tidal marshland that was drained and filled in 1914. Nine hundred households sit in a FEMA designated flood zone protected by two miles of levees, six pump stations, and a drainage system—all of which are not adequate to protect the community from the projected sea level rise. This site has more affordable homes than is typical of the rest of Marin County, given the history of flooding and the location of many homes that are below sea level. There are two apartment complexes serving low income and/or Section 8 tenants. There is a need to address sea level rise and outdated infrastructure. The area is near the Gallinas Creek estuary, a significant natural habitat for endangered species. This offers a unique design opportunity to safeguard a threatened neighborhood by combining cutting-edge engineering and modern watershed science to improve the estuary's natural mechanisms. Protecting the neighborhood by bolstering the creek's natural habitat will promote an ideal symbiosis and could serve as a model for a broader paradigm shift of working with nature as opposed to constraining nature. After above average rainfall during this past year, Santa Venetia has an immediate need to improve its levees. The greater watershed of Las Gallinas Creek is ripe for a rethinking of its biological and geomorphic functions, and its interactions with the human infrastructure. A breach of the levee system could displace the residents from over 900 households and impact the greater community of 1,600 single family homes, low-income housing complexes, and a complex for low income seniors and people with disabilities. The Las Gallinas Valley Sanitary District wastewater treatment ponds (currently serving 30,000 people and 2.9 million gallons of water) would also be at risk from a levee failure in the lower watershed, which could result in an untreated discharge of wastewater into the bay and a disruption of sewage treatment service. The tracks of the regional SMART train are also vulnerable to sea level rise through this area. Furthermore, Marin County faces a housing shortage on all fronts. The potential of having Santa Venetia reclaimed by the sea from a combination of wet winters and high tides, and sea level rise, would severely impact the County's already limited housing supply.

## Tiburon/Belvedere

**County:** Marin

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, inadequate educational systems, inadequate health systems

The City of Belvedere is a residential community situated between Richardson Bay and greater San Francisco Bay at the entrance to Raccoon Strait, and consisting of two former islands connected to the Tiburon peninsula by two causeways (Beach Road and San Rafael Avenue). These roads act as levees which enclose a lagoon, built out in the 1950s on seismically-sensitive fill. About 250 single family homes and about 100 rental units front the lagoon and about 100 additional homes front open water of the bays; many of these homes are built partially on pilings. Access to Belvedere is solely through Tiburon, which in turn is vulnerable to flooding, because it has a single main access artery to Hwy 101 (Tiburon Blvd), and a single two-lane alternate route, Paradise Drive, both subject to flooding. Weekday ferry service transports commuters from Tiburon to San Francisco. Belvedere has its own police department, but contracts with Tiburon for fire and medical emergency service. The cities share a water treatment facility, also located in Tiburon. Belvedere's location presents sea level rise resiliency challenges that many other shoreline communities face, not just in the San Francisco Bay Area, but worldwide such as Portofino, Italy, another coastal town where hillsides meet the rising sea. The potential vulnerabilities that threaten this site include flooding, sea level rise, storm surge and critical infrastructure. The most vulnerable buildings are hundreds of residential properties located on Belvedere lagoon, residences located directly above the Bay on Belvedere Island and Corinthian Island; government facilities including City Hall, the police station and the corporation yard; as well as parks and open spaces. Emergency services are accessed by only two roads, which are located on levees. FEMA has recently declined to certify the levees so the city is currently evaluating the integrity and sufficiency of its levee system, particularly as relates to storm surges and sea level rise, and is partnering with the California Department of Water Resources to accomplish this work.

Belvedere has a population of approximately 2,100 residents, of whom 30% are seniors 65 years or older. There are many families with small children, yet the only school within the city limits is a nursery school. All school age children attend the public schools in the Tiburon Reed School District or elsewhere. Government buildings, including police and public works headquarters are all within the floodplain. There is no hospital, medical service, emergency shelter, or fire department within the City. Beach Road and San Rafael Ave (atop the levees) are the only access arteries into and out of Belvedere. Critical infrastructure, including telecommunications, utilities and water, is largely undergrounded via these access points.

## Richardson's Bay

**County:** Marin

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, lack of affordable housing

Richardson's Bay is located in southern Marin County, extending from unincorporated northern Sausalito to the City of Mill Valley's shoreline to Shelter Bay. The area already floods due to a combination of rising tides and natural geography: steep upper hills draining to flat and sinking bay-filled lands. It includes Golden Gate Village in Marin City, Marin's only public housing for families with 297 units. The natural habitat includes areas of rich diversity from protected wetlands to deep and shallow waters, and a number of creeks that drain to the bay. Upper watershed lands include the Golden Gate National Recreation Area, Pt. Reyes National Seashore and the Mount Tamalpais State Park lands. Communities include: unincorporated Marin County in northern Sausalito, Tamalpais Valley, Almonte and Homestead Valley; the City of Mill Valley; and the multi-ethnic, economically disadvantaged community of Marin City. Flooding in the area from the bay's rising tides, creeks and stormwater drainage led to Highway 101 in Marin City closing for several hours after storms in December 2014, cutting off the community from jobs and necessary income, vital health and social services for vulnerable seniors, and creating a heightened sense of isolation and vulnerability. The Manzanita Park and Ride, located under Highway 101 on State Route One (Shoreline Highway) regularly shuts down with high tides that flood the regional park-and-ride with several feet of water. Recent flooding threatened the southern access to all of Mill Valley and the communities of West Marin. Several vulnerable populations are impacted and in Marin, with limited opportunities for new or affordable housing, the most vulnerable residents need to be protected. Marin City's 2,500 residents compose a vibrant, multi-ethnic, economically disadvantaged community with historic roots dating back to relocation from the South to join the WWII shipbuilding effort. The Redwoods houses seniors in independent, assisted living and skilled nursing units on 10 acres of shoreline. Waldo Point Harbor consists of several hundred floating homes residents including the Gates Cooperative, home to low-income residents and families. The recently completed sea level rise vulnerability assessment for Marin's shoreline identifies further and even more imminent risks to this reach: emergency response and access to those in need; transportation vulnerabilities (highways, roads, and transit including bus lines, ferries, and bike/pedestrian pathways); lost tax revenues for school districts, Mill Valley, and Marin County; property losses for home and business owners; and perhaps, most importantly, the threatened devastation of interconnected communities along the shoreline that live with water, but that with sea level rise will need a comprehensive solution to address local and regional issues.

