Adaptation Planning for the Bay Point Operational Landscape Unit

PREPARED BY
San Francisco Estuary Institute

FUNDED BY
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COVER IMAGE

Bay Point Regional Shoreline, photo by Ellen Plane (SFEI).

CONTENTS

1. Introduction

PLANNING AT THE OPERATIONAL LANDSCAPE UNIT SCALE

Operational Landscape Units (OLUs) are a practical way to manage the physical and jurisdictional complexity of shoreline adaptation. Given the diverse uses and conditions of San Francisco Bay's 400-mile shoreline, a framework is needed to guide development of adaptation strategies appropriate to the specific conditions of each shoreline segment. OLUs, delineated for the San Francisco Bay in the *SF Bay Shoreline Adaptation Atlas* (SFEI and SPUR 2019), share common physical characteristics and therefore can benefit from being managed as individual units (Figure 1). OLUs cross traditional jurisdictional boundaries (e.g., cities, counties), and instead follow the boundaries of natural processes like tides, waves, and sediment movement. By planning at the OLU scale, it is possible to prioritize adaptation strategies that yield multiple benefits to people and wildlife, including reducing flood risks, establishing wildlife habitat, creating recreational shoreline access, and saving money in the long term (SFEI and SPUR 2019). Coordinated OLU planning can help avoid unintended impacts on neighboring locales and identify synergies to make use of limited resources in a more efficient manner.

OLU-scale planning is a regional goal for sea level rise (SLR) adaptation in San Francisco Bay. Bay Adapt Draft Implementation Framework Task 8.2 is to "encourage collaboration among people doing projects in the same area." The task suggests formalizing organizations at the OLU scale to accelerate funding, development, and construction in places spanning jurisdictions. According to the Bay Adapt framework, planning at the OLU scale allows for coordinated action to achieve better project outcomes, inclusion of community based organizations from the outset, and regional coordination linking together efforts at the OLU scale.

Successful cross-jurisdictional collaborations for SLR adaptation planning in San Francisco Bay to date include the Hayward Area Shoreline Planning Agency Joint Powers Authority, the Sunnyvale Shoreline Resilience Vision, the San Mateo Flood and Sea Level Rise Resiliency District, Resilient SR37, and the San Francisquito Creek JPA.

PURPOSE OF THIS DOCUMENT

This document is not a vision or an adaptation plan, but rather is meant to catalyze discussion and offer resources around nature-based opportunities for SLR adaptation along Bay Point's shoreline. The engagement and leadership of community-based stakeholders is key to the success of any adaptation planning effort, especially around issues as long-term and far-reaching as SLR and associated storm and tidal flooding. Without transparency and intentional community engagement throughout the planning process, opportunities for creative solutions will surely be missed and might lead to new problems or exacerbate existing ones disproportionately felt by low-income communities and communities of color. At the time this memo was written, there was not an active SLR adaptation working group or equivalent effort happening along the Bay Point shoreline. Consequently, the intent of this memo is to offer useful resources and ideas to support meaningful dialogue among stakeholders about shoreline adaptation planning.

The Bay Point OLU study area is a mix of open space and developed areas at the mouth of the Sacramento and San Joaquin rivers, where the Delta meets the San Francisco Bay. The Bay Point OLU comprises unincorporated land known as Bay Point, a census-designated place within Contra

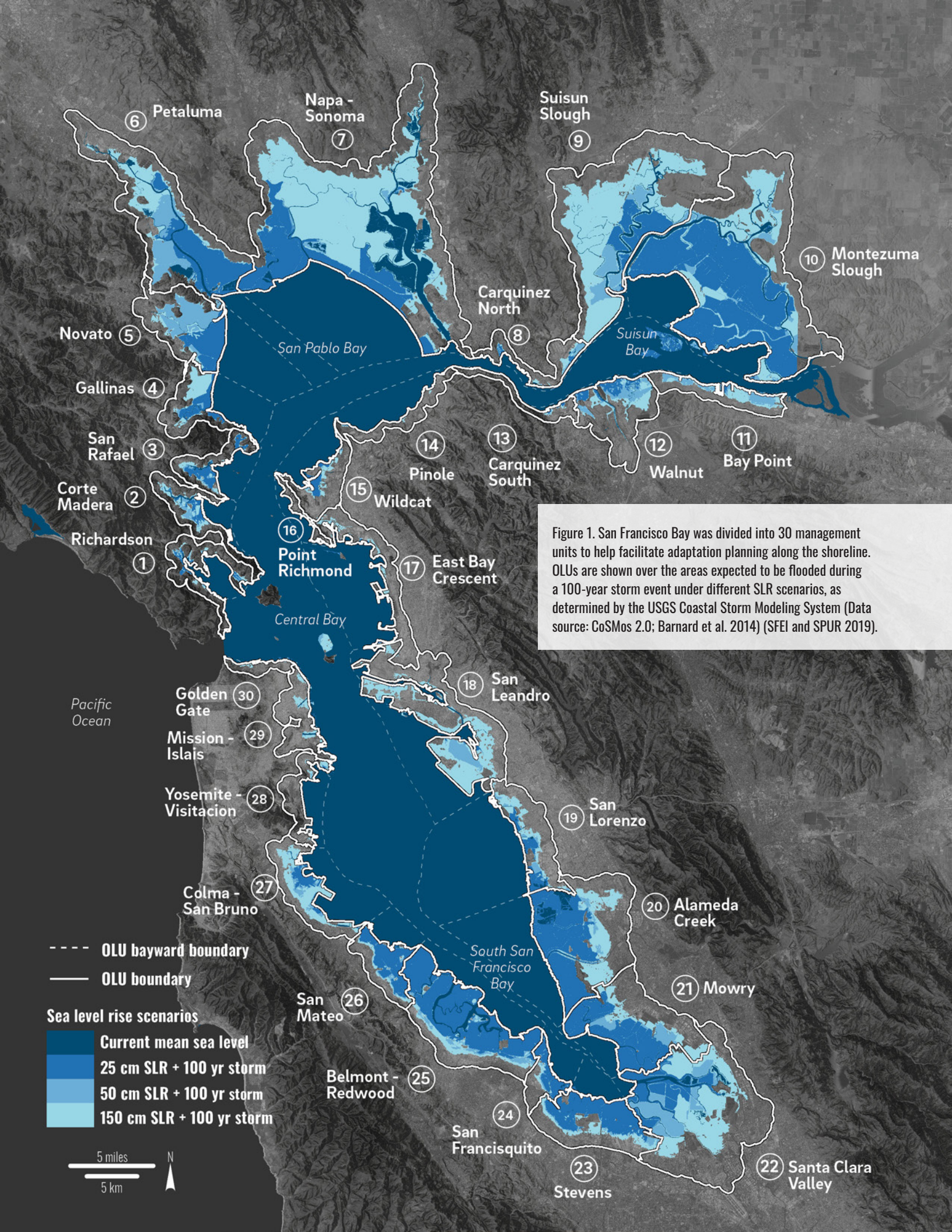
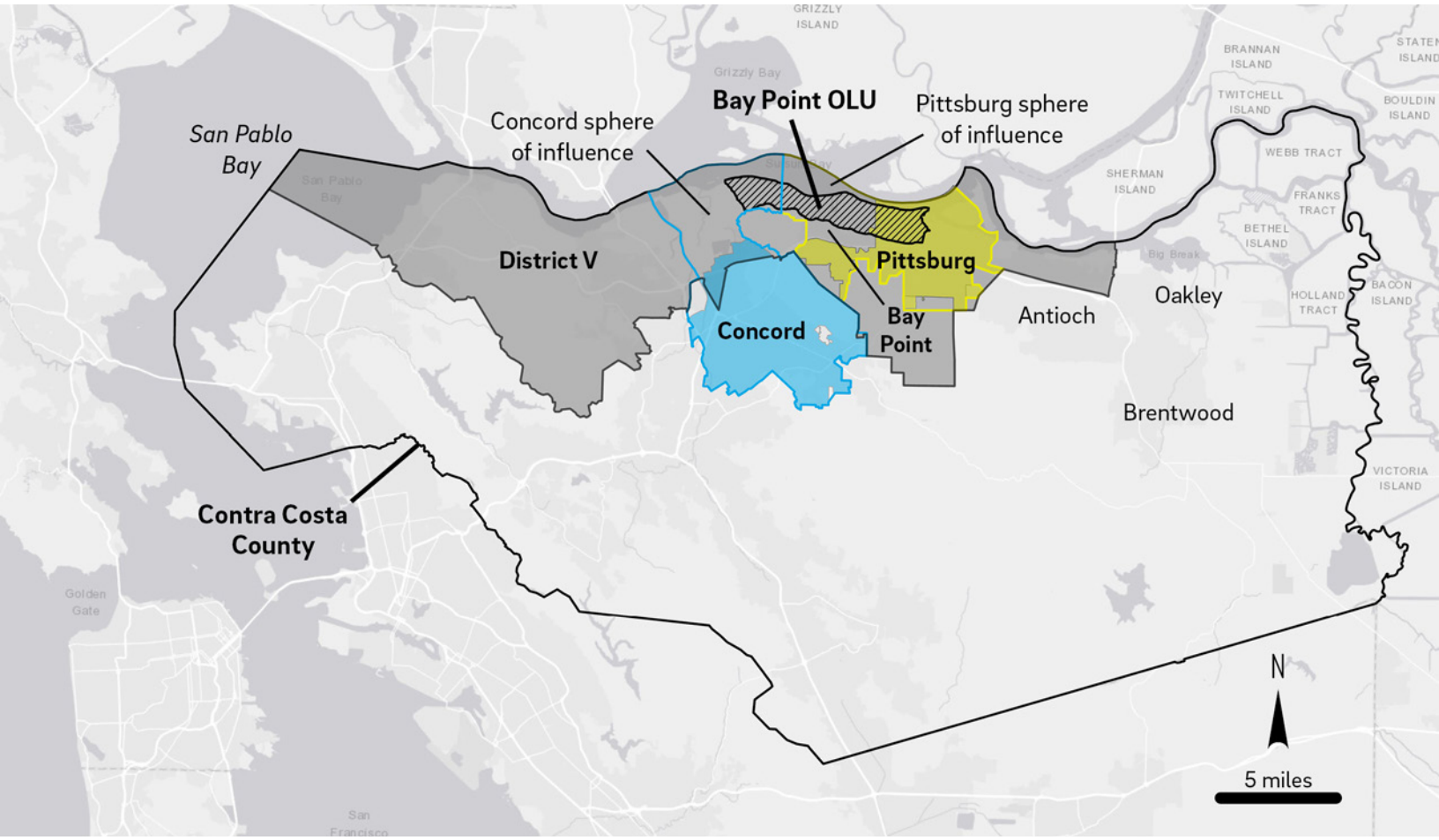


Figure 1. San Francisco Bay was divided into 30 management units to help facilitate adaptation planning along the shoreline. OLUs are shown over the areas expected to be flooded during a 100-year storm event under different SLR scenarios, as determined by the USGS Coastal Storm Modeling System (Data source: CoSMos 2.0; Barnard et al. 2014) (SFEI and SPUR 2019).

Costa County, the City of Pittsburg, the spheres of influence of Pittsburg and Concord, and District V of Contra Costa County (Figure 2). Chapter 2 examines how Bay Point's landscape has changed over time and Chapter 3 summarizes some of the vulnerability studies, habitat goals, and adaptation plans that have been developed for the study area. Chapter 4 offers more in-depth descriptions of the Bay Point OLU along with detailed maps that can be used to kick start SLR adaptation planning with a stakeholder working group along this reach of shoreline. Chapter 5 concludes with conceptual ideas that may be appropriate for different reaches of the shoreline, as a menu of possibilities to be further developed through a stakeholder process. Chapter 6 suggests ideas on next steps needed to move this work forward and offers a list of potential stakeholders as a starting place towards an adaptation working group to identify, evaluate, and prioritize adaptation strategies to manage flood risks along Bay Point's shoreline.

Figure 2. The Bay Point OLU comprises the city of Pittsburg, Bay Point (an unincorporated census-designated place), the spheres of influence of Concord and Pittsburg, and District V of Contra Costa County (Data Source: CCC 2022).

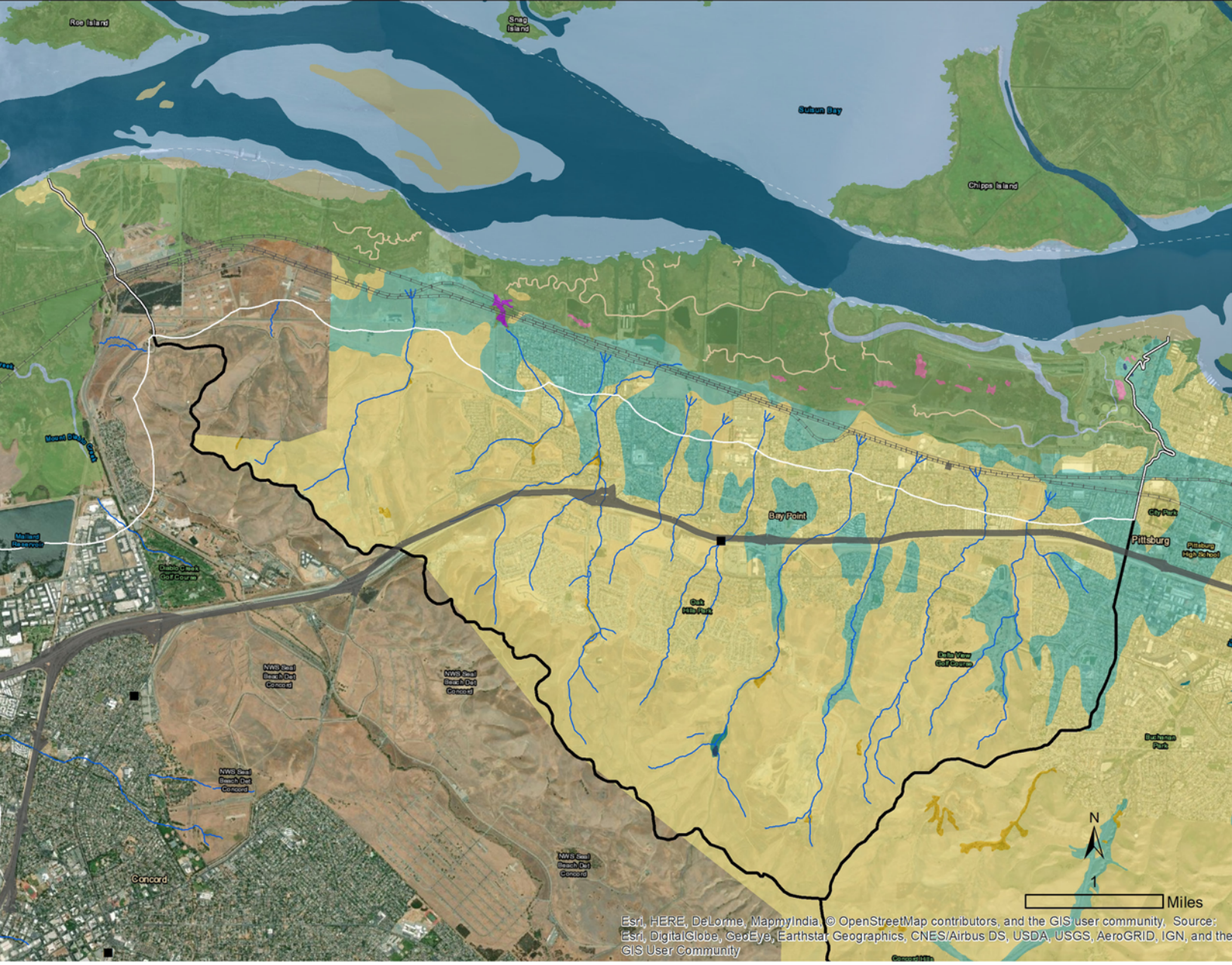


2. Landscape change

The landscape in the study area has changed considerably since the 19th century to make way for development. Most of the creeks that drain Willow Creek and adjacent watersheds were historically discontinuous, typical of many smaller systems across the San Francisco Bay Area (Figure 3) (Stanford et al. 2011). Rather than maintaining well-defined discrete channels into tidal marsh, the creeks terminated into seasonally wet alkali meadows or grasslands, transporting freshwater, nutrients, and sediment onto flat alluvial plains (Stanford et al. 2011). Tidal marsh over three-quarters of a mile wide stretched continuously along this reach of shoreline, with salt flats interspersed in areas of high marsh plain subject to less frequent inundation (Stanford et al. 2011). Although the creeks in this region terminated before reaching marshlands except during very large flood events, these habitats maintained seasonal surface water connections with marshlands during periods of high flows, likely creating intermittent habitat for fish (Stanford et al. 2011). Tidal flats were limited in this area due to the proximity to the deep water channel maintained by outflows from the mouth of the Sacramento-San Joaquin Delta. The marshes along this shoreline were supported by tidal action from both the San Francisco Bay and the Delta, transporting fine sediment, freshwater, and nutrients into the marshlands during flood tides and scouring the channel network during ebb tides.

Throughout the late 1800s and early 1900s, large portions of marsh in the eastern and western portions of the study area were diked, drained, and filled to support heavy industry along the shoreline as industrial development took hold (Figure 4). By 1908, after the completion of the railroad, many of the creeks draining the study area were straightened, leveed, and extended to convey floodwaters around development and into the Bay (Stanford et al. 2011). Around the 1930s, additional marshes were drained and diked as the U.S. military made way for Port Chicago, a naval base that provided critical support to the war efforts in the Pacific during World War II (see pg. 21 for more information on the historical significance of Port Chicago). Current development sites on bay fill (i.e. former marsh) include most of the development bayward of the rail lines, as shown in gray in Figure 4, which increases the vulnerability of these areas and any new developments on bay fill to future flooding.

Vulnerability to flooding comes from multiple sources, including SLR, storm surge, king tides, outflows from the Delta, and fluvial flooding from local creeks. At present, the railroad cuts through the middle of the study area, built at the upland edge of the historic marsh boundary. While the railroad alignment may be viewed as a line of defense from Bay-Delta flooding, it acts as a dam to stormwater flows by causing floodwaters to back up during periods of high flows along low-lying creek channels. Bayward of the railway, several marshes and low-lying diked baylands persist along Bay Point's shoreline today, all of which are vulnerable to SLR. The study area landward of the railroad is much less vulnerable to SLR since it slopes upland, with the exception of low-lying spots along creek channels and areas likely to be flooded as groundwater levels increase with rising sea level. More discussion and maps on future flooding considerations are provided in Chapter 4.



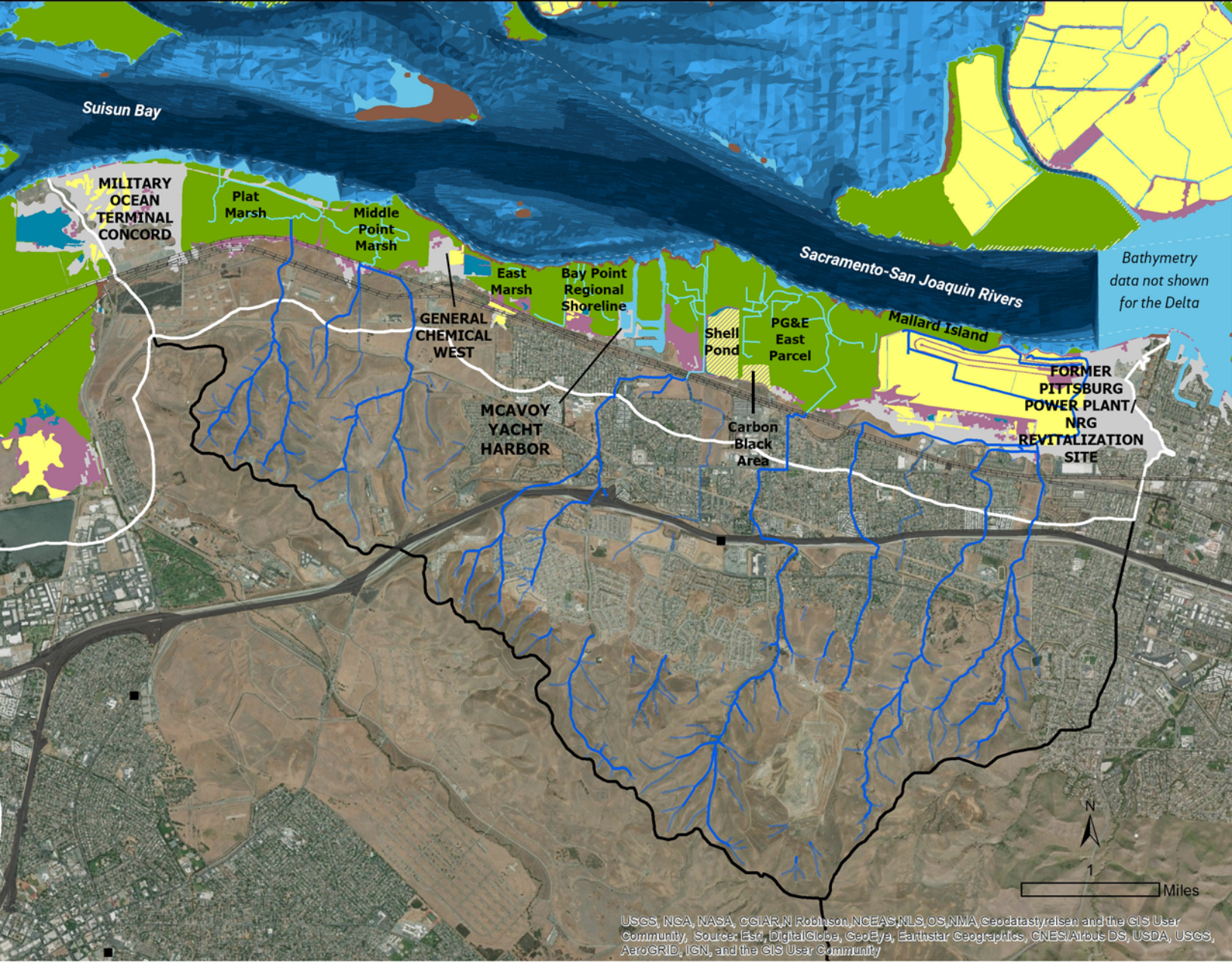
Legend

- Watershed boundary
- OLU boundary
- Creek
- Railway
- Road
- BART Station

Historical habitats (ca. 1800)

- Deep water
- Shallow water
- Tidal flat
- Marsh panne/salt flat
- Tidal marsh
- Lagoon
- Wet/alkali meadow
- Freshwater marsh
- Perennial pond/lake
- Grassland/savanna
- Oak woodland

Figure 3. Historical habitats in Willow Creek and adjacent watersheds prior to major Euro-American modification (ca. 1800) (Stanford et al. 2011).



Legend

- Watershed boundary
- OLU boundary
- OLU subtidal boundary
- Creek
- Railway
- Road
- BART Station

Bathymetry (ft, NAVD88)

- <29.5
- -29.5 to -18.0
- -18.0 to -4.9
- -4.9 to 0

Modern baylands

- Bay/channel
- Tidal flat
- Tidal marsh
- Managed pond
- Diked wetland
- Undeveloped areas
- Developed areas

Recently restored or planned restoration*

- Diked wetland

*Includes restoration sites that have been breached and area in the process of accreting to intertidal elevations

Figure 4. Modern day habitats and creek alignments in Willow Creek and adjacent watersheds (Data source: SFEI-ASC 2017).

3. Bay Point OLU in previous planning documents

VULNERABILITY STUDIES

Several baywide and county-specific studies have been conducted to evaluate the future impacts of SLR and climate change within Contra Costa County that overlap with the Bay Point OLU study area. Two recent and readily available studies created by Adapting to Rising Tides (ART) provide relevant vulnerability information to begin adaptation planning within the Bay Point OLU.

In 2014, the ART Program staff collaborated with local agencies, jurisdictions and organizations in Contra Costa County to identify vulnerabilities and consequences that shoreline communities face with respect to climate change and SLR. The analysis, described in *Contra Costa County Assessment and Adaptation Project* (BCDC 2017), assesses the stretch of shoreline from Richmond to Bay Point and approximately a half-mile inland from the 6ft sea-level-rise projection during mean higher high water (MHHW) to the closest major roadway or natural feature. The ART Adaptation Planning processes included an exposure analysis and detailed vulnerability assessment of numerous asset classes across several sectors (e.g., business and industry, parks and recreation, housing). The ART report provides a useful framework to consider the key issues of each asset class including exposure to flooding and other vulnerabilities in addition to the social, environmental, and economic consequences in the context of future flood risks. The ART report also highlights several specific public and private stakeholders located along Bay Point's shoreline (e.g., State Point-Mallard Island Marsh, McAvoy Yacht Harbor, Bay Point Works) and presents demographic information to understand important characteristics that could affect the residents of Bay Point's ability to prepare for, respond to, and recover from a flood event. A snapshot of flooding in Bay Point and Pittsburg with 3 ft SLR from the ART Bay Shoreline Flood Explorer is shown below (Figure 5), the majority of which is projected bayward of the rail lines within marshes, diked baylands, and bay fill.

In 2020, the ART Adaptation Planning process was employed for the rest of Contra Costa County not previously included in the 2014 study, through the *East Contra Costa County (ECC) Vulnerability Assessment & Adaptation Project*. The ECC Project assessed vulnerability and adaptation considerations for Pittsburg, Antioch, Oakley, and Brentwood (BCDC 2020).

Additionally, Balance Hydrologics conducted a stormwater assessment of Bay Point in 2017 as part of an examination of critical water quality and flood protection needs in underserved communities. The findings detail present-day flood control challenges within Bay Point throughout the Willow Creek watershed and suggest broad actions that can be taken to alleviate flooding. This effort resulted in the development of detailed stormwater models for Bay Point and recommendations on where to locate green stormwater infrastructure to reduce flooding in hard-hit communities. The report highlights the need for upgrades to culverts and other stormwater infrastructure throughout the study area (Balance Hydrologics 2017).

Another useful resource to understand the current industrial uses and opportunities throughout the study area is the *Contra Costa County Northern Waterfront Atlas* (2014). The CCC Northern Waterfront Atlas provides numerous maps detailing the flows of people, goods, and services along the northern shoreline of Contra Costa County, from Pinole to Oakley (DCD 2014). The Northern Waterfront Atlas also delineates the legislative and regulatory boundaries as well as the current land uses and industrial businesses along this stretch of shoreline.

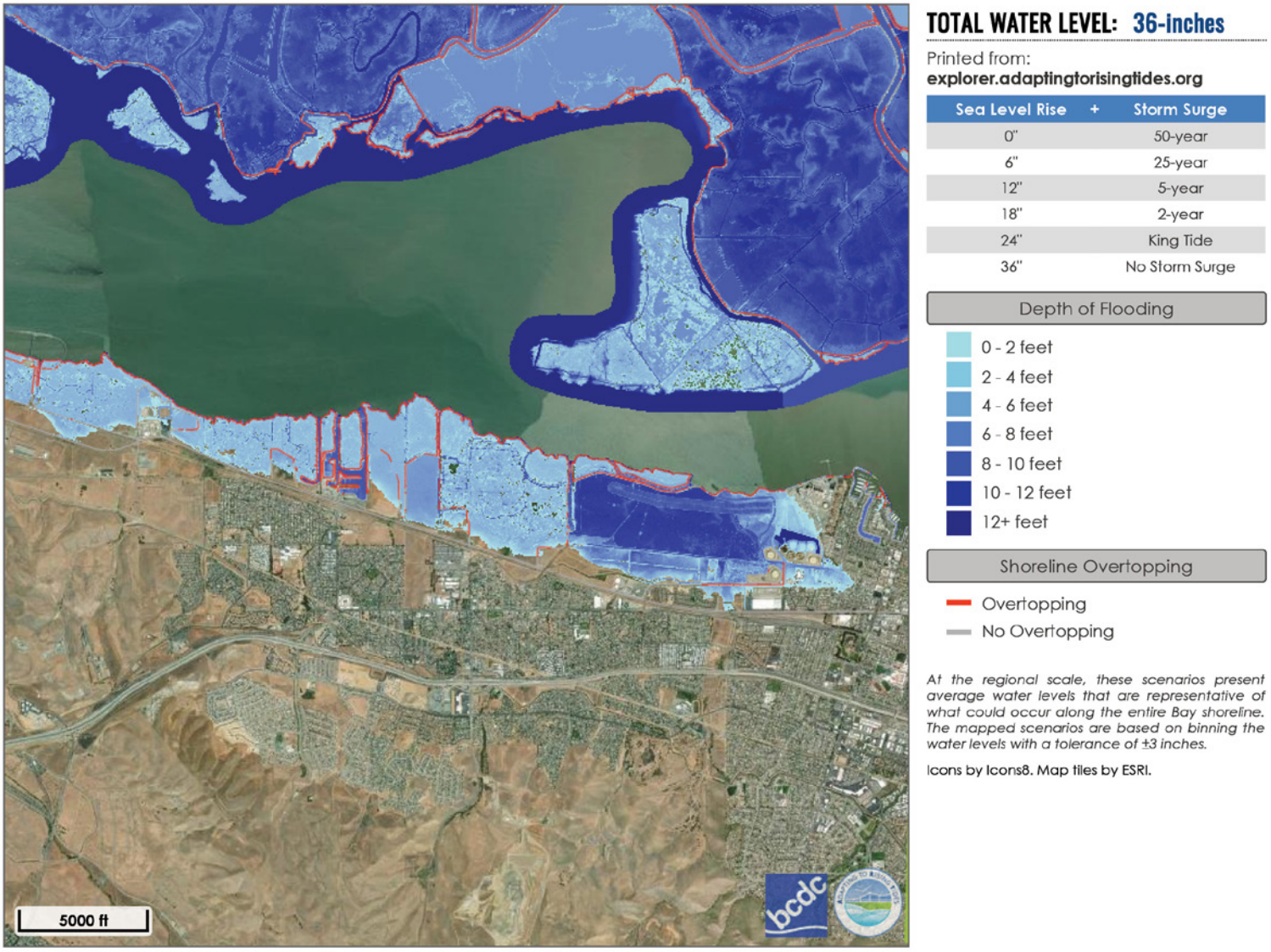


Figure 5. Flood projections of 36" of SLR along Bay Point's shoreline, as determined by the ART Bay Shoreline Flood Explorer (Vandever 2017).

SAN FRANCISCO BAY SHORELINE ADAPTATION ATLAS

Adaptation measures are specific interventions or ways to manage the shoreline in response to or in anticipation of climate change. Natural and nature-based measures are physical landscape features designed to evolve over time through the actions of environmental processes, such as the flow of water and sediment (PBCS et al. 2019). They can provide coastal protection and many other ecosystem services. They can include measures that are engineered to mimic characteristics of natural features. They can also be used in combination with conventional hard infrastructure (e.g. levees and seawalls) to develop hybrid, large-scale, multi-objective shoreline adaptation strategies (PBCS et al. 2019). The *San Francisco Bay Shoreline Adaptation Atlas* (Adaptation Atlas) defines and describes more than two dozen adaptation measures that are potentially appropriate to the Baylands OLUs (SFEI and SPUR 2019). Below is a summary of the adaptation measures described in the Adaptation Atlas for the Bay Point OLU.

Although the majority of Bay Point OLU's shoreline bayward of the railroad is open space, very little is publicly owned and protected. Bay Point's shoreline is dominated by a mix of industrial, commercial and military uses, with the exception of the 138 acres comprising the Bay Point Regional Shoreline. The Adaptation Atlas notes that there are several small areas suitable for tidal marsh restoration along the back edge of existing tidal marshes (Figure 6). The largest opportunity for tidal marsh restoration is within a diked pond (Shell Pond), but this site is currently undergoing remediation for legacy contamination (see pg. 22 for more information). Opportunities for marsh migration space as well as ecotone levees (i.e. gentle slopes bayward of flood risk management levees and landward of tidal marsh that provide wildlife and other benefits) along the backside of marshes also exist, albeit with limited extents.

A recent analysis conducted as an addendum to the Adaptation Atlas mapped 3.8 miles of additional shoreline as ecotone levee opportunity due to the need to protect rail lines, Superfund sites, and other shoreline developments from future flooding (Figure 7) (SFEI 2021). These additional ecotone levee opportunity areas are not a proposal of what should happen along this stretch of shoreline but rather highlights areas where ecotone levees may be suitable, which could be implemented in smaller sections if desired. Additionally, a large subsided area over 400 acres in size is located westward of the former Pittsburg Power Plant, comprising diked wetlands and deep cooling canals. If this area were to be acquired by the County or other public entity, reverse subsidence measures could help raise the elevation of this area before restoring it to tidal action to transition into tidal marsh. If left as diked wetlands without any management, this area will become more difficult to manage as sea level rises, due to continued subsidence, reduction in mineral sediment supply from the Delta, increasing summer salinity, and reduction in peat accretion. The proximity of the shoreline to deep channel within Suisun Bay and the low salinity levels leave little opportunity for subtidal measures, although there may be opportunities for subtidal management of native submerged aquatic vegetation such as *Stuckenia pectinata* to reduce erosion impacts along the shoreline when assessing opportunities at the project scale. In the upper watershed, green stormwater infrastructure could be implemented to reduce fluvial flooding in developed areas.

The Adaptation Atlas also suggests actions to facilitate adaptation in developed areas. Since limited development exists bayward of the rail corridor, a levee bayward of the existing rail alignment could provide flood protection to the commercial and residential communities upland of the rail line. For developed areas most at risk of SLR, building retrofits, site elevation, and road elevation could be suitable alternatives to relocation or voluntary buyouts, depending on community priorities. Since little of the open space in this OLU is publicly protected, public agencies could consider buying land or easements along the shoreline to prevent additional development in areas at high risk of future flooding.