# Romberg-Tiburon Center

**County:** Marin

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, lack of investment

The Romberg-Tiburon Center includes ½ mile of shoreline and associated tide land lots that were transformed by extensive filling and armoring to support US Navy operations (1904-1958). For 40 years, the site has been home to a university research center for marine and estuarine science, the only marine laboratory and aquatic research facility on SF Bay. Half the shoreline has critical infrastructure that relies on the integrity of a seawall, while the other half has failing seawall infrastructure and riprap. Almost half the site is undeveloped allowing for design possibilities that incorporate shoreline migration and connectivity with upland habitat. The site is also open to the public and has growing program of public engagement on topics related to coastal resiliency. These attributes provide a unique opportunity to amplify ongoing public engagement and education about resilient design concepts to a very diverse set of audiences through the entire lifecycle of the projects from design to inception and beyond.

Physical vulnerabilities that threaten this site include flooding, seismic activity, sea level rise, storm surge and critical infrastructure. This site and much of its critical infrastructure, including potentially historic buildings, are located on a filled and armored shoreline (seawalls and riprap). The armoring is failing in several places, exposing areas of fill that are highly vulnerable to catastrophic erosion. The former cove, filled and held in place by a seawall, is now a large concrete tarmac with a mix of public university facilities and historic structures. Most of the buildings on the site require some seismic retrofitting, some are no longer considered suitable for public occupancy. The site is currently served by a septic system but defunct wastewater treatment infrastructure remains on the shore from the days when the US Navy owned it.

Social vulnerabilities include: 1) the loss of SF Bay's only marine laboratory and aquatic research facility; 2) displacement and loss of three outstanding public institutions working on interdisciplinary research, education and environmental stewardship of SF Bay; 3) loss of unique opportunities for urban university students to conduct hands-on research in marine and estuarine sciences near their main campus and 4) loss of public access to SF Bay and its history. The Center is embedded in one of the wealthiest communities in the nation creating a confusing juxtaposition that often increases the social vulnerability of its programs. Without it, resources for socially vulnerable communities are less likely to be allocated to public institutions embedded in a community of high socioeconomic status.

# San Rafael Inner Canal District

**County:** Marin

**Risks:** sea level rise, storm surge and tidal flooding

The San Rafael shoreline and levees are diverse—with expansive areas vulnerable to projected sea level rise. There are number of large geographic areas of San Rafael that are at risk for flooding during storms and will be dramatically impacted by sea level rise. These geographic areas include valley floors, properties with low-lying elevations (some at sea level), and areas that are now filled and were once marshland. The Inner Canal (areas bordering the San Rafael Creek) is especially flood-prone and includes areas such as the Central San Rafael Basin and the southern portions of Downtown San Rafael extending from the San Rafael Canal/Creek westward.

This site encompasses complex ecological conditions: fragile wetlands, wildlife corridors and migratory corridors. It also include parklands, trails, and developed infill. Diverse communities abutting the Bay in this part of San Rafael: immigrants from Mexico, and Central America living in dense communities in the Canals and other low lying flood zones. Middle class and upper class people living in wealthier enclaves ringing the shoreline. Downtown San Rafael and surrounding businesses catering to a diverse population of local residents from those communities are in threatened areas. Civic organizations and activists are poised to be further engaged in cohesive, innovative efforts to respond creatively to the threats of storm surge, sea level rise and other environmental consequences of climate change. Public agencies are currently conducting research, developing long-range strategies, and collaborating to mobilize the community.

There are numerous areas of San Rafael that are prone to flooding and are within the two FEMA flood zones. Areas within the flood zone are near or border waterways. They are typically former diked baylands and marshlands encompassing low-lying areas that were filled in the last century and border the Bay. Projected sea level rise maps show the entire flood zones being inundated.

The dense immigrant communities living in the Canals are the most vulnerable. Pickleweed Park, at the edge of the bay is one of the hubs of community life. The buildings, streets, schools and public spaces in the residential community in the Canals, and downtown/industrial areas will all be impacted by sea level rise and increased flooding from storm surges and storm events.

## Mill Valley and Tam Junction

**County:** Marin

**Risks:** sea level rise, storm surge and tidal flooding, liquefaction, aging infrastructure

Mill Valley and Tam Junction are located in southern Marin County and its major resources include the Manzanita Park and Ride at the Hwy 101 overpass of the Shoreline Hwy and The Bay Trail.

Tam Junction is a multi-modal transit hub that serves a great number of residents, businesses, and visitors/tourists. It's one of the key gateways from San Francisco to southern Marin destinations and visa versa. In recent years, king tides and storm surges have been increasingly flooding the roadways, trails, sidewalks, and parking areas to such a degree that access must be restricted. This site is also home to unique geography and ecology, as it's in the intertidal zone between sensitive wetlands/estuary habitat and the Headlands, Muir Woods and other open spaces around Mt Tamalpais. The site represents a set of complex conditions which are replicated all across the nine county Bay Area: a bottleneck point of transportation infrastructure, a multi-modal intersection and aging infrastructure overlaid against sensitive habitat, rising bay waters, flooding creeks, unstable soils (landslides and liquefaction).

Vulnerabilities include potential isolation of multiple communities due to loss of infrastructure including loss of access to public transportation and alternative transportation for workers, which disproportionately affects lower-income community members. Other threats include pollution of waterways from combined sewer overflows, roadway surface runoff and other sources which enter both fresh and marine water systems, and may introduce toxins that can bioaccumulate in the food chain and water supply, ultimately impacting health. Because this is a multi-modal transit area, but mostly dominated by vehicular travel; there is an opportunity to improve access, ease and appeal of alternative transit modes to reduce VMTs, GHGs and local air pollution.

## Point Bonita to Point Lobos

**County:** Marin

**Risks:** sea level rise, storm surge and tidal flooding, earthquake, aging infrastructure

The Point Bonita to Point Lobos shoal area stretches from Marin to San Francisco. This shallow area allows for a single barrier to protect the entire bay. The Dutch designed North Sea project and Singapore's water reclamation efforts demonstrate a single barrage possibility for the area. It is important to note that increased hydrostatic pressure on surface and subsurface foundations along with large horizontal structures, such as, roads, runways, tennis courts could reduce structural integrity.

The area faces several threats: the San Andreas Fault runs parallel approximately 1 mile to the west and severe storms threaten the area. The barrage could act to reduce weather events by eliminating the concentration of forces generated by the narrowing, funnel effect of the Golden Gate.

This system allows the Bay to remain saline or become a freshwater reservoir with minimum modification. Locks keep shipping and related jobs viable. Bay ecology, accessibility and marine activities remain intact. The barrage could be designed as a roadway to west Marin, but Marin's reluctance to support growth may see this possibility as a negative.