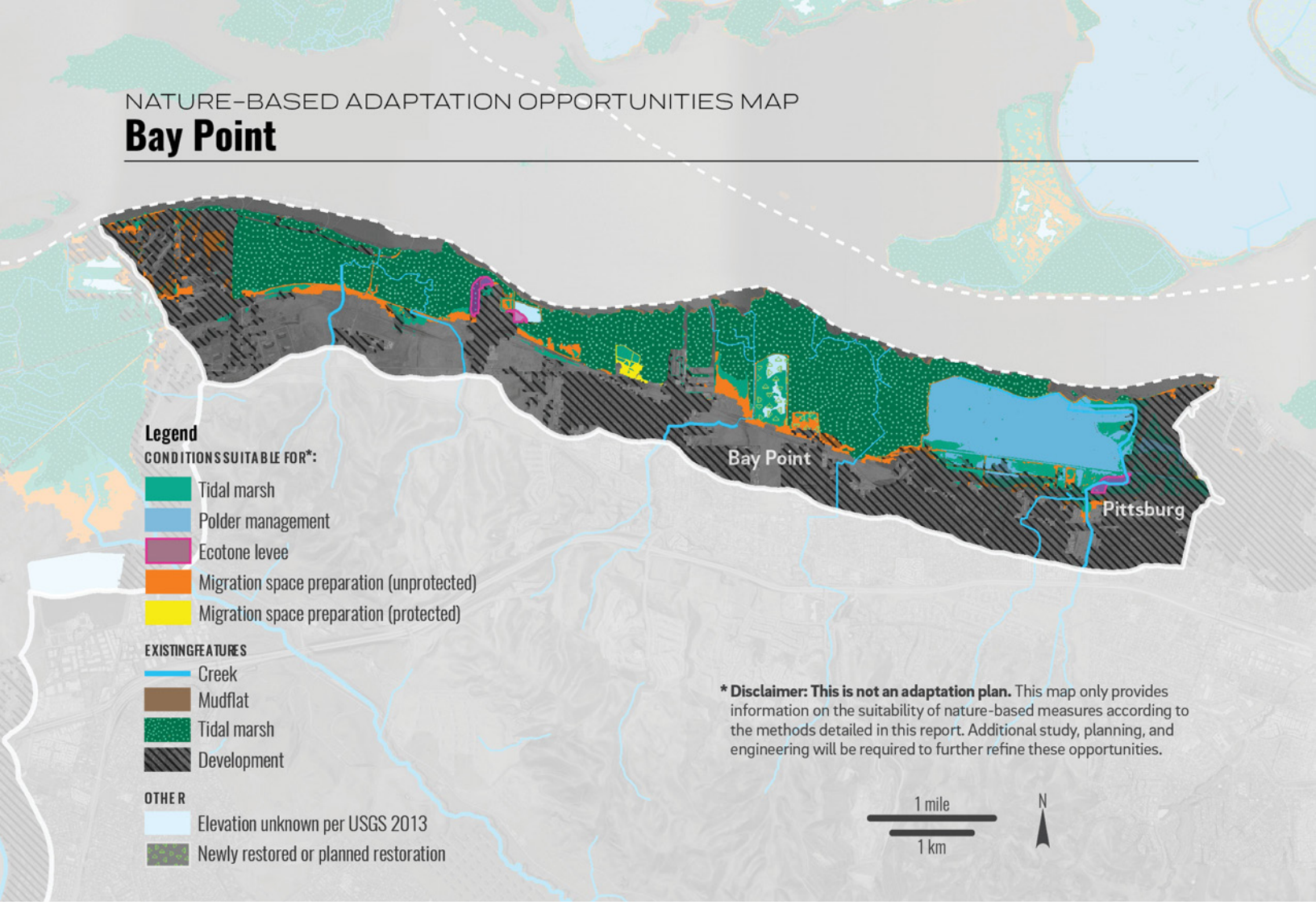


Figure 6. Opportunities for nature-based SLR adaptation in the Bay Point OLU as mapped in the San Francisco Bay Shoreline Adaptation Atlas (SFEI and SPUR 2019).

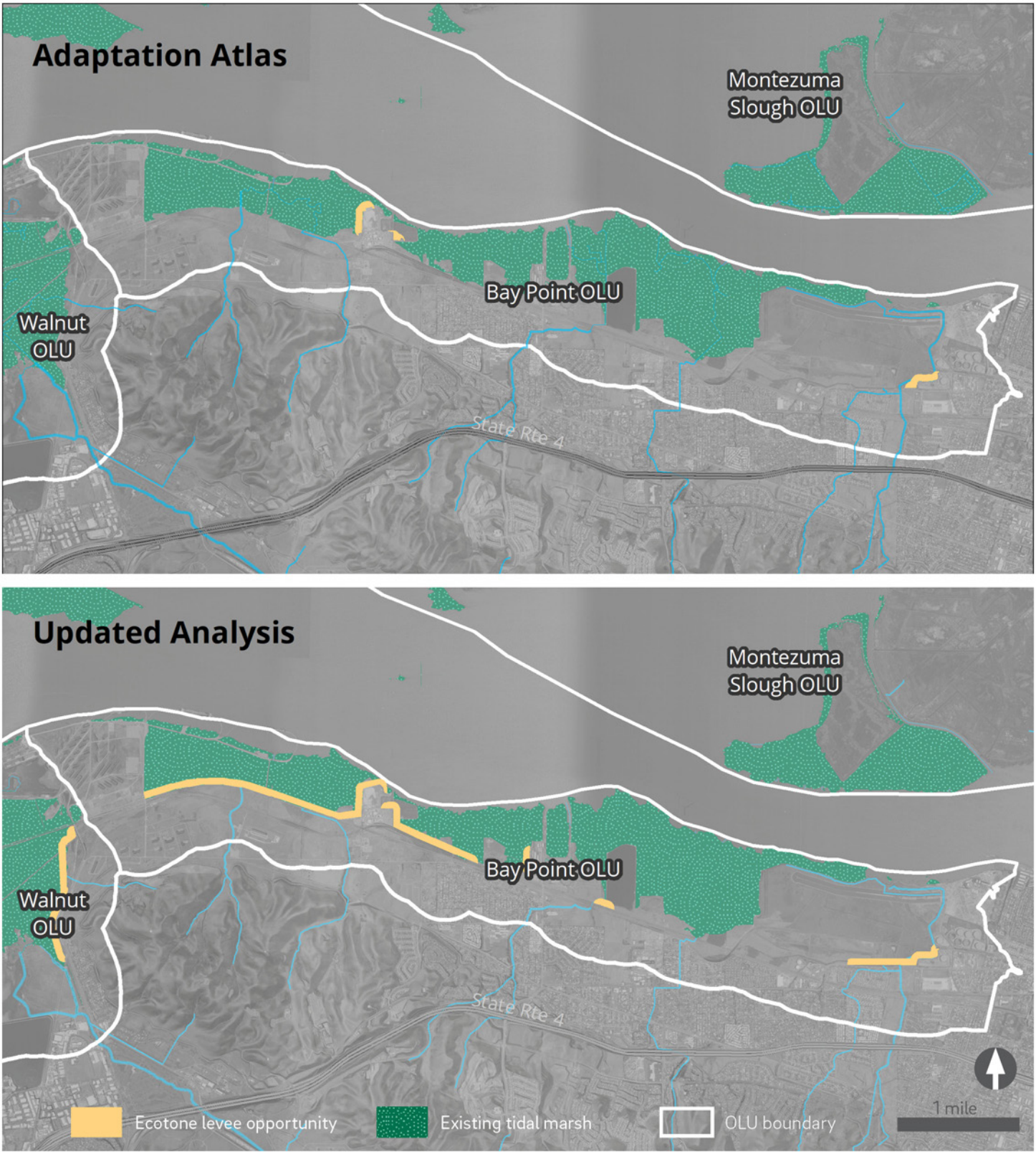


Figure 7. Additional opportunities for ecotone levees were mapped in the Bay Point OLU as an addendum to the Adaptation Atlas (SFEI 2021).

HABITAT CONSIDERATIONS

Although some of the tidal marshes have been diked and drained to make way for industrial and military uses, large areas of tidal marsh along the Bay Point OLU shoreline persist today (see Figure 4 on pg. 9). The *Baylands Ecosystem Habitat Goals Science Update* (Goals Project 2015) notes that some of these marshes may be home to significant populations of soft bird's-beak and salt marsh harvest mouse, two federally endangered species. Native eelgrass beds have been observed along this stretch of shoreline, specifically within Wharfs 2, 3, and 4 of the Military Ocean Terminal Concord (MOTCO) base. Based on environmental assessments within the tidal marshes at MOTCO, status species *potentially* occurring in the study area include the following (listed by type), with varying degrees of likelihood (MOTCO 2017):

- **Plants:** Soft Bird's-beak, Delta Mudwort, Mason's Lilaeopsis, Delta Tule Pea, Suisun Marsh Aster
- **Fish:** Delta Smelt, Sacramento Splittail, Longfin Smelt, Green Sturgeon, Central Valley Steelhead, Central California Coast Steelhead, Sacramento Chinook Salmon, Central Valley Chinook Salmon
- **Reptiles:** Northwestern Pond Turtle
- **Birds:** California Ridgway's Rail, California Black Rail, California Least Tern, San Francisco Common Yellowthroat, Suisun Song Sparrow, Loggerhead Shrike
- **Mammals:** Salt Marsh Harvest Mouse, Salt Marsh Wandering Shrew, Pacific Harbor Seal, California Sea Lion

The *Baylands Ecosystem Habitat Goals Science Update* specifies a number of priorities for habitat preservation and restoration in the context of climate change in the Bay Point OLU. These goals include acquiring and protecting open space bayward of flood-protection levees to create areas for existing marshes to migrate upslope to keep pace with SLR, or to implement ecotone levees, living shorelines, or other green infrastructure in this zone (Figure 8)(SFEI and SPUR 2019). Other important habitats to restore, protect and enhance include transition zones, riparian vegetation, historic pans, and native eelgrass beds (Goals Project 2015). A variety of species, including those listed above, would benefit from tidal marsh restoration/creation, marsh-upland transition zones enhancement/expansion, and improvements in riparian areas and subtidal aquatic vegetation. Management actions should aim to contain perennial pepperweed and eliminate populations in nearby marsh-upland transition areas, and implement aggressive measures to control invasive species like the yellow flag plant.

Another aspect of the addendum to the Adaptation Atlas was a wildlife connectivity analysis, to better understand the role of existing habitat patches in supporting vulnerable wildlife populations. A baywide assessment of the probability of connectivity resulted in the finding that the wetlands of Suisun Bay function as highly connected patches for salt marsh harvest mice across the contemporary landscape (Figure 9)(SFEI 2021). Genetically, the mice in the northern marshes of Suisun Bay behave as a single population, whereas populations along the Contra Costa shoreline are more distinct (SFEI 2021). The analysis indicates that the marshes in the Bay Point OLU, from MOTCO to Mallard Island, may be important for bridging these two subregions (SFEI 2021).

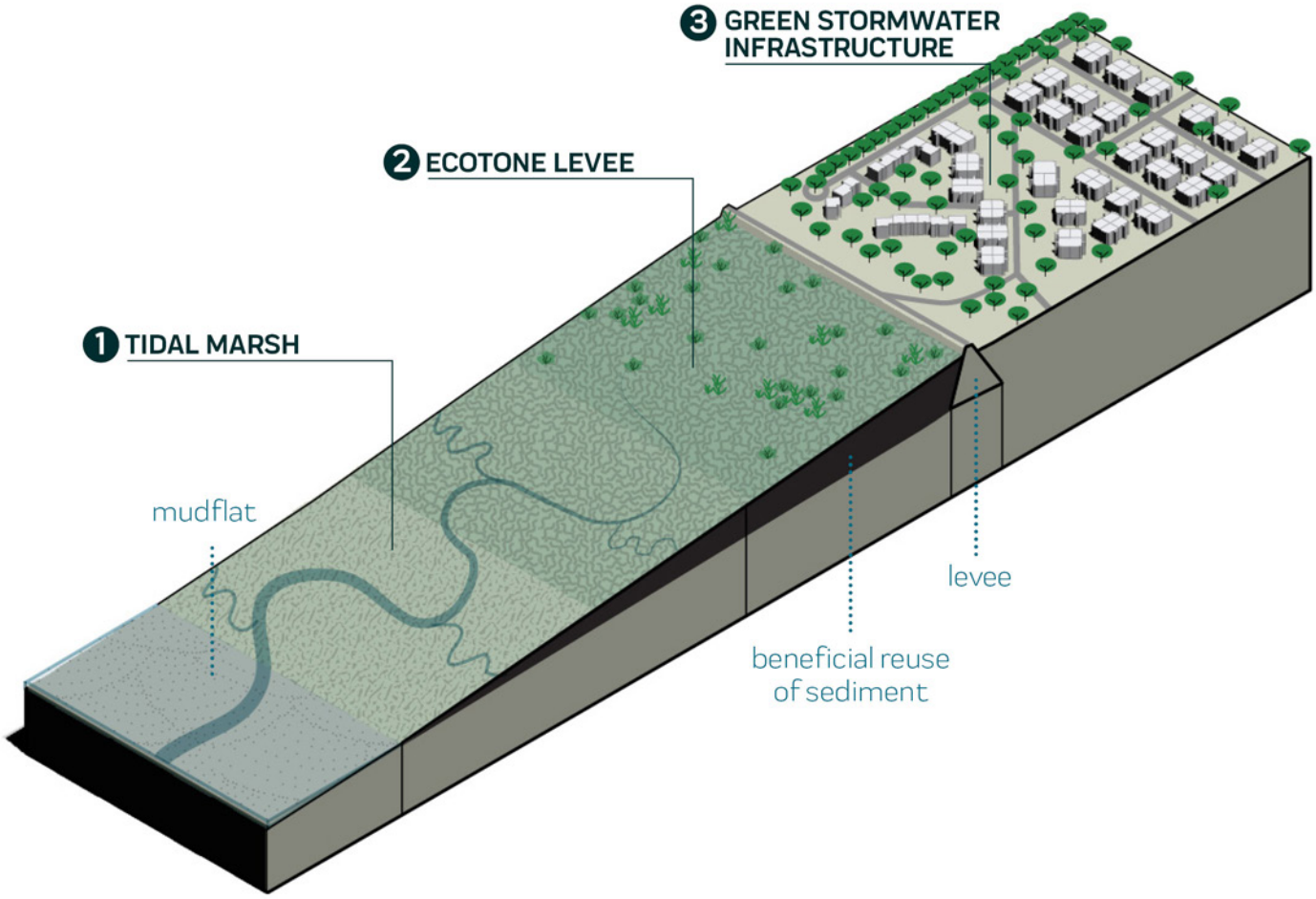


Figure 8. Conceptual diagram of multiple adaptation measures. In this conceptual example, a tidal marsh fronts a gently sloping ecotone levee which in the short term provides high-tide refuge for marsh wildlife, and in the long term provides space for marsh migration. Behind the flood risk levee at the back of the ecotone levee, green infrastructure is helpful for spreading and sinking runoff, and lowering peak flows (courtesy of SFEI and SPUR 2019).

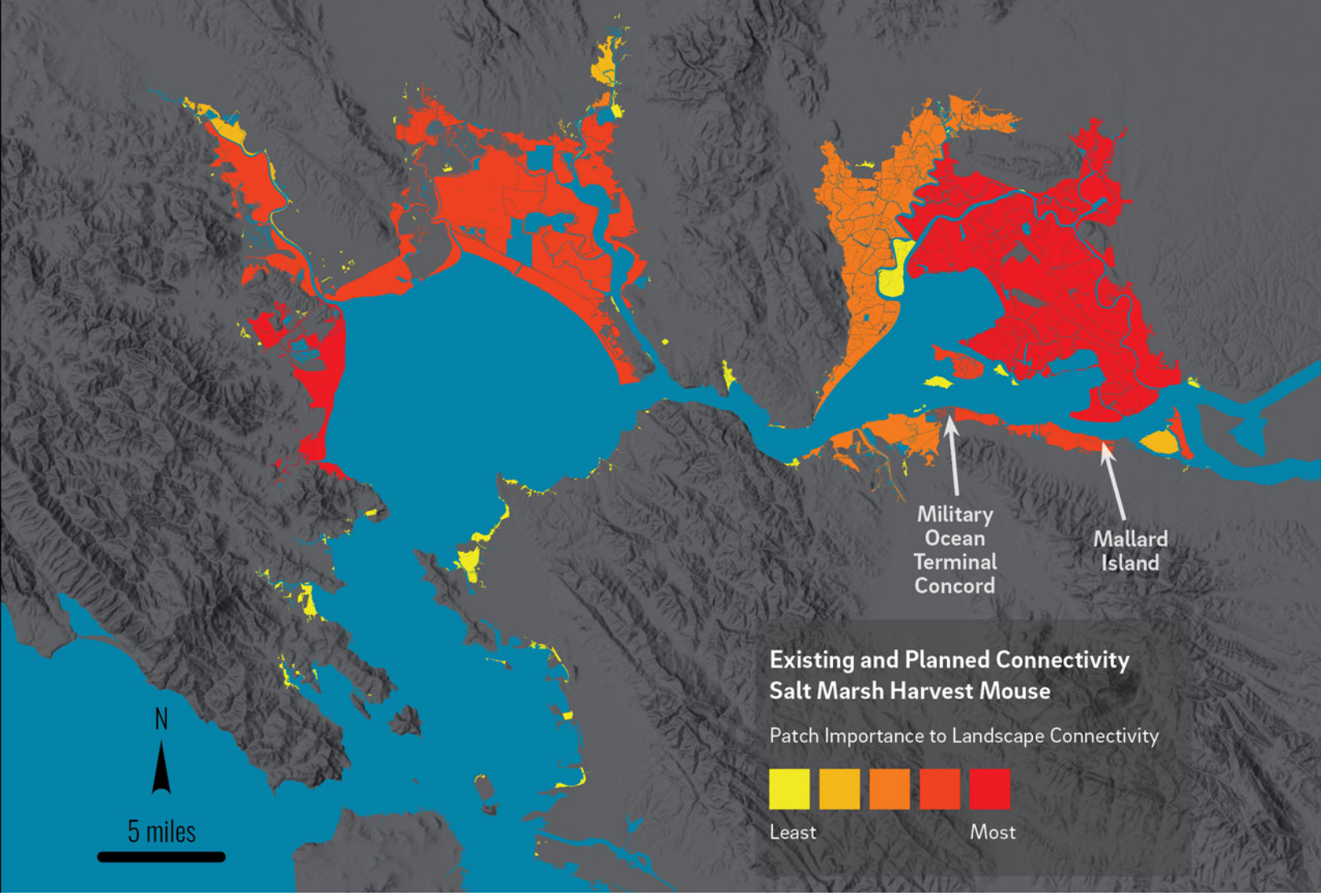


Figure 9. Modeled connectivity of the contemporary baylands for salt marsh harvest mice. Habitat patches include existing tidal and diked marshes and planned and in-progress restoration projects (SFEI 2021).

4. Key management considerations for adaptation planning

SOCIOECONOMIC BACKGROUND

Under Senate Bill (SB) 1000, the community of Bay Point has been identified by the State of California as a disadvantaged community. SB 1000 acknowledges the historic discrimination, negligence, and economic and political disempowerment that some communities throughout California have experienced (DCD 2020). Bay Point faces disproportionate social and economic disparities compared to the rest of the State, with higher rates of cost-burdened households and households in poverty living in low-lying areas at high risk of flooding (DCD 2020). Pollution from manufacturing and heavy industry takes a toll on the community's health outcomes, with higher instances of low birth weights and a greater frequency of asthma-induced and heart-attack induced emergency room visits (DCD 2020). Bay Point is very diverse, the population made up of about 15% Black or African American and 12% Asian, and over 56% of people identify as Hispanic or Latino (of any race) (DCD 2020, BCDC 2017). Approximately 15.2% of households have a head of household who is a non-English speaker (BCDC 2017).

Stakeholder engagement will be a critical part of the adaptation planning process. Meaningful stakeholder engagement requires building trust between community organizations, government entities, business owners, and project partners, which takes time to build. Best practices may include holding meetings in multiple languages, offering travel assistance or child care to encourage participation, and using common terminology that is easy to understand (PBCS et al. 2019). Many excellent resources on frameworks to achieve meaningful engagement with underserved communities already exist and could be employed to facilitate these efforts in the Bay Point OLU (e.g., Adapting to Rising Tides, Marin County C-SMART and BayWAVE, Alameda County Climate Change Adaptation Workshop Planning Guide, the National Association of Climate Resilience Planners' Community-driven Climate Resilience Planning framework) (PBCS et al. 2019).

Highlighted resource: For more information on community-driven climate resilience planning, see the National Association of Climate Resilience Planners' framework report available at www.nacrp.org.

EXISTING LAND USES ALONG THE SHORELINE

The majority of land bayward of the railway corridor is owned or managed by relatively few stakeholders, as shown in Figure 10. Land ownership and uses shown and discussed here were compiled using several data sources which may not be current. It will be important for these maps to be refined at the start of any future working group process to ensure the boundaries, ownership, and land uses are accurate. The below list is not exhaustive and serves to highlight the largest landowners and uses bayward of the rail corridor at the greatest risk of flooding.

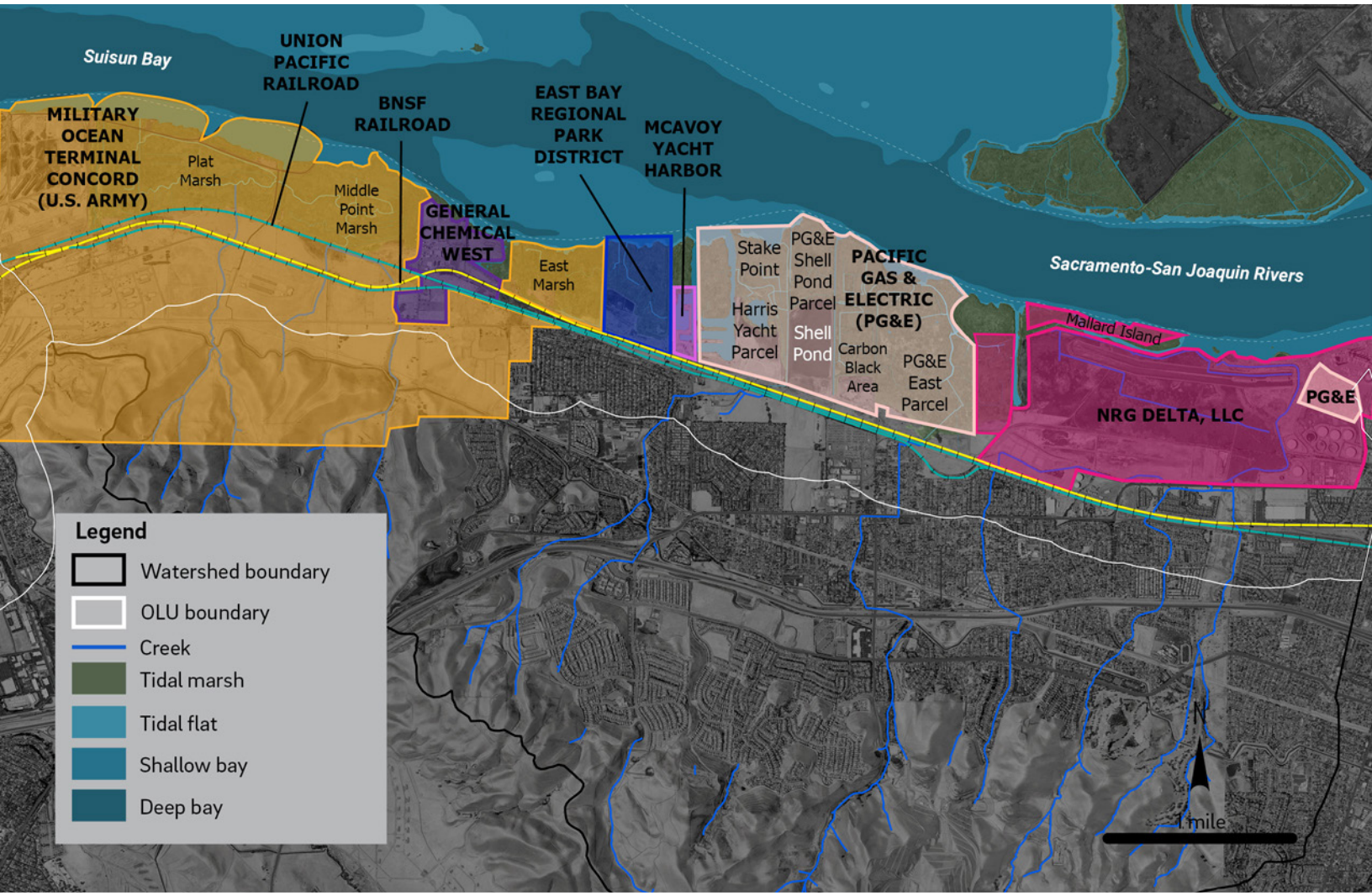


Figure 10. The majority of Bay Point OLU's shoreline bayward of the rail corridor is privately owned, dominated by industrial and commercial uses, or publicly owned but used for military operations. The only parcel identified as protected open space is the 138 acres of tidal marsh comprising the Bay Point Regional Shoreline managed by the East Bay Regional Park District (Data sources: CalTrans 2013, DCD 2014, EBRPD 2022a, LoopNet 2022, MOTCO 2021a, MTC 2017a and 2017b, PG&E 2022).

Military Ocean Terminal Concord (MOTCO): MOTCO is an active military base constructed by the U.S. Navy during World War II and transferred to the U.S. Army in 2008. MOTCO serves as an important link in the country's ammunition handling, with approximately 72% of the Army's West Coast ammunition and 25% of the nation's total ammunition passing through MOTCO at present (MOTCO 2021b). MOTCO recently developed a plan to maintain and repair aspects of the base between 2021-2031, including waterfront facilities, rail lines, and roads (MOTCO 2021a). The Department of Public Works at MOTCO is in the process of planning for SLR, although the current status of these plans is unknown. MOTCO is classified as a Superfund site so contamination is an ongoing and future concern, especially with respect to SLR and rising groundwater. MOTCO also manages three marshes within the study area: Plat Marsh, Middle Point Marsh, and East Marsh. Numerous environmental assessments related to various infrastructural upgrades are publicly available and provide extensive detail of sensitive and endangered species found within or suitable to MOTCO's marshes and surrounding habitats.

Port Chicago Naval Magazine National Memorial: The Port Chicago Naval Magazine National Memorial is a memorial dedicated in 1994 to the 320 American soldiers and civilians who lost their lives on July 17, 1944—the worst home-front disaster during World War II (NPS 2022). The majority of the deaths were Black soldiers serving the racially segregated U.S. Navy. The Port Chicago memorial consists of what remains of the original pier where the American sailors were loading munitions when the explosion occurred, with a plaque of the names of the soldiers who died overlooking the site. Although the memorial is open to the public, access is restricted due to the memorial's location on an active military base. The National Park Service manages the memorial and allows public access with advanced planning. Future planning efforts should consider how to preserve this important memorial as sea level rises.

Courtesy of National Parks Gallery, Public Domain Certification.

During World War II, Black sailors transport weapons and ammunition from rail cars to ships at Port Chicago under dangerous working conditions (courtesy of TradingCardsNPS, CC 2.0).

At Port Chicago, Black soldiers who had been trained for combat were relegated to transporting munitions onto ships under the command of white officers, neither of whom had adequate training (National WWII Museum 2020). Following the disaster, many of the surviving Black soldiers serving at Port Chicago refused to load munitions until safety measures were put in place. The U.S. Navy charged these officers with mutiny, imprisoned them, and put them on trial. The resulting trial catalyzed desegregation in the U.S. Navy but at the expense of the surviving Black soldiers who were charged with mutiny, imprisoned, dishonorably discharged, and to whom justice was never served (NWWM 2020).

General Chemical West Corporation Bay Point Works: Bay Point Works is a hazardous material site regulated by the California Accidental Release Prevention Program (CalARP) and ISO (BCDC 2017) located at 501 Nichols Road in Bay Point. This property was first developed in 1909 to manufacture sulfuric acid, selected for its proximity to rail and water transportation (CCHS 2006). As of 2006, Bay Point Works manufactures acids, etchants, cleaning formulations and other chemicals used by semiconductors and water fabrication (CCHS 2006). Examples of chemicals manufactured at Bay Point Works include hydrogen fluoride, anhydrous ammonia, aqueous ammonia, and hydrochloric acid. Bay Point Works is listed as a brownfield site (DCD 2014).

Bay Point Regional Shoreline: The Bay Point Regional Shoreline consists of about 138 acres of bayfront parkland managed by the East Bay Regional Park District. The California State Lands Commission owns about 87 acres of the park and the remaining 51 acres is owned by the East Bay Regional Park District (CPAD 2017). The Bay Point Restoration and Public Access Project, an effort to improve park facilities which included habitat restoration, trail and accessibility upgrades, educational signage, restroom improvements, and potable water access, was completed in December 2020. Access to the 1.1-mile loop trail is located at the end of McAvoy Road in Bay Point (EBRPD 2022a). During the recent park improvement efforts, approximately 30 acres of marshes were designed to accommodate SLR by incorporating higher ground for marsh migration and high-tide refuge for wildlife (EBRPD 2022b).

McAvoy Yacht Harbor: Located at 1001 McAvoy Road in Bay Point, the McAvoy Yacht Harbor is a privately owned marina that hosts 300 slips and dryland storage for boats, accommodating boats up to 65' in length (BCDC 2017). The Foundation Sportsman Club, located at McAvoy Yacht Harbor, hosts the Original Sturgeon Derby, an annual fishing tournament held on Super Bowl weekend that has been running for 38 years (FSC 2022). Additional facilities sited around McAvoy Yacht Harbor include a clubhouse, fishing access, boat repair and refueling services, a bait and tackle shop, and two cafes (Google Earth 2022).

Pacific Gas & Electric (PG&E): The PG&E parcel located near 100 Trojan Road in Bay Point consists of tidal marsh, a diked pond (Shell Pond), and a solid waste management unit (Carbon Black Area) (PG&E 2022). Under the purview of the California Department of Toxic Substances Control, PG&E is working to remediate Shell Pond, a 73-acre former wastewater treatment pond, and the Carbon Black Area, a 22-acre solid waste area. These sites are remnants of the industrial processes undertaken by Shell Oil from the 1950s to the 1970s (PG&E 2022). PG&E acquired both sites in 1973 with the intent to expand operations, which never occurred. Plans to remediate Shell Pond using plants, fungi and bacteria to break down and clean up contaminants were approved in 2019 and are expected to continue through 2027. Additional efforts are underway in the Carbon Black Area to maintain a protective cover of clean soil and plants over portions of the site. Monitoring and maintenance efforts are ongoing (PG&E 2022).

Former Pittsburg Power Plant/NRG Revitalization Site: This 1,052-acre complex was formerly the Pittsburg Power Plant (also referred to as the Pittsburg Generation Station), a natural-gas-fired power plant in operation from 1954 to 2016 (CCPC 2021; Wikipedia 2022; EBT 2018). An extensive area of diked wetlands is located within the property, with deep hardened channels constructed in the 1970s along the bayward boundary for use as cooling canals in power generating operations (Tetra Tech 2008). This complex was bought in January 2020 (LoopNet 2020) and continues to operate as mixed industrial and diked open space. An assessment of the complex, known as the NRG Revitalization Site, was published in September 2021 as part of the City of Pittsburg's Envision Pittsburg General Plan update and Brownfields Revitalization Planning effort (CCPC 2021). NRG Delta, LLC, owns the majority of the complex (approximately 1,014 acres) and the rest of the complex (about 38 acres) is owned by PG&E (CCPC 2021). The assessment details existing conditions, zoning considerations, flooding vulnerabilities and other planning considerations, and offers several visioning alternatives for high-density housing, commercial, industrial and open space uses within the NRG Revitalization Site (CCPC 2021). There are many constraints to the redevelopment of the NRG Revitalization Site, including legacy contamination, risk of liquefaction, and high likelihood of flooding from rising groundwater and SLR if adequate levees, pumps, or other infrastructure are not implemented.

Railway corridor: Since the early 1900s, Bay Point has served as an important linkage for railway transportation, with two transcontinental railroads and one electric railroad passing through the area (EBRPD 2022c). Today, the railroads in the study area serve as an important corridor to move passengers and freight between the Bay Area, Sacramento and beyond. The existing rail lines through the study area are owned and operated by Union Pacific and Burlington Northern Santa Fe (BNSF) Railways (SFEI and SPUR 2019). The rail corridor serves as the main structural barrier between developed areas in the study area and the shoreline but it was not constructed and is not maintained as flood protection (BCDC 2017).

SEA LEVEL RISE CONSIDERATIONS

Overtopping

When Bay water levels exceed the ground elevations of surrounding shoreline infrastructure, overtopping occurs. Understanding the thresholds in which different amounts of SLR will begin to close roads, disrupt rail lines, or flood housing complexes is a critical piece of the adaptation planning process (Figures 11 and 12). The average mean higher high water (MHHW) level along the Bay Point OLU shoreline is currently about 6.1 ft NAVD (AECOM 2016). A comparison of projected SLR scenarios + MHHW to ground elevations of the existing shoreline infrastructure is shown in Figure 12. Additional factors will exacerbate future water levels such as fluvial flooding, storm surge, king tides, and inflows from the Delta, which should all be considered in adaptation planning efforts.

The most low-lying areas within the Bay Point OLU include McAvoy Marina, sections of Stevens Rd. and Wharf 4 within MOTCO, and the former Pittsburg Power Plant, with overtopping occurring in these areas with just 0.5 ft of SLR on top of current MHHW. With 1 ft of SLR, overtopping extends to Willow Pass Rd. near an existing transmission tower area and housing developments. With 2 ft of SLR, overtopping occurs around General Chemical West Bay Point Works, the Bay Point Regional Shoreline trail, the Shell Pond and the Carbon Black Area, as well as more extensive overtopping throughout all the properties listed previously. With 4 ft of SLR, overtopping occurs along the Union Pacific railway located within MOTCO, which extends to the BNSF railway segments with 6 ft SLR.