## Central San Rafael Reach

**County:** Marin

**Risks:** sea level rise, storm surge and tidal flooding, insecure municipal finances

The site area, referred to as the Central San Rafael Reach, encompasses the low-lying valley floor of the Central San Rafael watershed. The valley is contained within hilly topography on its north and south sides. This area is most vulnerable to flooding and will be impacted by sea level rise. It extends from the East San Rafael shoreline westward, and through the San Rafael Creek, a navigable channel, to the edge of Downtown San Rafael. The low-lying area contains dense urban development including Marin County's largest concentration of commercial businesses, public services and its highest density residential neighborhood (Canal Neighborhood). It also includes the convergence of two major freeways (US 101 and Interstate I-580), SMART (a regional passenger railroad), and the service centers and facilities for major utilities (PG&E and Central Marin Sanitation Agency). San Rafael has a population of about 58,000 and its residents and businesses pay the largest cumulative annual flood insurance premiums of any jurisdiction in Marin County. This is due to the combined risk of maritime and fluvial flooding.

The site area is comprised of multiple diverse physical and geographic conditions that make it suitable for exploring a variety of creative adaptation design solutions. Conditions include a linear shoreline with a mix of filled lands and levees that vary in elevation, a closed landfill, a portion of the Bay Trail, expansive tidelands and mudflats outboard of the levee, a navigable creek/channel (San Rafael Creek) with a narrow mouth, inboard seasonal marshes and wetlands, and freshwater storm drainage ponds. Nearly all of the developed area is built on filled lands over bay mud within the FEMA Special Flood Hazard Zone A (100-year flood). The City's large vulnerable population, significant exposure of public and private assets at risk, and the County's largest cumulative flood insurance premiums offer the greatest potential in Marin County to demonstrate meaningful solutions. In addition, multiple community groups and stakeholders have been engaged by our nonprofit partners, Resilient Shore and Shore Up Marin, and are prepared to participate in the RbD Challenge.

A variety of languages are spoken in the Canal neighborhood, including Spanish, Vietnamese, and Mayan. Residents face the risk of permanent displacement resulting from a severe flood event and sea level rise. Characterized by apartment buildings mostly constructed in the 1960's it's built at elevations subject to flooding and inundation, most of the residential buildings constructed along the San Rafael Creek (The Canal) are not protected by seawalls or similar features.

## Rush Creek Marsh Wildlife Area

**County:** Marin

**Risks:** sea level rise, storm surge and tidal flooding

The Rush Creek Marsh Wildlife area, which is managed by the Department of Fish and Wildlife, is fed by a network of open channels and culverts from the Novato Downtown area that drain to this Marsh by a double 12 ft wide by 8 ft high reinforced concrete box culvert under US 101. From the Marsh, Rush Creek then drains into Black John Slough east of the city limits and then drains to Petaluma River. This lower portion of the Rush Creek is tidally influenced but an operated tide gate structure is located upstream of the confluence with Black John Slough. A Map is attached for clarity.

Localized flooding has occurred in the drainage ditches from Highway 101 junction, south to downtown area, Sweetser Avenue and along Olive Avenue. There are businesses along this stretch that have been affected by the flooding. New tide gate valve structure and pump station could mitigate the flooding at this area.

The potential vulnerabilities that threaten this site includes flooding due to a storm event and sea level rise, which would impact downtown area and result in the loss of property.

# Corte Madera

**County:** Marin

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, liquefaction

Corte Madera, particularly east of Highway 101, is a low lying area within the FEMA Special Flood Hazard Area. A portion of the site is protected by an existing levee while another portion of the site is open to San Francisco Bay and currently experiences tidal inundation during king tide events. The site was originally marsh land and was constructed over varying thicknesses of bay mud. The site continues to experience settlement and is in an area known to be susceptible to liquefaction.

The site contains a unique combination of physical vulnerability challenges as well as social vulnerability challenges. Physical deficiencies within the site need to be addressed in the near future considering the site already experiences inundation during king tides. The site contains an array of residences, businesses, public safety facilities, public infrastructure, several schools and an arterial street that connects these elements.

Physically, the site is partially protected by an approximate one mile long levee that has started to sag in several sections due to settlement. In addition, the levee was constructed over 60 years ago and was not originally designed to account for sea level rise. Another portion of the site is open to San Clemente Creek and San Francisco Bay and instead of being protected by a levee, this portion was originally designed higher in elevation to drain naturally; however, continued settlement has significantly lowered ground surface elevations such that in king tide events, some of the site is inundated by bay water. This past winter, a 10-year storm coupled with a king tide event, caused extensive inundation and the temporary closure of major streets.

Disruption in services due to frequent inundation would cause a significant hardship not only on Corte Madera, but surrounding communities as well, including public safety services, housing, schools, significant utility infrastructure, businesses, and transportation infrastructure.

# NAPA COUNTY

## South Napa County

**County:** Napa

**Risks:** sea level rise, storm surge and tidal flooding, lack of investment

The Carneros Region of Napa Valley in South Napa County has a unique location with 135+ homes and associated infrastructure, bracketed by the Napa River on one side and Mud Slough on the other side. The natural ecosystem has been preserved through decades of returning salt ponds to natural habitat for wildlife. Extensive community access for all of the activities mentioned above is available and there is potential to connect to regional Bay Area water and bike trails. Surrounded by water, the Edgerly Island and Ingersoll Tract homes have marshes and sloughs for miles behind the properties and the Napa River out front. Some of the levees that protect this area from tidal inundation are over 100 years old and are mostly privately owned. The Napa County Flood Control and Water Conservation District and the California Department of Fish & Wildlife own large tracts of land that could be further enhanced to create an aesthetically and environmentally beneficial estuarial/riparian buffer zone, with trails for walking, hiking, biking and running, while also providing more resilient flood protection. Napa Valley Marina and other ranch and vineyard properties are also adjacent and similarly threatened by rising tide levels.

This site offers an opportunity to develop flood protection strategies resilient to future flooding and sea level rise, combined with green spaces accessible to the broader surrounding communities. The homes and infrastructure in this area were not included in the greater city of Napa's award winning "Living River" flood project. Opportunities for restoration and flood protection include: (1) building upon the Living River design to include the homes and infrastructure within Napa County's southern tidal baylands to address sea level rise, (2) investigating and implementing project solutions which will be replicable for other Bay Area communities, (3) addressing community outreach and consensus building to strengthen resilience and mitigation planning to protect against future flooding and natural disasters. Because the community is in an area that is typically not on the radar for large scale public infrastructure investments, the potential for human and property endangerment and loss is ever present. There are risks to life, property, wildlife habitat and infrastructure. Some residents are retired and on fixed incomes – unable to afford to maintain their river front levees and would be devastated by loss or damage of their property, either a short-term loss or a permanent loss.

# COUNTY OF SAN FRANCISCO

## Mission Creek

**County:** San Francisco

**Risks:** sea level rise, storm surge and tidal flooding

Mission Creek/SOMA is a highly developed and quickly growing neighborhood in San Francisco. The creek and neighborhood have urban flooding issues that will be exacerbated by sea level rise. The neighborhood contains residential buildings, affordable housing, extensive commercial development, regional attractions like AT&T Park and the future Warriors Arena, and regional transportation infrastructure including Caltrain, I-280 and Muni lines. Flood risk in this area is severe and near-term. Solutions will need to account for urban flooding as well. In addition, there is public land in this area such as Port of San Francisco properties and parks. The many private landowners will make adaptation planning more difficult to coordinate. Coastal vulnerability, development and open space potential, and the timing of nearby investments in High Speed Rail, a sewer tunnel, housing and other urban development make an addition of a Super-Levee an attractive candidate.

Flood risk in this area comes from coastal flooding at the shoreline and along Mission Creek. Urban flooding problems and especially pertinent north of the creek and will likely worsen with sea level rise and inefficient water drainage due to higher volumes of water. Flooding could cause regional impacts if Caltrain or other transportation infrastructure were impacted.

SOMA is also home to a large concentration of the San Francisco's homeless population, low-income residents, and residents with a physical disability. Development in San Francisco is a key vulnerability due to affordability and displacement pressure. Example neighborhoods and developments that are vulnerable include The Hub neighborhood at Van Ness and Market and the Central SOMA area surrounding the 4th St transit corridor on two sides of the proposed boulevard due to the high risk of displacement that may follow upzoning of those land areas.

## Islais Creek

**County:** San Francisco

**Risks:** sea level rise, storm surge and tidal flooding, liquefaction, earthquake, aging infrastructure, lack of investment

Islais Creek, a waterway in southeastern San Francisco, is surrounded by industrial land uses, the city's biggest wastewater treatment plant, and Port of San Francisco maritime facilities. The creek borders Bayview/Hunters Point, a predominately African American neighborhood with high socioeconomic vulnerability. The site contains important public infrastructure including extensive stormwater/wastewater facilities and a transit maintenance yard. As the site is located on a creek, it is vulnerable to both coastal and riverine flooding. The pier site is located between Heron's Head Park and the mouth of Islais Creek and is an active industrial/maritime use area with approximately 50 acres of paved apron area. Various plants, cargo handling facilities, and a recycling facility are located in this area. Through a partnership between the Port of San Francisco and the Golden Gate Audubon Society, a constructed wetlands project has been implemented adjacent to the piers, which has successfully restored about 5 acres of tidal marsh. Physical vulnerabilities to address include flooding from storm surge and sea level rise, urban flash flooding from rainfall, seismic vulnerability, and liquefaction. The Port of San Francisco has a project to improve drainage in the area using vegetated swales and other green techniques. They are willing to remove some of the pavement from the site in order to create the swale areas, so long as necessary access can be maintained. Opportunities include managing drainage from a large paved area with expanded tidal wetlands and beneficial reuse of debris from previous disasters. Major pieces of public infrastructure are exposed to coastal and riverine flood risk including: Piers 80, 90, and 92; Cargo Way, the 280, Third Street and the Third Street Bridge; MUNI Facilities and light rail, and the Southeast Treatment Plant. Commercial land uses in the area provide important community services like the San Francisco Wholesale Produce Market that would otherwise find it difficult to operate in San Francisco.

Islais Creek brings together a complex coastal and riverine flooding problem with important industrial and infrastructure facilities in a disadvantaged neighborhood that has not benefited from extensive waterfront planning in the past. The site has both near and long term flood risk which makes designing for future resilience urgent, but there is room to consider creative and green solutions to flooding. Unemployment in the area is higher than other neighborhoods in San Francisco and many jobs have left the area due to decommissioning of industrial facilities. Community vulnerabilities should be addressed as well such as the higher concentration of low-income families and the fewer public transit and healthy food options.

## Fisherman's Wharf

**County:** San Francisco

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure

Fisherman's Wharf is an iconic San Francisco neighborhood with maritime history, extensive tourism businesses and related jobs, and shoreline recreation facilities. Millions of people visit Fisherman's Wharf each year from around the city, region, country and world. The site includes attractions such as Pier 39, Aquatic Park, the San Francisco Maritime National Historic Park and portions of the Bay Trail. This is an area that is precious to San Francisco and visitors. Adapting the site to future flooding while preserving its character will present an interesting design challenge and collaborative neighborhood process.

Public and private facilities are exposed to future flooding, including port marinas and finger piers; the Jefferson Street MUNI historic streetcars and buses; commercial, maritime, and residential uses; Pier 39 and Aquatic Park; and the North Point Wet Weather Treatment Facility. This site is adjacent to San Francisco's primary seawall, undergoing its own resilience project now. Portions of the site are already dilapidated and will be endangered by small amounts of sea level rise.

# Crissy Field

**County:** San Francisco

**Risks:** sea level rise, storm surge and tidal flooding

Crissy Field is within the Golden Gate National Recreation Area, along the northern waterfront of San Francisco. Crissy Field is a highly visible and well-used destination loved by local residents, recreational visitors, and tourists. Completed in 2001, the transformation of Crissy Field from former military airfield to acclaimed National Park has provided recreational and learning opportunities for Bay Area residents and visitors. Crissy Field is one of the few Federal properties adjacent to the San Francisco Bay and is managed by the National Park Service. It includes the 1.5 mile long, twenty-foot wide promenade trail, a segment of the Bay Trail that attracts over 1.2 million visitors each year who move through the various park landscapes. Various recreational opportunities are available to picnickers, beach visitors, runners, yacht club visitors, bike renters, and dog walkers. The waters are heavily used by board sailors and open water swimmers. Crissy Field is home to the Crissy Field Center at East Beach, which serves a diverse local youth population as a dynamic hub of youth engagement. With over fifteen years of experience and use, Crissy Field is in need of rejuvenation - some areas of the park are so well-used they are in need of repair; other areas have not reached the potential originally envisioned.