Rising groundwater

Groundwater levels near the shoreline can be strongly influenced by rising sea levels. A recent study mapped projected impacts of SLR on water table levels along the coast of California (Befus et al. 2020a). Results can be viewed in the Our Coast Our Future Webmap. A map of existing conditions based on this modeling is shown in Figure 13. More localized modeling is needed to better understand how geologic conditions influence the water table and how discharge to streams may influence the rate of rise in groundwater levels. However, this statewide mapping provides valuable information about hotspots of concern where rising groundwater levels may impact subsurface infrastructure and eventually emerge aboveground, causing flooding. In the Bay Point OLU, groundwater is already near the ground surface in the neighborhoods of Pittsburg that are also subject to overland flooding from SLR (Figure 14). This area also has some legacy contamination which could be remobilized by shifting groundwater flows due to SLR. There is also shallow groundwater in several places on the land side of the railroad tracks, which could exacerbate existing drainage issues as groundwater levels rise higher and reduce outflow capacity. Design of any new adaptation projects should take rising groundwater levels into consideration.

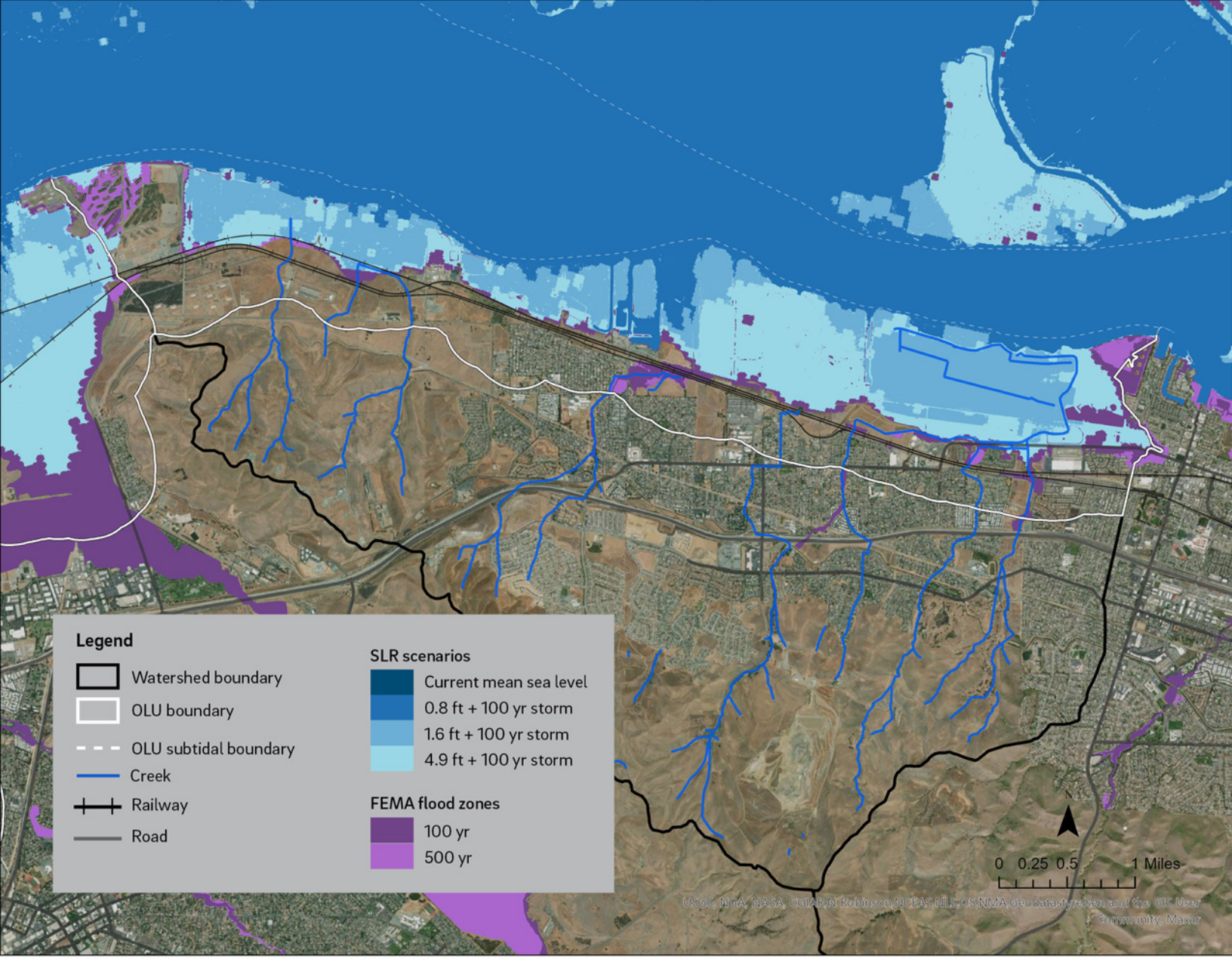


Figure 11. Most areas bayward of the rail corridor are expected to flood during a 100-year storm event under different SLR scenarios, as mapped here using the USGS Coastal Storm Modeling System (CoSMos 2.0, Bernard et al. 2014). During periods of high rainfall, additional flooding along the lower reaches of creek corridors and adjacent low relief areas is also expected (FEMA 2021).

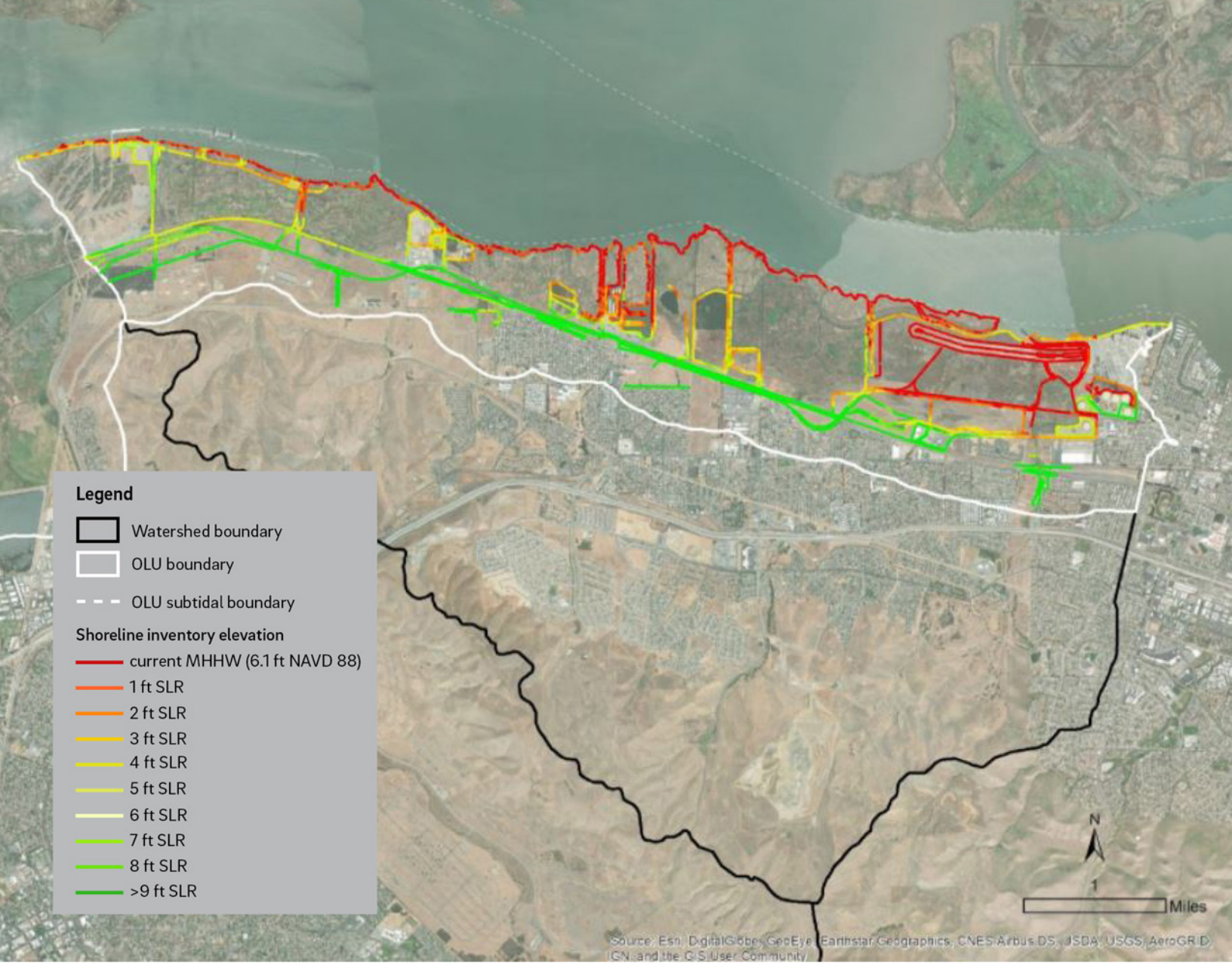


Figure 12. Bay Point OLU's shoreline is comprised of a mix of natural protections (e.g. tidal marsh) and built structures with varying vulnerabilities to SLR (e.g., rip rap, unengineered berms). Elevations of Bay Point OLU's shoreline infrastructure are shown relative to SLR (SFEI 2016).

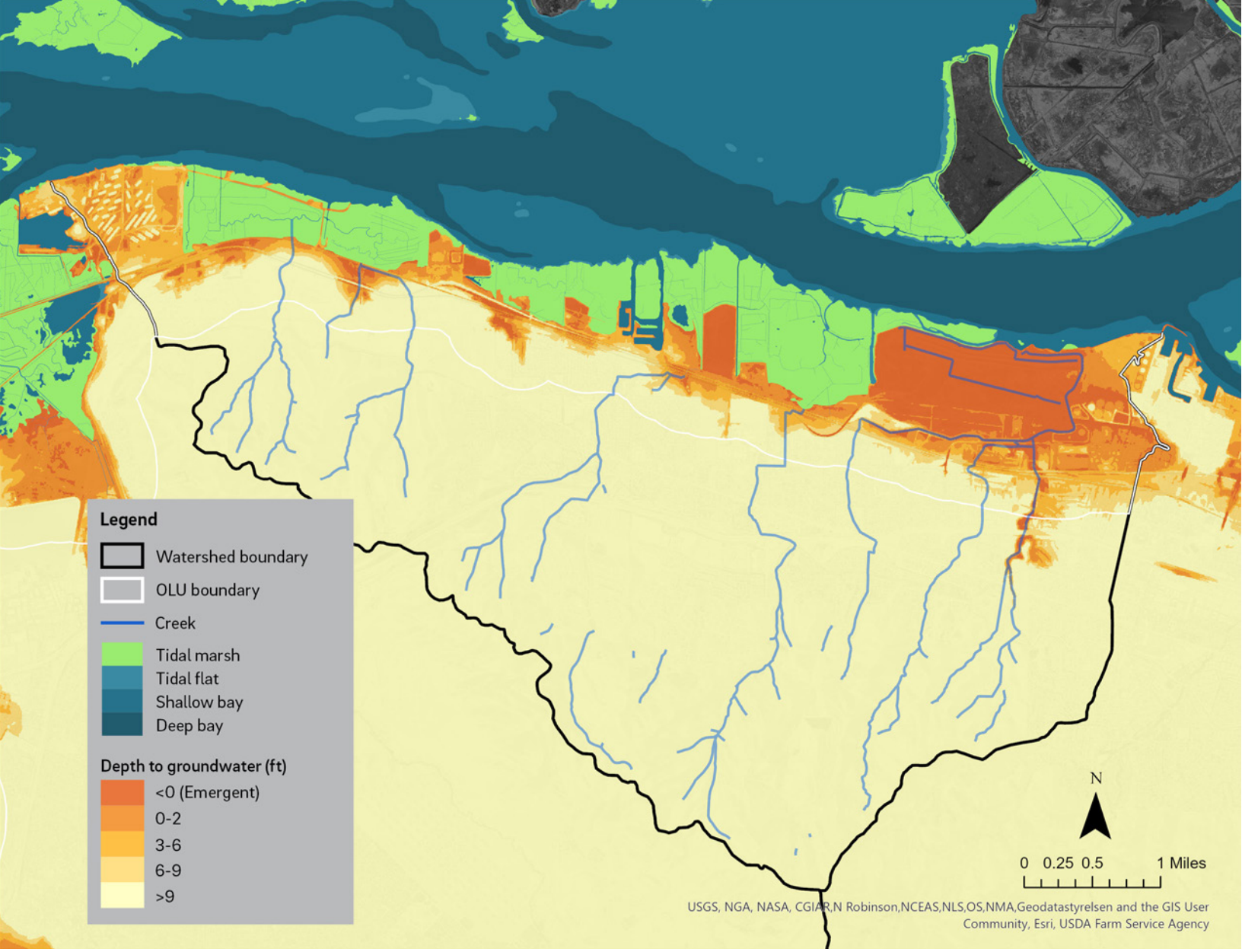


Figure 13. Depth to groundwater under existing sea level conditions at MHHW, assuming moderate permeability (Kh=1.0) (Data source: Befus et al. 2020b).

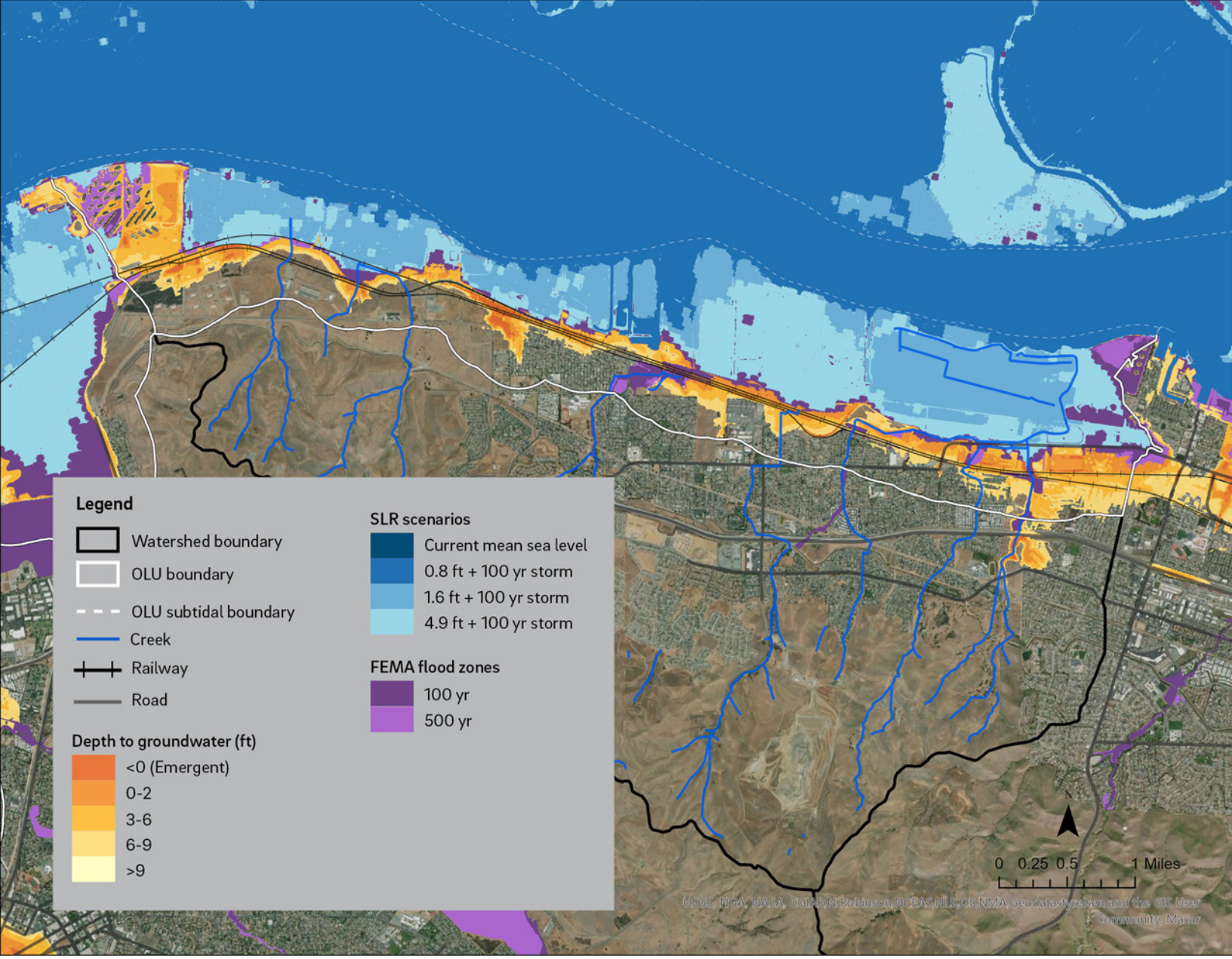


Figure 14. Depth to groundwater overlaid with future areas projected to flood during 100-year and 500-year storm events and different sea level rise scenarios (Data sources: Befus et al. 2020b, Barnard et al. 2014, FEMA 2021).