The potential physical vulnerabilities include sea level rise and climate change. Three feet of sea level rise at the 100 year flood event will impact trails, park facilities, buildings, and habitat. There are several historic buildings along Mason Street that include museums, park facilities, and commercial buildings. With greater Sea Level Rise the major roads and facilities will be affected.

## Fort Baker

**County:** San Francisco

**Risks:** sea level rise, storm surge and tidal flooding

Fort Baker is a 335 acre former U.S. Army post located immediately north of the Golden Gate Bridge. Managed by the National Park Service, the site consists of over 25 historic army buildings clustered around a main parade ground, a sheltered harbor protected by a jetty, a number of historic gun emplacements, and trails and forested areas climbing gently up from San Francisco Bay. Over the last twenty years the National Park Service, Golden Gate National Parks Conservancy, and other partners (Bay Area Discovery Museum, Cavallo Point, and US Coast Guard), have worked to preserve, restore, and rehabilitate the unique natural and cultural resources at Fort Baker.

The Fort Baker Master Plan and Final Environmental Impact Statement of 2001 and the later 2005 Cultural Landscape Plan recommended opportunities to enhance the Fort Baker Waterfront in order to serve a wide range of park visitors, community members, and future users to the National Park. The Fort Baker waterfront includes historic buildings and coastal open spaces at Horseshoe Cove that are in need of restoration, rehabilitation, and enhanced public access.

The National Park Service and Golden Gate National Parks Conservancy plans to initiate a waterfront planning process, which would offer improved recreational experiences and opportunities for programming and access that connect people to parks. The Resilient by Design process could inform shoreline restoration, the marina and sailing center, climate change adaptation, enhancement of natural ecological process, native plant revegetation, Bay Trail connections, stormwater management, and infrastructure improvements.

The potential physical vulnerabilities include sea level rise and climate change that could impact the park's cultural, natural, and visitor resources such as the historic fishing pier, bulkhead, marina and boat slips, breakwater, and U.S. Coast Guard station.

Fort Baker is part of the Golden Gate National Recreation Area, a National Park Service unit. Park units belong to everyone and the National Park Service seeks to be welcoming and inclusive to all. A goal of NPS is to better serve underrepresented and disadvantaged communities. Future ferry transit opportunities could increase transportation and public access to Fort Baker and help diversify visitation to this iconic site.

## Treasure Island/Yerba Buena Island

**County:** San Francisco

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure

Treasure Island and Yerba Buena Island are located in the middle of San Francisco Bay between Oakland and San Francisco. There is currently a proposal for a Treasure Island redevelopment project that could include new sewer collection, new wastewater treatment and new water recycling infrastructure in addition to housing, retail, and commercial spaces.

Currently, the islands use conventional gravity sewer collection but a Final Environmental Impact Report (FEIR) concluded that conventional gravity sewers may be less than ideal for the location given risk associated with sea level rise which will raise groundwater elevations over time. Gravity sewers inherently leak, and leakage rates increase with age. The infiltration of saline groundwater into the system will degrade the recycled water quality produced by the onsite recycling plant. The FEIR states that reverse osmosis (RO) will be used any recycled water not discharged to the bay for turf and landscape irrigation, and potentially toilet flushing. In addition to challenges in drainage posed by sea level rise, the TI site is classified as "Very High Liquefaction Susceptibility" by the USGS. One potential solution to reduce seismic risk is a pressure collection system where rigid pipelines, manholes, and pump stations are replaced with flexible pipeline material such as HDPE. The flexible pipelines are fuse welded, and do not use conventional bell and spigot couplings that can separate in seismic events. The pressure collection substantially reduces wet weather and high tide influence on sewer flows, risks that threaten a gravity collection system.

Social implications of the pressure sewer alternative is that on a long term basis, sewer and recycled water rates for residents of TI may be substantially lower relative to the alternative of conventional gravity sewers.

# SAN MATEO COUNTY

## San Bruno- Colma Creek, South SF

**County:** San Mateo

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, poverty

The San Bruno-Colma Creek Lower watershed is located in the cities of South San Francisco and San Bruno, north of the San Francisco International Airport (SFO) between Highway 101 and the San Francisco Bay. In addition to SFO, this area contains mix of land uses, including two rail stations (BART and Caltrain), industrial lands, commercial development, a large biotechnology company, substantial public infrastructure, residential neighborhoods that have been subject to severe flooding and habitat for threatened and endangered species. The site area also includes two major creeks, the San Bruno and Colma Creeks, which have overflowed their banks during high tides and storm events, and are vulnerable to increased flood risk with sea level rise. The total drainage area is approximately 15.8 square miles and is mostly developed. San Bruno Channel collects runoff from the City of San Bruno, a drainage area of approximately 4.5 square miles, which lies south of the Colma Creek drainage basin. The channel exits to the Bay through a tide gate structure.

This area has a number of assets that are at risk from sea level rise that are critical to the functioning of the region and is home to a number of socially vulnerable communities. The Bay shoreline in the San Bruno-Colma Creek Lower Watershed is largely unprotected from sea level rise. A number of studies to better understand the vulnerabilities within this area and its vicinity have been conducted; however, limited funding to study viable adaptation measures has been an issue. Flood risk to both SFO and the adjacent communities, the development east of the Caltrain tracks, was built on settling marshlands, the SamTrans bus depot, warehouses, office buildings, airport-related businesses, homeless shelter and residential neighborhoods, and parts of the Bay Area's regional Bay Trail providing pedestrian and bicycle connections require protection.

The area includes three relatively low income neighborhoods, with residents who cannot afford high deductible flood insurance. Specifically, the neighborhoods of Bel Air in San Bruno and Tanforan and Lindenville in South San Francisco constitute the most susceptible communities to increased coastal flooding due to sea-level rise. These populations also have a heightened vulnerability to sea level rise impacts due to demographic and socio-economic characteristics as nearly a quarter of the population falls below 200 percent of the federal poverty level.

# Burlingame Bayfront

**County:** San Mateo

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, insecure municipal finances

Burlingame's Bayfront is located between Highway 101 and the San Francisco Bay in Burlingame. The Bayfront runs about 2.5 miles long and contains recreation and open spaces, office buildings, restaurants, airport related businesses, a wastewater treatment plant, and a hotel corridor comprised of 12 major hotels. The Bay Area's regional Bay Trail extends along the Bayfront and provides pedestrian and bicycle connections to recreation areas along the Bay. The Bayfront is an important economic hub for Burlingame, the San Francisco International Airport (SFO), and the Bay Area. The Bayfront is separated from the rest of Burlingame by Highway 101 and is built on imported fill materials. The area is low lying and exposed to flood risks and sea level rise hazards. The Bayfront currently does not include any residential sites nor are any planned in the near future.