Marsh drowning

Most of the marshes along the Bay Point OLU shoreline are either predominantly high marsh (e.g. Mallard Island; 0.07 to 1.0 ft NAVD) or mid marsh (e.g. Plat and Middle Point Marsh; -0.3 to 0.02m NAVD) (Figure 15). A modeling assessment by Point Blue Conservation Science (Veloz et al. 2014) predicts that under high projections of SLR (i.e. 5.4 ft by 2110), the marshes in the study area are at risk of converting to low and mid marsh by mid-century (~2050; Figure 16) and to mudflat with small extents of low marsh by the end of the century respectively (~2110; Figure 17). The ratio of converted habitats varies only slightly for both endpoints under the low/high sedimentation and low/high organic materials scenarios in the model. However, the underlying assumptions used in the model to predict future mineral sediment supply and organic matter accretion may shift over time as more refined modeling of these factors becomes available for the Delta and Suisun Bay.

Another resource to help understand how marshes in the study area might adapt to SLR is the 2021 Sediment for Survival report (Dusterhoff et al. 2021). Sediment for Survival is a regional analysis to determine how much sediment may be available for tidal marshes and mudflats in San Francisco Bay under wetter and drier future climate scenarios. The ratio of local bayland demand to local tributary sediment supply for both a wetter and drier future in the Bay Point OLU is favorable under nearly all climate scenarios analyzed (Figure 18). This means that if local creeks could be connected to their downstream marshes, local tributary sediment supply could go a long way in helping marsh keep pace as sea level rises. Under a drier climate, however, local bayland sediment demand might outpace local tributary sediment supply near the end of the century. Fortunately, mineral sediment supply from local tributaries is not the only factor that will determine the fate of these marshes. Marshes located in Suisun Bay have a high potential to capture a large portion of the Delta's sediment supply and also benefit from the Delta's freshwater inflows to support lower salinity tidal marshes with relatively high organic matter production and accumulation rates (Dusterhoff et al. 2021). Given the prime location of the Bay Point OLU to the mouth of the Sacramento-San Joaquin rivers, the marshes in the study area are well poised to take advantage of these potential benefits.

Given the uncertainty around whether the marshes in the Bay Point OLU will be able to keep pace with SLR, preparing areas for marshes to migrate inland will help ensure persistence over time. Sediment management approaches could also be taken to augment sediment delivery and facilitate faster rates of vertical marsh accretion in the study area and are discussed in more detail in the next chapter.

Delta influence on total water level

The contributing factors to extreme water levels vary across the Bay. An analysis to characterize contributions to the 100-year extreme Bay water level was conducted by Nederhoff et al. (2021). For the central and south Bay, the study showed nearly 100% of the extreme water level can be attributed to tide and remote non-tidal residual ("remote NTR"). Remote NTR factors originate from outside the Golden Gate and include sea level anomalies associated with El Niño, the Pacific Decadal Oscillation, up- and down-welling, etc. Near Bay Point, the study showed a larger portion of extreme water level contributions can be attributed to discharge from the Delta and to "other" factors, like wind-driven wave set-up and local storm surge. This means that more extreme precipitation events and corresponding changes in Delta outflow could have a larger impact in Bay Point and surrounding areas than in other parts of the Bay.

Figure 15. Baseline elevations (ca. 2010) of marshes in the Bay Point OLU study area (Veloz et. al 2014).

Figure 16. Predicted marsh elevations under high SLR (5.6 ft by 2110), high sedimentation, and high organic material scenarios by mid century (2050) in the Bay Point OLU study area as modeled using WARMER (Veloz et. al 2014).

Figure 17. Predicted marsh elevations under high SLR (5.6 ft), high sedimentation, and high organic material scenarios by the end of the century (2110) in the Bay Point OLU study area as modeled using WARMER (Veloz et. al 2014).

Figure 18 (next page). Map indicating baylands with the highest potential for resilience with respect to vertical accretion for a drier or wetter future based on the findings from the Sediment for Survival report and associated assumptions used in the analyses (Dusterhoff et al. 2021).

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Legend

Marshes

Projected elevation

- Subtidal
- Mudflat
- Low marsh
- Mid marsh
- High marsh
- Upland

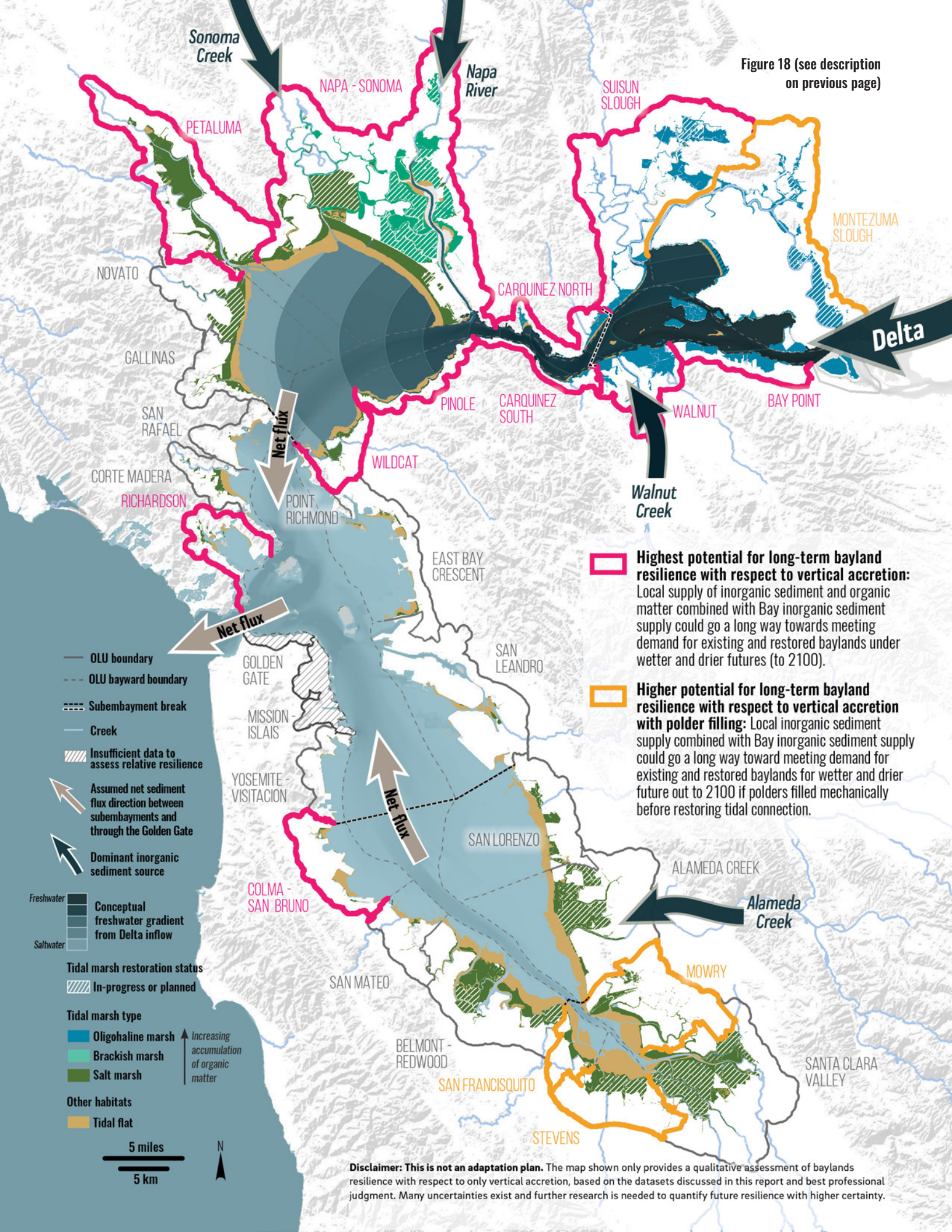


Figure 18 (see description on previous page)

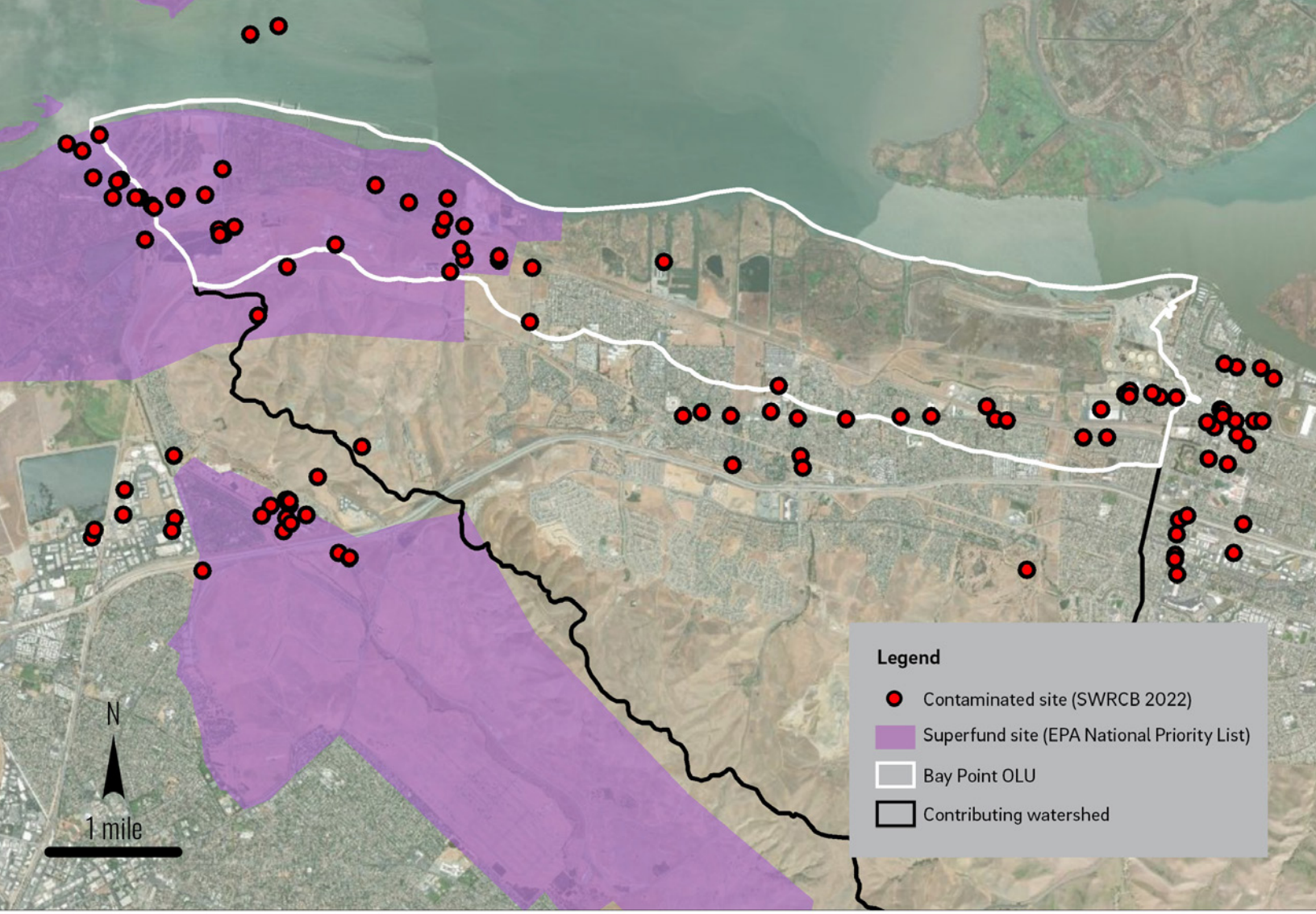


Figure 19. Known contamination sites along the Bay Point OLU shoreline (Sources: ATSDR 2010; SWRCB 2022).

Contamination

Legacy contamination from the heavy industries and military operations that were previously located and currently operate along Bay Point's shoreline will be of increasing concern as sea level rises. In some instances, SLR could pose pollution risks to the Bay by saturating underground contaminants suspected to persist from historical contamination sites such as the Superfund site at MOTCO and the brownfield site at General Chemical West Bay Point Works. In addition, rising groundwater could mobilize contaminants further inland and pose human health risks to nearby communities. Other ways these harmful toxins could be released is through soil exposure and release into the air (BCDC 2017). These pathways can result in direct exposure to people and sensitive species, as well as contamination of drinking water and food sources (BCDC 2017), making it essential that future planning efforts consider the location and characteristics of the contamination as well as the communities and ecosystems that will be impacted. There are dozens of sites of known contaminants along Bay Point's shoreline (Figure 19), with varying remediation statuses, so the threats of future flooding should be considered on a site-by-site basis.

5. Potential adaptation opportunities

This section highlights opportunities for natural and nature-based adaptation measures that can be used to enhance the resilience of Bay Point's shoreline. This effort draws heavily on the work in the Adaptation Atlas while also refining those ideas based on the site-specific information on habitat goals, vulnerabilities, and priorities identified in preceding sections. The adaptation measures described here are intended to catalyze the discussion around shoreline adaptation planning in the Bay Point OLU and are not meant to prescribe how adaptation should happen. They are a starting point of ideas that can be incorporated into a future adaptation planning framework for the Bay Point OLU. To better organize and describe these adaptation ideas, the study area is divided into three sections: Western Reach, Central Reach, and Eastern Reach (Figure 20).

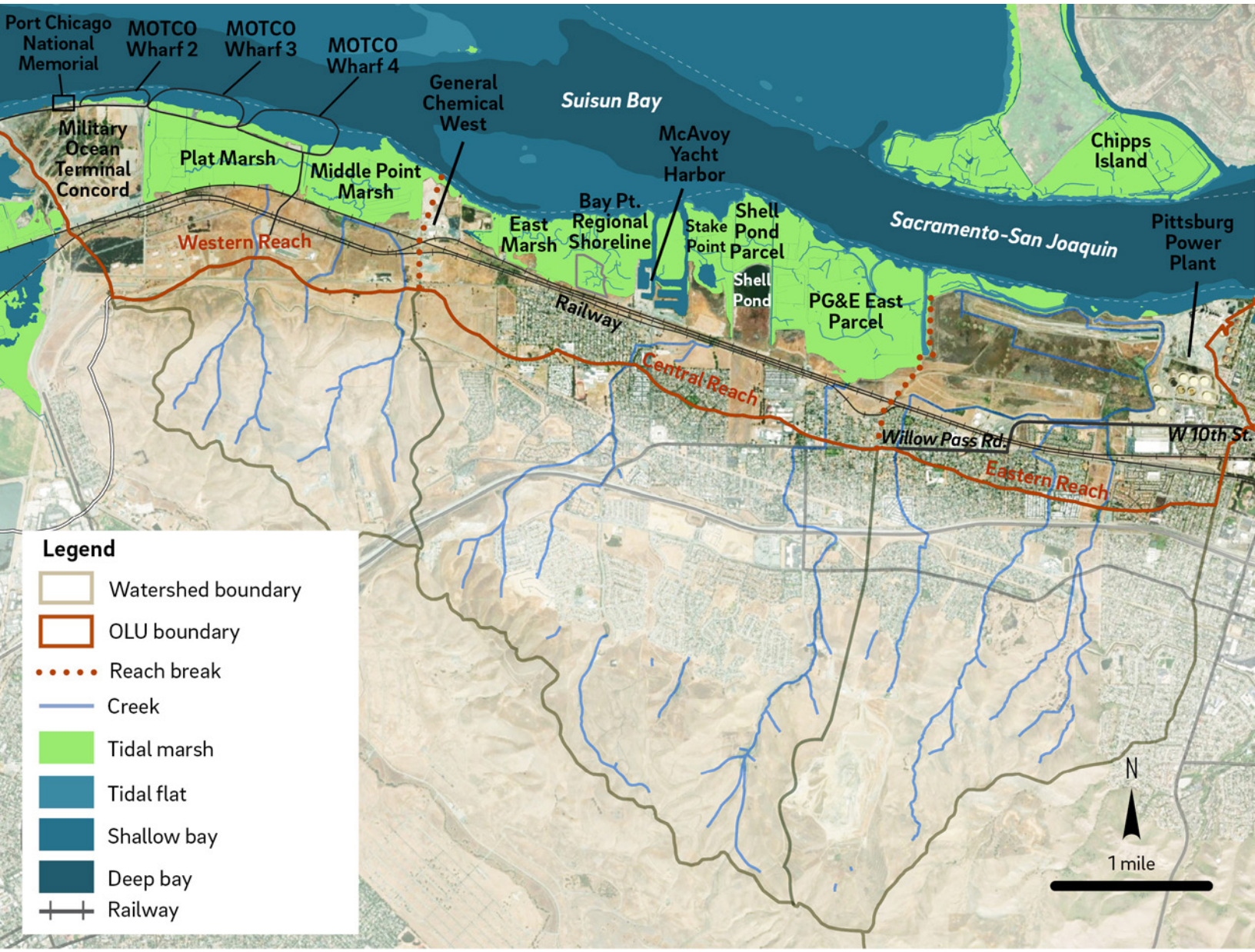


Figure 20. Existing tidal marshes and creek connections in the study area overlaid onto aerial imagery and divided into three reaches (Data source: SFEI 2016).