The Bayfront is vulnerable to flooding, sea level rise, storm surges, and damage to critical infrastructure. Existing scattered riprap floodwalls are not engineered, and provide only minimal protection. The area is vulnerable to storm surges and flooding and this past year's storm events resulted in first time floods at some of the hotel sites. San Mateo County prepared an asset vulnerability profile for Burlingame as part of the County's Sea Level Rise Vulnerability Assessment. The assessment found that sea level rise and flooding events could inundate Old Bayshore Highway and Airport Boulevard, the primary access routes to Bayfront businesses and SFO. Flooding would also impact Bayfront businesses and a wastewater treatment plant that services the cities of Burlingame and Hillsborough. Several recreation sites would be impacted including segments of the Bay Trail, Bayfront Park, and Bayside Park sports fields.

The Bayfront's hotel corridor contributes 35-40% of the City of Burlingame's annual budget via Transient Occupancy Tax payments. Any loss of Bayfront businesses and hotels would directly impact the City's budget and spending on city-wide programs. The hotels are also integral to the local and regional economy by providing lodging to support businesses, with occupancies typically highest during the workweek; and employing hundreds of people at multi-level positions.

## Cooley Landing/East Palo Alto

**County:** San Mateo

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, poverty, crime and violence, insecure municipal finances, lack of investment

Cooley Landing in East Palo Alto is managed by the City of East Palo Alto & the Grassroots Ecology nonprofit. It is right next to Ravenswood Preserve which is managed by Midpeninsula Regional Open Space District. The City of East Palo Alto is located in the southeast corner of San Mateo County and has a total land area of 2.6 square miles with a population of 28,155. Despite easy access and surrounding capital possibilities, East Palo Alto remains disadvantaged compared to neighboring cities in regards to economic stability due to historic discriminatory government policies. East Palo Alto is mostly residential with limited commercial land which a significant number of industrial business have contaminated the land. Over 20% of city land is categorized as a natural community or habitat, including northern coastal salt marsh, non-tidal diked salt marsh, brackish marsh, open water, non-native grasslands and riparian woodlands. Most of these are protected and located near the Bay Shoreline and along the San Francisquito Creek.

Physical threats include earthquakes and sea level rise. The city has a limited capacity and lack of resources to address urgent adaptation needs. With only one person working on environmental programs, the city doesn't have the ability and human resources to address urgent adaptation needs to protect the community. Without proper infrastructure to control water flow in natural disaster scenarios, increasing sea levels has increased the risk of flooding and coverage from storm surges and king tides. According to ABAG, 2015, sea level rise in East Palo Alto will diminish the capacity of the stormwater system to collect and discharge runoff due to higher tides and rising groundwater levels. Approximately 49% of the City is now covered under the FEMA regulated flood areas.

Cooley Landing is in the community of East Palo Alto, an area in the mid-peninsula area that has and continues to have disparities in affordable housing, income, safety, and resources. Because funding did not cover staffing of the Cooley Landing education center, community members are not able to access the space. Instead, it is rented out to tech companies for meetings. It is clear East Palo Alto could significantly benefit from a design solution that would seek to incorporate community needs and desires and hear their worries and fears. The community deserves to have more.

## Redwood Creek

**County:** San Mateo

**Risks:** sea level rise, storm surge and tidal flooding, shoreline erosion, aging infrastructure, earthquake

Redwood Creek runs from the Redwood City wetlands system from the San Francisco Bay to the heart of downtown Redwood City. The corridor surrounding the creek is around 65 acres, with an exposed portion running under Highway 101, Veterans Blvd., and into the densest part of the city. The creek continues underground and is an essential part of the city's flood and water management network.

Downtown Redwood City has experienced increased development after the adoption of the Downtown Precise Plan (DTPP) and is now a cultural and civic hub for the region. Redwood City and neighboring North Fair Oaks are home to some of the Bay Area's most vulnerable populations. There are multiple affordable housing developments either completed or being constructed in the area, along with commercial centers, expansion of Kaiser Redwood City Hospital, mixed use mid-rises, and heavy and light industry. Housing cost in the midst of these developments is an important issue to the residents of Redwood City.

With rising sea levels, much of the area around Redwood Creek is projected to be submerged after 3 ft of sea level rise, something predicted to happen within the next 20-40 years. The city has traditionally been very innovative in its planning solutions and is very open to green infrastructure. Redwood Creek provides a unique opportunity to connect the regionally vital wetlands with urban center, potentially using Measure RR funding to protect the regionally vital freeway corridor.

The potential vulnerabilities at this site include flooding from the bay, sea level rise, and storms as well as damage to infrastructure and development through earthquakes. Ecological damage is present further up the creek in the form of urban runoff, which could result in excessive nutrient deposit in the recently restored intertidal habitat. Erosion to the embankments is already present at the exposed portion within the urban setting, with this expected to increase with SLR.

The risks to housing, health centers, and affordable commercial services are all threatened by the physical risks associated with the site. As the social and cultural center of the area, flooding to restaurants, theaters, and public spaces could all be threatened.

## Sierra Point, Brisbane to Coyote Point, San Mateo

**County:** San Mateo

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, poverty, inadequate health systems

This site spans Sierra Point in Brisbane to Coyote Point in San Mateo. The reach is adjacent to the San Francisco International Airport (SFO) to the north, south and east. It consists of natural and/or non-engineered shorelines (not including the airport itself, or the engineered upstream creeks and associated tide gates and pump stations). The majority of the shoreline consists of bay fill originally built for the Bayshore Highway (US Highway 101), SFO and commercial businesses. The area includes seven cities and several unincorporated areas, including San Mateo, Millbrae, Burlingame, San Bruno, South San Francisco, Colma, and Brisbane. The land uses along the shoreline include a County Park, hotels, new development, industrial, and some residential development.

The Brisbane to Coyote Point shoreline is largely unprotected from sea level rise. The few engineered shoreline protections along the Bay in this area are limited and/or outdated. It will be difficult to protect, design or adapt one area of this shoreline without protecting the other areas of the shoreline. In addition, this shoreline is fundamental to the protection of SFO, the 7th busiest airport in the USA, one of the largest biotech industry centers in the USA, dozens of hotels, three key transportation corridors (Highway 101, BART and Caltrain), as well as habitat for endangered species. All of these assets are significant drivers for businesses in the Bay Area.