OPPORTUNITIES IN THE WESTERN REACH

The western reach of the study area has limited natural and nature-based adaptation opportunities if the current alignments of rail, industry, and military uses persist (Figure 21). Potential actions that could be taken include expanding and supporting eelgrass beds in shallow subtidal areas around Wharfs 2, 3, and 4, where they have been documented to exist. Given the known contamination issues at MOTCO and General Chemical West, ecotone levees could be implemented along the back of Plat and Middle Point marshes to protect against shoreline erosion while also creating areas of high-tide refuge for salt marsh harvest mice and other sensitive species known to this area. A strip of undeveloped area between Plat and Middle Point marshes exists at elevations suitable for marsh to move into and migrate landward as sea level rises, so acquiring, protecting and preparing these areas would encourage Plat and Middle Point marshes' survival into the future. Opportunity also exists to improve creek-marsh connection points draining into Middle Point Marsh. The easternmost creek in this reach currently runs west along the railway corridor before making a 90-degree turn into Middle Point Marsh. A more natural creek alignment could be designed to better convey sediment, nutrients and floodwaters into Middle Point Marsh.

This reach has the most low-lying section of railway in the Bay Point OLU, with the most bayward rail line being the most vulnerable. Longer-term planning actions could consider elevating or realigning these low-lying sections of railway and creating additional space for marsh migration and transition zone habitats, although these possibilities may be limited by gradient and curvature limitations which should be considered. If sections of railway were to be realigned, there would be additional opportunities to create ecotone levees between the back of the marsh and the ultimate railroad alignment. These ecotone areas would provide high-tide refuge to sensitive wildlife populations while protecting the railway from future storm surge. Careful attention, however, should be given to contamination challenges if such actions were to be taken. The contamination that exists at MOTCO and General Chemical West may affect the ability to implement long-term measures, such as realigning the railroad to allow for marsh migration. Further investigation is needed to better understand the contamination concerns at the site and to weigh the risks against the benefits of allowing for marsh migration and flood risk reduction. Other long-term actions could consider redirecting locally dredged sediment from operations to maintain MOTCO's wharfs into Plat and Middle Point marshes through thin layer placement or other techniques if these marshes are not keeping pace with SLR.

MIGRATION SPACE VS. TRANSITION ZONE

In this report, ***migration space*** refers to the area at appropriate topographic elevations to support marsh migration with SLR. In the Adaptation Atlas, "migration space" was defined as the area expected to be inundated by 6.6 ft (2.0 m) of SLR (SFEI and SPUR 2019). ***Transition zone*** is used here to describe a broader buffer area where key physical and biological transitions occur between tidal marshes and uplands, and includes areas within 550 yds (500 m) horizontally inland from today's highest tides (Robinson et al. 2017). As such, "migration space" fits within and is a part of the "transition zone."

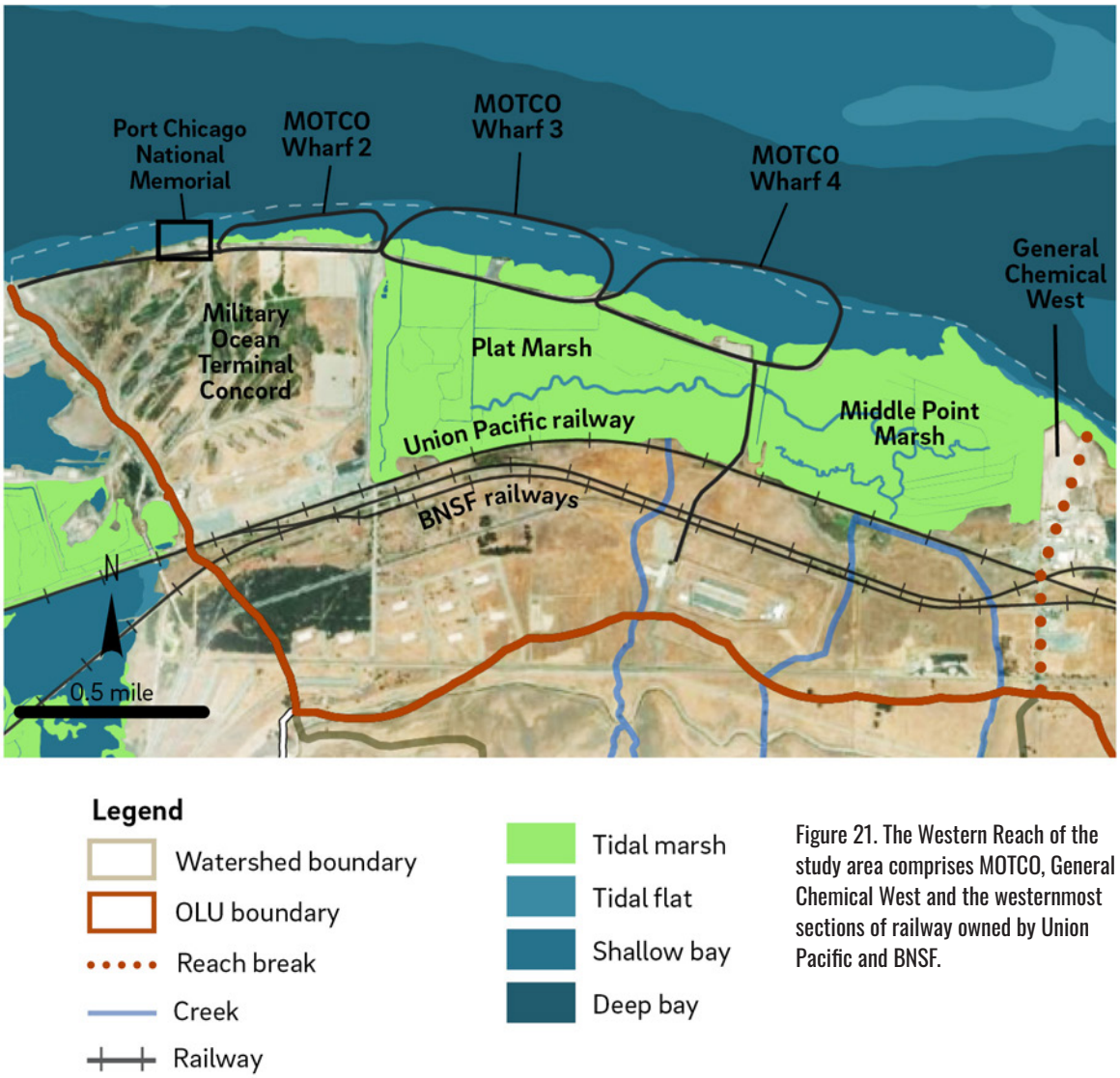


Figure 21. The Western Reach of the study area comprises MOTCO, General Chemical West and the westernmost sections of railway owned by Union Pacific and BNSF.

Potential near-term measures:

- Expand and support eelgrass beds in shallow subtidal areas
- Create ecotone levees along the back of Plat and Middle Point marshes
- Acquire and protect open space vulnerable to flooding or adjacent to existing marsh
- Prepare marsh migration and transition zone habitats
- Redesign creeks to drain directly onto marshes

Potential long-term measures:

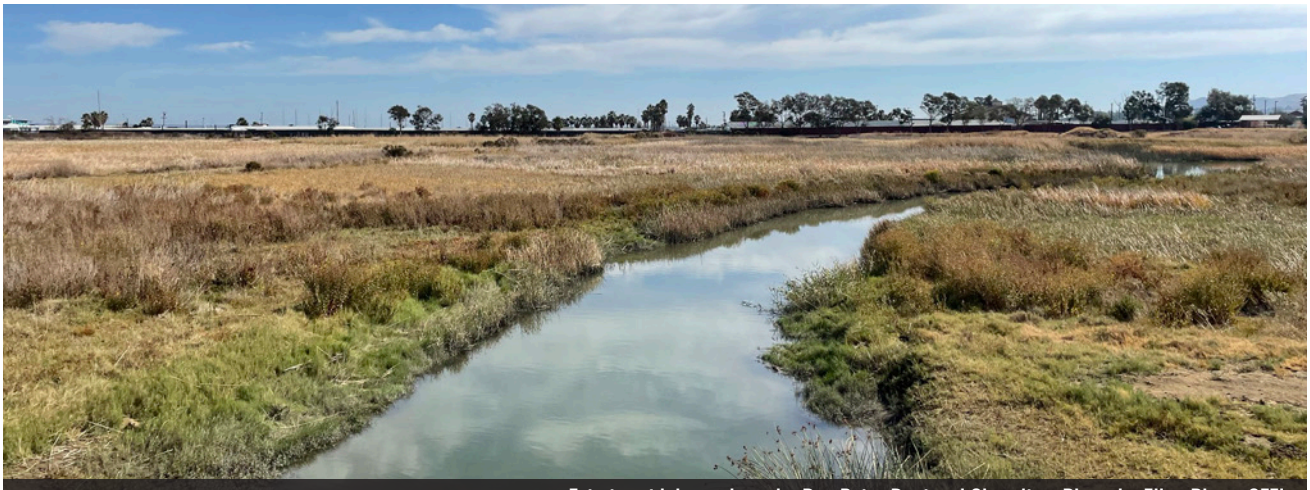
- Consider elevating or realigning low-lying rail corridors
- Create ecotone levees in front of realigned railways, where appropriate
- Re-use locally dredged sediment to augment vertical marsh accretion

OPPORTUNITIES IN THE CENTRAL REACH

The central reach of the study area has similar opportunities as the western reach (Figure 22). More information is needed to determine whether eelgrass currently exists in this reach, with potential opportunities to create and/or expand eelgrass beds in the shallow subtidal areas between East Marsh to Stake Point Marsh, where feasible. Ecotone levees could be implemented along the back edge of East Marsh to reduce shoreline erosion around the eastern edge of the brownfield site at General Chemical West. Additional ecotone levees could be built along the back edge of East Marsh and Bay Point Regional Shoreline (BPRS) marsh to protect the railway from erosion and establish high tide refuge for resident marsh wildlife. The section of railway running along the back of East Marsh and BPRS also abuts the Port Chicago Highway and the community of Shore Acres, so in the near-term an ecotone levee could help protect these areas from future flooding. One of the challenges in this reach, though, that should be considered when discussing ecotone levees is the potential of future groundwater flooding. In the long-term, this area is at risk of flooding from rising groundwater tables which will not be prevented through further hardening of the shoreline.

A band of undeveloped land at suitable elevations for marsh restoration, migration space, and transition zone exists bayward of the rail line from just east of McAvoy Marina to the back edge of the PG&E East Parcel. Acquiring and protecting these areas would avoid any future developments becoming established in areas at high risk of flooding while also allowing space at appropriate elevations for marsh to move into and adapt as sea level rises. This could also allow more space to open up the creek-bayland connection that drains under the railroad just west of Shell Pond, to alleviate flooding during large storm events. Maintenance dredge from McAvoy Yacht Harbor could be reused locally in this reach to augment vertical marsh elevations if the marshes are not keeping pace with SLR. In the long-term, the public access trail around the Bay Point Regional Shoreline marsh will be overtopped as sea level rises if no action is taken. The public access trail could be reconfigured into a floating boardwalk, raised in elevation, or realigned to an area of higher ground. The latter option could be accommodated along the band of undeveloped land bayward of the rail line if these undeveloped areas are able to be acquired and protected.

Decontamination efforts are planned to continue at Shell Pond and Carbon Black Area for several years, but it is unclear whether SLR is factored into these efforts. Proper planning will be important to ensure containment of hazardous materials. In the long-term, when remediation is complete at both sites, actions could be taken to connect these areas to surrounding marsh and upland marsh migration space to improve habitat connectivity throughout this reach.



Existing tidal marsh at the Bay Point Regional Shoreline. Photo by Ellen Plane, SFEI.

Figure 22. The Central Reach of the study area spans the reach of shoreline from General Chemical West to the PG&E marsh complex.

Potential near-term measures:

- Expand and/or create eelgrass beds in shallow subtidal areas, where feasible
- Create ecotone levees along the back of East Marsh in front of General Chemical West and consider extending ecotone levees at the back of the Bay Point Regional Shoreline in front of railways
- Acquire and protect open space vulnerable to flooding or adjacent to existing marsh
- Prepare marsh migration and transition zone habitats
- Redesign creeks to drain directly onto marshes
- Manage Shell Pond and Carbon Black Area wetlands while remediation is in progress

Potential long-term measures:

- Re-use locally dredged sediment to augment vertical marsh accretion
- Raise, redesign, or realign the public access trail
- Improve habitat connectivity by reconnecting managed wetlands when remediation is complete

OPPORTUNITIES IN THE EASTERN REACH

The eastern reach of the study area comprises the former Pittsburg Power Plant/NRG Revitalization Site and surrounding diked wetlands, as well as a large expanse of at-risk housing, commercial and industrial developments along Willow Creek Road and W 10th Street in Pittsburg (Figure 23). A large complex of levees currently convey fluvial flows from creeks around the diked wetland complex before draining to the Bay. This complex is very low lying and, if not protected by dikes as it is currently, it would be subtidal. Planning efforts for this area are underway through the City of Pittsburg, the most recent of which outline four land use map alternatives (CCPC 2021). All four alternatives show a large portion of the diked wetland complex remaining as open space, with various configurations of industrial, commercial, and high-density housing land uses in adjacent areas (CCPC 2021). If mixed-use development plans were to move forward, this area would need to be protected by a levee and also have adequate pumping infrastructure to protect against future SLR and groundwater flooding.

If the areas slated to be open space within this complex were to remain as is (diked wetland), they would need to be protected with levees or other infrastructure and maintained with pumps as groundwater and sea level rises. In addition, since this site is situated on bayfill, it is at high risk of liquefaction. If this area continues to be cut off from tidal action, subsidence is anticipated. An alternative idea would be to convert the diked wetlands in this complex into tidal marsh, or turn this parcel into a mitigation bank. If acquired for restoration, there could be opportunities to re-establish delivery of sediment and freshwater from local watersheds to this area. The creeks in this reach make several 90-degree turns, which likely exacerbate sedimentation and flood conveyance issues, as they near the baylands before draining to the Bay. Redesigning these creek connections into the current diked marsh area would help to raise the elevations back to tidal marsh and potentially alleviate backwater flooding in these lower creek reaches where they intersect infrastructure during periods of high flow. An ecotone slope and flood risk management levee could be created along the back edge of the diked wetland complex to provide

Former Pittsburg Power Plant. Photo by Ellen Plane, SFEI.

high tide refuge habitat to resident wildlife and protect the levee from erosion. Water control structures would be needed at realigned creek mouths to prevent potential backflows of floodwater into nearby developments during periods of amplified water levels. In addition, the decommissioned cooling canals could be repurposed as deep channel habitat within the restored marsh complex to support Delta smelt and other aquatic species who would benefit from cooler water habitat as the mean water temperature of the Bay-Delta is projected to rise due to climate change. Before being breached, channels could be cut within the marsh restoration project connecting the realigned creek mouths to the deepwater habitat.

A big challenge with converting the diked wetland area to tidal marsh restoration and constructing ecotone levees around the perimeter will be acquiring enough sediment to do so. As adaptation efforts take off around the region, sediment will be in high demand. Sediment draining from the local tributaries in this reach will likely be insufficient to achieve these goals given their relatively small size. One opportunity would be to acquire and re-use dredge sediment generated locally in nearby navigation channels, although it may be difficult given the high demand at Montezuma Wetlands or other nearby restoration projects in need of sediment.

There also may be opportunities within the Eastern Reach to implement stormwater retention basins, through existing open spaces like parks or undeveloped areas. One such opportunity is located in an open area where the creek in the eastern portion of the reach runs under Willow Creek Road. This parcel could be converted into a stormwater retention basin which could be connected to the tides and function as muted tidal wetlands. A water control structure (e.g. flap gate) would likely be needed to prevent backflows during periods of amplified tides.

Park nearby the Pittsburg Power Plant. Photo by Katie McKnight, SFEI.