This area also contains habitat for threatened and endangered species as well as several relatively low income neighborhoods, with residents who may not be able to afford flood insurance, such as the Belle Air neighborhoods in San Bruno, the Bayside Manor neighborhood in Millbrae and the Lindenville and Tanforan neighborhood in South San Francisco. The median household income for the census tract which contains the neighborhoods in both San Bruno and South San Francisco is \$75,000 or less and nearly a quarter of more of the population falls below the 200% federal poverty level (FPL). Furthermore, 50% of more of the population in South San Francisco and San Bruno and 25% in Millbrae are rent burdened and thus spend 30% or more of their income on rent and other housing costs, which diverts wages away from important needs, such as health care and healthy food.

## Bair Island State Marine Park

**County:** San Mateo

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, shoreline erosion, lack of investment

The Bair Island State Marine Park is one of the few places where the US 101 comes adjacent to the San Francisco Bay. This site and its surrounding areas include the Bair Island State Marine Park, Bay Trail, Highway 101, the San Carlos Airport, and commercial and light industrial properties.

This site provides the characteristically complex combination of wetlands, transportation infrastructure, and private development, all at risk with rising sea levels and storm surges. This stretch of the Highway 101 corridor is considered to be a critical point for future flooding scenarios. The opportunities for creative funding opportunities, adaptive land management, and public access make this site ripe for innovation.

Erosion, seasonal and long term flooding, stormwater management, and pollution all pose risks to both the landowners of San Carlos, Redwood City, and the critical ecosystems of the state marine park.

The low lying areas at risk behind this stretch of the 101 have historically been the most disadvantaged in terms of access to public space, environmental justice, and socioeconomic inequalities. This site is key to the protection of the region's most vulnerable communities.

# Port of Redwood City

**County:** San Mateo

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, shifting macroeconomic trends

The Port of Redwood City sits on a peninsula surrounded by Redwood Creek to the NW and the Cargill development site to the SE with Seaport Blvd. serving as the core thoroughfare. The top of the peninsula has both the Seaport Office Park and the Cemex Office at its tip which has the closest access to the dredged channel accessing the SF Bay.

This site provides the unique opportunity to design for regional connectivity, creative use of dredge material, ecological restoration, and coastal resilience. Google has recently leased out the majority of the office space in hopes to create a ferry that would carry commuters from San Francisco and Oakland. While the port and potential ferry are important economic drivers for the area, the required dredging poses risks to the critical habitat ecosystems of which it is surrounded by. The opportunity to create a sustainable dredging practice could solve the importance of lost sediment in the bay waters, risking collapse of wetland systems with rapid sea level rise.

Erosion, flooding, dredging, and pollution are all physical threats to this site. In terms of social vulnerabilities, the Port has provided and continues to provide economic opportunities for the residents of Redwood City. The Port risks being compromised by both competing industry and environmental changes. The role of large tech companies in the region could be improved to better serve all residents of the region. The loss of the Pacific Shores Bayfront park is also a risk to those residents whose only access to the bay lies within the office park.

# SANTA CLARA COUNTY

## Palo Alto Baylands

**County:** Santa Clara

**Risks:** sea level rise, storm surge and tidal flooding

Bounded by Mountain View and East Palo Alto, the 1,940-acre Baylands Preserve is one of the largest tracts of undisturbed marshland remaining in the San Francisco Bay. Fifteen miles of multi-use trails provide access to a unique mixture of tidal and freshwater habitats.

The site has the potential to be to be much more actively used than as a place to walk, enjoy nature, and watch birds. There is access via a dock that could enable much richer engagement with the bay, both recreational and educational. The dock alone could support tourism and bay harvesting activity should the bay be restored to early 20th century conditions.

With only a few feet of sea rise, the site will largely be underwater. Flooding could force closure of the adjacent airport. It would eliminate access to nature for tens of thousands of residents from Palo Alto, East Palo Alto, Menlo Park, and Mountain View.

If flooded, many will lose access to nature which could affect their overall well-being. Some jobs would be lost as well as much revenue to the local area with the loss of airport and golf course fees.

# Alviso

**County:** Santa Clara

**Risks:** sea level rise, storm surge and tidal flooding, aging infrastructure, liquefaction

Alviso is a neighborhood in San José, Santa Clara County, California, and until 1968, it was an independent city of the same name. It is located approximately 1.5 miles (2.4 km) south of the town of Drawbridge, at the north end of San José where it meets the southern end of the San Francisco Bay and borders the cities of Milpitas, Sunnyvale, and Santa Clara. The Guadalupe River and Coyote Creek both end at Alviso, emptying into the Bay through Alviso Slough and Mud Slough. Alviso is the lowest point in the San Francisco Bay Area at 13 feet (4.0 m) below sea level and throughout the 20th Century, Alviso has been victim to severe flooding most recently in 1983 and 1995.

This area is in danger of sea rise and is home to many billions of dollars of infrastructure and assets including housing, Moffett Field and the NASA Ames Research Center, large business parks and huge companies like Google and Facebook, major wastewater treatment plants and freeways. Levees currently protect Alviso from small storms, but storm surge from the Bay during larger storms remains a threat. Between Coyote Creek and the Guadalupe River, fluvial floods are also an ongoing threat. The Bay's mud and alluvial soils pose a liquefaction threat during earthquakes due to Alviso's proximity to both the San Andreas and Hayward faults.

A potential opportunity exists as California State Parks is interested in partnering with San Jose or other municipality to enable a true multi use park bay-side on reclaimed land at the Santa Clara/San Jose wastewater treatment plant with paved walking and biking trails, dirt trails for off road electric bikes, BMX track, separate mountain and E-bike trails and other forms of active and passive recreation. The partnership could utilize state and federal funding for the environmental restoration and stewardship of the reclaimed plant land and to create and operate a world class park.

As with most disadvantaged communities, Alviso has been left behind in terms of its economic and social potential. Addressing the community's needs ways that are sustainable will help the address social vulnerabilities of the Alviso community.

## San Jose to Sunnyvale shoreline

**County:** Santa Clara

**Risks:** sea level rise, storm surge and tidal flooding

This shoreline in the South Bay from the cities of San Jose to Sunnyvale includes former salt ponds, tidal marsh areas, disconnected creeks running from upstream toward the Bay but stopping short through four artificial alignments and the Sunnyvale Water Pollution Control Plant. This area provides an important barrier to important infrastructure just inland as well as an important habitat for sensitive/special status plant and animal species.