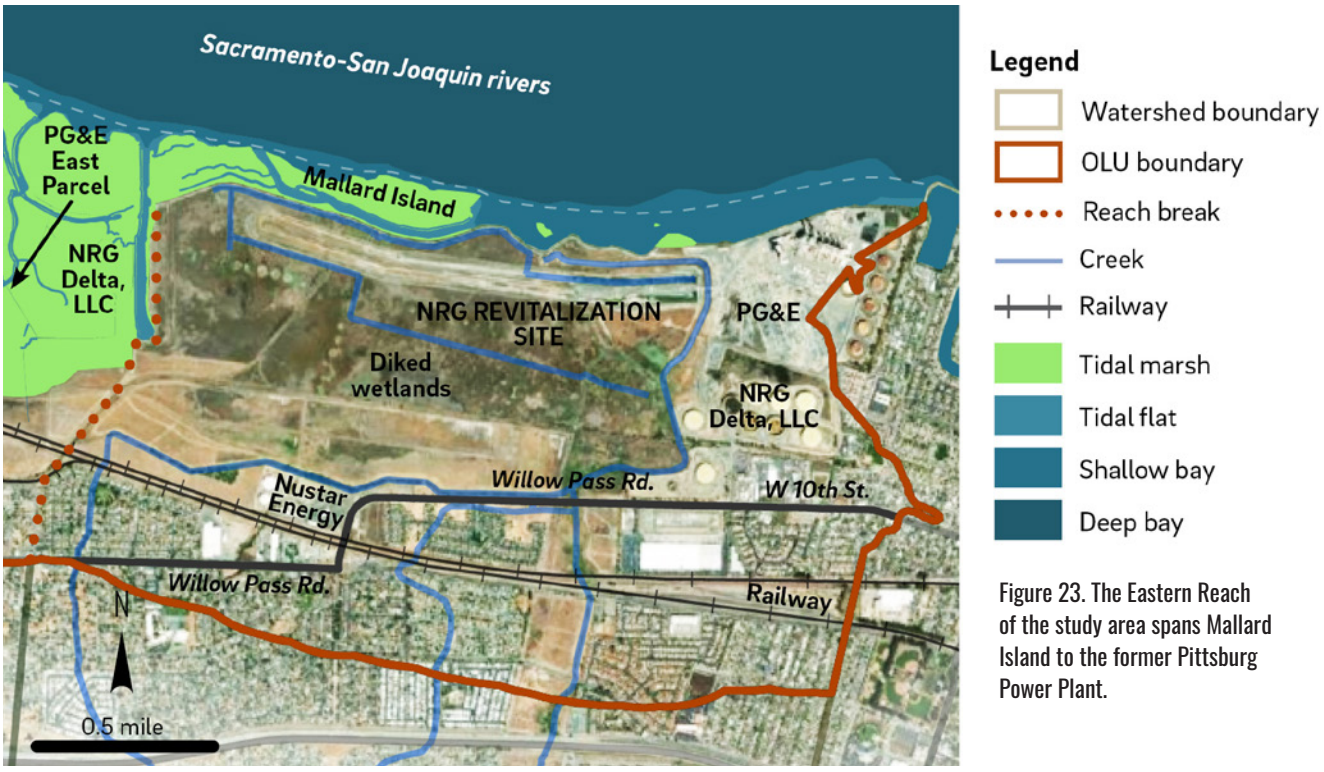


Figure 23. The Eastern Reach of the study area spans Mallard Island to the former Pittsburg Power Plant.

Potential near-term measures:

- Protect diked wetland area with sea walls or levees; OR
- Consider acquiring the diked wetland complex for use as open space or as part of a mitigation bank. Subsequent actions could include the following:
    - Create an ecotone slope and flood risk management levee along the back edge of the diked wetland complex
    - Re-use dredged sediment from nearby navigation channel to raise elevations of diked wetland or construct ecotone levees
    - Realign creek mouths to drain directly into the diked wetland complex
    - Decommission the cooling channels and repurpose as deep channel habitat within the restored marsh complex
    - Design marsh channels to connect the mouths of the realigned creeks to the decommissioned cooling channels
    - Implement water control structures (e.g. flap gates) at realigned creek mouths
- Create stormwater retention basins in open areas along creeks

Potential long-term measures:

- If the diked wetland complex is acquired for marsh restoration, reconnect to tidal action when optimal to do so

6. Next steps

A clear governance structure and decision-making process is needed to move adaptation planning forward along Bay Point OLU's shoreline. A key first step in this process will be the development of an adaptation working group to ensure the voices of all stakeholders are heard, particularly that of local landowners and community members, and stakeholders from state, regional, tribal, and local agencies.

Once the working group is created and governance structure decided, moving from vulnerability assessments to adaptation visions with broad stakeholder support will be key. This process may entail envisioning desired scenarios (e.g., hold the line, maximize ecological opportunities) and development of adaptation strategies to achieve them, evaluating trade-offs between each scenario, and prioritizing strategies based on SLR triggers and stakeholder values. The information described in this memo could be incorporated into the development of future adaptation strategies for Bay Point's shoreline if the measures align with stakeholder priorities. In addition, more extensive nature-based adaptation opportunities may be possible in the long term with more changes to existing development than discussed here.

The sooner adaptation planning begins along Bay Point's shoreline, the more opportunity there will be to start implementing early actions to safeguard communities, infrastructure, and industry from the far-reaching impacts of SLR and future flooding. A list of potential stakeholders to kickstart the process of forming an adaptation working group is provided below:

POTENTIAL STAKEHOLDERS

Key landowners:

- Union Pacific railway
- BNSF Railway
- U.S. Army (MOTCO)
- General Chemical West Bay Point Works
- East Bay Regional Park District
- California State Lands Commission
- McAvoy Yacht Harbor
- PG&E
- NRG Delta, LLC

Local communities and agencies:

- Residential and commercial landowners around W 10th St. and Willow Pass Rd.
- Residents of the Shore Acres neighborhood and surrounding neighborhoods in Bay Point
- Residents of Pittsburg

- Cortina Band of Indians
- Ione Band of Miwok Indians
- Contra Costa County Board of Supervisors, District V
- Mayor of Concord
- Mayor of Pittsburg
- Ambrose Recreation and Park District

Regional and State Agencies:

- Association of Bay Area Governments
- East Bay Regional Park District
- Bay Area Ridge Trail
- California Department of Fish and Wildlife
- California State Clearinghouse
- California Department of Toxic Substances Control
- California Department of Water Resources
- California Ocean Protection Council
- San Francisco Bay Regional Water Quality Control Board
- Bay Conservation and Development Commission
- State Historic Preservation Office
- State Assembly, District 14

Federal Agencies:

- Fish and Wildlife Service
- National Marine Fisheries Service
- National Park Service
- U.S. Army Corps of Engineers
- Environmental Protection Agency, Region 9
- Federal Emergency Management Agency
- 11th Congressional District

7. References

AECOM. 2016. San Francisco Bay Tidal Datums and Extreme Tides Study, Final Report.

ATSDR (Agency for Toxic Substances and Disease Registry). 2010. ATSDR Hazardous Waste Site Polygon Data, Version 2. Socioeconomic Data and Applications Center (SEDAC), Palisades, NY.

Balance Hydrologics. 2017. Stormwater Infrastructure Assessment Bay Point, California. Berkeley, CA: Balance Hydrologics, Inc. https://thewatershedproject.org/wp-content/uploads/2018/06/Stormwater-Infrastructure-Assessment-Bay-Point.pdf.

Barnard, P.L., van Ormondt, M., Erikson, L.H., Eshleman, J., Hapke, C., Ruggiero, P., Adams, P.N., and A.C. Foxgrover. 2014. Development of the Coastal Storm Modeling System (CoSMoS) for Predicting the Impact of Storms on High-Energy, Active-Margin Coasts. Natural Hazards 74:1095-1125.

BCDC (Bay Conservation and Development Commission). 2017. Adapting to Rising Tides: Contra Costa County Assessment and Adaptation Project. San Francisco, CA: San Francisco Bay Conservation and Development Commission. http://www.adaptingtorisingtides.org/project/contra-costa-county-adapting-to-rising-tides-project/.

BCDC (Bay Conservation and Development Commission). 2020. Adapting to Rising Tides: East Contra Costa County Vulnerability Assessment & Adaptation Project. San Francisco, CA: San Francisco Bay Conservation and Development Commission. http://www.adaptingtorisingtides.org/project/eastern-contra-costa-county/.

Befus, K.M., Barnard, P.L., Hoover, D.J., Finzi Hart, J.A., and C.I. Voss. 2020a. Increasing threat of coastal groundwater hazards from sea-level rise in California. Nature Climate Change.

Befus, K.M., Hoover, D.J., Barnard, P.L., and L.H. Erikson. 2020b. Projected responses of the coastal water table for California using present-day and future sea-level rise scenarios: U.S. Geological Survey data release, https://doi.org/10.5066/P9H5PBXP.

CalTrans. 2013. California Rail Network, GIS Data. California Department of Transportation.

CCC (Contra Costa County). 2022. "GIS Data Download." Contra Costa County, California. https://www.contracosta.ca.gov/1818/GIS.

CCHS (Contra Costa Health Services). General Chemical West Bay Point Works Fact Sheet. Martinez, CA: CCHS Hazardous Materials Office, 2006. https://cchealth.org/hazmat/pdf/gen_chemical_bp_fact_sheet_2006.pdf.

CCPC (City Council and Planning Commission). 2021. "Site Reuse Assessment - Opportunity Area A: NRG Revitalization Site." In Land Use Alternatives and Capacity Report. Pittsburg, CA: City of Pittsburg Planning Division. https://static1.squarespace.com/static/5c741fe1b10f25b8de62226a/t/613ed9332e6f8b39bc4c03dc/1631508805684/SiteReuseAssessmentReport_NRG-Area+A_9-8-21.pdf.

CPAD (California Protected Areas Database). 2017. California Protected Areas Database (CPAD). Greeninfo Network.

DCD (Department of Conservation and Development). 2014. Contra Costa County Northern Waterfront Atlas. Martinez, CA: Contra Costa County Department of Conservation and Development. https://www.contracosta.ca.gov/DocumentCenter/View/28747/NorthernWaterfrontAtlas_Feb2014?bidId=.

DCD (Department of Conservation and Development). 2020. "Bay Point Context." Envision Contra Costa 2040, Contra Costa County, Accesses March 15, 2022. https://envisioncontracosta2040.org/wp-content/uploads/2020/02/BayPoint_Draft_01-30-2020_corrected-1.pdf.

Dusterhoff, S., McKnight, K., Grenier, L., and N. Kauffman. 2021. Sediment for Survival: A Strategy for the Resilience of Bay Wetlands in the Lower San Francisco Estuary. SFEI Contribution No. 1015. San Francisco Estuary Institute: Richmond, CA.

EBRPD (East Bay Regional Park District). 2022a. "Bay Point Regional Shoreline." East Bay Regional Park District. Accessed February 20, 2022. https://www.ebparks.org/parks/bay-point.

EBRPD (East Bay Regional Park District). 2022b. "When Water Rises, So Will We!" East Bay Regional Park District. Accessed February 20, 2022. https://www.ebparks.org/sites/default/files/baypoint_whenwaterrises.pdf

EBRPD (East Bay Regional Park District). 2022c. "Railways of Bay Point." East Bay Regional Park District. Accessed February 20, 2022. https://www.ebparks.org/sites/default/files/baypoint_railways.pdf

EBT (East Bay Times). 2018. "Pittsburg Power Plant Restarts Operations, Reclaims Title of Largest in Bay Area." East Bay Times. Published February 27, 2018. https://www.eastbaytimes.com/2018/02/26/pittsburg-power-plant-restarts-full-operations-reclaims-title-of-largest-in-bay-area/.

FEMA (Federal Emergency Management Agency). 2021. "FEMA Flood Hazard Zones." Metropolitan Transportation Commission. https://mtc.maps.arcgis.com/home/item.html?id=929195bc63d74955bb54cf26c94b7659.

FSC (Foundation Sportsman Club). 2022. "Original Sturgeon Derby." Foundation Sportsman Club. Accessed March 12, 2022. http://www.originalsturgeonderby.com/.

Goals Project. 2015. The Baylands and Climate Change: What We Can Do. The 2015 Science Update to the Baylands Ecosystem Habitat Goals Prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. California State Coastal Conservancy, Oakland, CA

Google Earth. 2022. Map of Bay Point, CA. Google Earth. Accessed March 02, 2022. earth.google.com/web/.

LoopNet. 2020. "696 W 10th St Pittsburg, CA 94565 Land For Sale 115.50 AC." LoopNet. Accessed February 21, 2022. https://www.loopnet.com/Listing/696-W-10th-St-Pittsburg-CA/18252417/.

MOTCO (Military Ocean Terminal Concord). 2017. "Chapter 3: Affected Environment." In Final Supplemental Assessment for Pier 2 Modernization and Repair Design Changes at Military Ocean Terminal Concord, CA. Concord, CA: Military Ocean Terminal Concord, 2017. Pgs. 48-50.

MOTCO (Military Ocean Terminal Concord). 2021a. Draft Final Programmatic Environmental Assessment for Routine Maintenance and Repair at Military Ocean Terminal Concord, CA. Concord, CA: Military Ocean Terminal Concord, 2021. https://www.sddc.army.mil/motco/Shared%20Documents/Forms/AllItems.aspx.

MOTCO (Military Ocean Terminal Concord). 2021b. "Appendix B." In Draft Final Programmatic Environmental Assessment for Routine Maintenance and Repair at Military Ocean Terminal Concord. Concord, CA: U.S. Army, 2021. https://www.sddc.army.mil/motco/Shared%20Documents/Forms/AllItems.aspx.

MTC (Metropolitan Transportation Commission). 2017a. Passenger Rail Stations, Spatial Dataset.

MTC (Metropolitan Transportation Commission). 2017b. Passenger Railways, Spatial Dataset.

Nederhoff, K., Saleh, R., Tehranirad, B., Herdman, L., Erikson, L., Barnard, P.L. and M. Van der Wegen. 2021. Drivers of extreme water levels in a large, urban, high-energy coastal estuary–A case study of the San Francisco Bay. Coastal Engineering, 170, p.103984.

NPS (National Park Service). 2022. "Port Chicago Naval Magazine." U.S. Department of the Interior, Accessed March 1, 2022. https://www.nps.gov/poch/index.htm.

NWWM (National WWII Museum). 2020. "The Port Chicago 50 at 76: Time for Exoneration by Thurgood Marshall, Jr. and John A. Lawrence." The National WWII Museum, 2022. March 1. https://www.nationalww2museum.org/war/articles/port-chicago-exoneration-thurgood-marshall-jr-john-lawrence.

PBCS (Point Blue Conservation Science), SFEI (San Francisco Estuary Institute, and County of Marin. 2019. Sea Level Rise Adaptation Framework - A user guide to planning with nature as demonstrated in Marin County. Point Blue Conservation Science (Contribution #2239), Petaluma, CA. San Francisco Estuary Institute (Publication #946), Richmond, CA. Version: 1.0, August 2019

PG&E (Pacific Gas & Electric). 2022. "Shell Pond Cleanup & Wetland Restoration." Pacific Gas & Electric. February 25. https://www.pge.com/en_US/about-pge/environment/taking-responsibility/shell-pond-cleanup-and-wetland-restoration/shell-pond-cleanup-and-wetland-restoration.page.

Robinson, A., Fulfrost, B., Lowe, J., Nutters, H., and J. Bradt. 2017. Transition Zone Mapping Methodology: Integrating the Bay Margin and Upper Boundary Methods. San Francisco Estuary Partnership, San Francisco Estuary Institute.

SFEI. 2016. San Francisco Bay Shore Inventory. San Francisco Estuary Institute, Richmond, CA.

SFEI. 2021. Ecotone Levees and Wildlife Connectivity: A Technical Update to the Adaptation Atlas. Page 64. San Francisco Estuary Institute, Richmond, CA.

SFEI-ASC (San Francisco Estuary Institute-Aquatic Science Center). 2017. Bay Area Aquatic Resource Inventory (BAARI) Version 2.1 GIS Data.

SFEI and SPUR. 2019. San Francisco Bay Shoreline Adaptation Atlas: Working with Nature to Plan for Sea Level Rise Using Operational Landscape Units. San Francisco Estuary Institute, Richmond, CA.

Stanford, B., Grossinger, R.M., Askevold, R.A., Whipple, A.W., Leidy, R.A., Beller, E.E., Salomon, M.N., and C.J. Striplen. 2011. East Contra Costa County Historical Ecology Study. Prepared for Contra Costa County and the Contra Costa Watershed Forum. A Report of SFEI's Historical Ecology Program, SFEI Publication #648, San Francisco Estuary Institute, Oakland, CA.

SWRCB (State Water Resources Control Board). 2022. GeoTracker. [web application]. Accessed February 2022. https://geotracker.waterboards.ca.gov/

Tetra Tech. 2008. "Chapter 7: Facility Profiles (L. Pittsburg Power Plant)." In California's Coastal Power Plants: Alternative Cooling System Analysis. Golden, CO: Tetra Tech, Inc. http://www.opc.ca.gov/webmaster/ftp/project_pages/OTC/engineering%20study/CA_Power_Plant_Analysis_Complete.pdf.

Vandever, J., Lightner, M., Kassem, S., Guyenet, J., Mak, M., and C. Bonham-Carter. 2017. Adapting to Rising Tides: Bay Area Sea Level Rise Analysis and Mapping Project. BCDC, MTC, Bay Area Toll Authority, AECOM.

Veloz, S., Fitzgibbon, M., Stralberg, D., Michaile, S., Jongsomjit, D., Moody, D., Nur, N., Salas, L., Wood, J., Elrod, M., and G. Ballard. 2014. Future San Francisco Bay Tidal Marshes: A climate-smart planning tool. [web application]. Petaluma, California. (www.pointblue.org/sfbayslr).

Wikipedia. 2022. "List of Power Stations in California." Wikipedia. Accessed March 12, 2022. https://en.wikipedia.org/wiki/List_of_power_stations_in_California.