Sea level rise, storm surge, critical infrastructure, and water quality are additional physical vulnerabilities of the area, which would impact critical infrastructure, transportation, and parks and recreation facilities. The site is the subject of numerous efforts in the planning phase with an overall emphasis on shoreline protection, habitat restoration (both tidal and fluvial), reverse osmosis concentrate management from the existing treatment plant, and potential wetland treatment options. Opportunities exist to create solutions to expand tidal restoration and horizontal levees and design channel modifications to flow to the Bay to allow for more freshwater and sediment movement.

# SOLANO COUNTY

## Mare Island

**County:** Solano

**Risks:** sea level rise, storm surge and tidal flooding, earthquake

The Waterfront District, Mare Island North, Independence Park and south of the Ferry Terminal compose the immediate site along Mare Island strait. These areas are especially valued for their open space for kite flying and other informal activities, as well as picnic spaces for families, playscapes for children, and public art or monuments with interpretive signage highlighting the City's proud military and maritime history. The Ferry Terminal is a major hub of transportation to San Francisco and the Service Club area operates as an open space available for festivals, events, and informal play. In the Northern Waterfront south of the Mare Island causeway, open space areas along Harbor Way provide a setting for recreation and possibly music and entertainment, as well as a visual amenity with interpretive features for scenic recreation. On the western side of Mare Strait, on Mare Island, a waterfront promenade extends from the Causeway north and south to the Historic Core Plaza and shipyard area. The southern and western portions of Mare Island offer an array of recreational opportunities, including a 188-acre Regional Park, a 26-acre Community Park, and an 18-hole golf course.

Based on the National Research Council's mid-range Pacific coast sea level rise projections, Climate Central, predictions show nearly 3 feet of sea rise from a 1992 baseline. There is a very high certainty that there will be at least one flood that exceeds 6 feet in the future which would expose the downtown area, the Ferry terminal, the yacht clubs and Mare Island to significant flooding. This would have an impact on the local population, property and roads and overwhelm the storm water and sanitation district. Vallejo is ranked in the top 5 of cities in California of cities with percentage of homes exposed in a flooding event and the highest observed flood in this area was in 1983, 3.05 feet.

The potential vulnerabilities that threaten this site include flooding, seismic events, sea level rise, storm surge and critical infrastructure. The Vallejo Water, Sewer and Sanitation District and shipyards lie along the waterfront and would be impacted. This area houses a number of low income apartments and residents. In addition, as a major hub for transportation, it would remove the ability for many residents to travel without expending additional funds for finance.

## Highway 37, Vallejo

**County:** Solano

**Risks:** sea level rise, storm surge and fluvial flooding, earthquake

State Route 37 is a 21-mile roadway spanning the northern arc of San Pablo Bay and connecting four counties. It lies along the north end of San Pablo Bay and extends from Novato at the west end to Vallejo at the east end. Sometimes referred to as the “flyway highway”, the road passes through one of the most important sections of the Pacific Flyway for migrating birds, farm and ranch land, and public recreation. SR37 has become a major focus for local policy makers, transportation agencies and the public due to congestion and highway closure due to flooding at Novato Creek last winter. The Metropolitan Transportation Commission, working in partnership with a SR37 Policy Committee (consisting of the congestion management agencies of Solano, Sonoma, Marin and Napa), is currently examining widening and raising SR37 along its existing alignment. SR37 is unique in San Francisco Bay because the current land uses of farming, ranching, public wildlife areas and recreation have maintained the site’s open space character. Myriad federal, state, and private partners have invested hundreds of millions of dollars in restoring wetlands along this corridor from Hamilton Airfield to Napa Sonoma Marshes. These wetlands are a high priority for conservation, and provide countless ecosystem services from food production and nursery grounds to flood attenuation, and habitat for waterbirds, fish, and other wildlife.

Under existing conditions, sections of SR37 flood on the shoulder under high tide conditions. This is exacerbated by storm surges and fluvial flooding. Seismic activity is another vulnerability and the Napa earthquake resulted in four inches of movement along this corridor causing \$2 million in damage to the Skaggs Island bridge, just north of SR37. SR37 likely also experienced damage in the quake. These vulnerabilities are intensified by sea level rise.

Vallejo is a disadvantaged community and Vallejo residents commute to Marin and other bay area communities along SR37 daily. Typically, over 40,000 cars use this route daily, and it is becoming increasingly congested. When SR37 was closed for a short period last winter due to flooding and storm surge tides, alternate routes became choked with the additional commuters, and average commute times all over the region became much longer. This increases commuting cost to a community already in or on the edge of poverty and could result in displacement as the delicate financial balance that is sustaining the Vallejo community shifts.

## Benicia

**County:** Solano

**Risks:** sea level rise, storm surge and tidal flooding, shifting macroeconomic trends, lack of affordable housing

Lower Downtown Benicia includes a vibrant historic business community, nearly 2 miles of Carquinez Strait shoreline, infill residential communities, a marina, National Register listed historic structures such as Benicia Capitol State Historic Park and the Benicia Southern Pacific Depot, and a growing shoreline trail system that includes shared alignments of the San Francisco Bay Trail, Bay Area Ridge Trail, and Great California Delta Trail.

The site was once a densely developed industrial waterfront and dock for the train ferry that served the transcontinental railroad for 50 years. The downtown is now characterized by a mix of newer residential communities integrated with the historic business district. The site is at the nexus of the downtown Benicia Priority Development Area and the San Francisco Bay Trail Priority Conservation Area, as designated in Plan Bay Area. There is a unique opportunity to bring visitors to the edge of the bay system, supporting regional placemaking, economic development, and conservation goals..

The key physical vulnerabilities of this site are sea level rise and flooding, particularly during king tide storm events. The Carquinez Strait drains both the Sacramento and San Joaquin River watersheds, and Benicia's shoreline is vulnerable to both tidal impacts and storm flows. There is regular flooding in Lower Downtown Benicia, the Waterfront Park and adjacent streets, at the Marina, adjacent to an affordable senior trailer park community that has previously endured a significant flood event, and across several Bay/Ridge/Delta Trail segments. Flood mitigation in the form of green infrastructure and stormwater retention could be incorporated into publicly owned land and road right-of-ways.

Vulnerable assets include affordable and market rate housing, streets, trails, parks, and a wastewater treatment facility. Key social vulnerabilities include flood impacts and potential displacement of affordable senior housing and other residential communities. In addition, sea level rise could impact one of California's oldest business districts, close roads, parks, and trails at an increasing frequency, and threaten the community's sole wastewater facility.