SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY, CA

DRAFT APPENDIX D ENVIRONMENTAL AND CULTURAL RESOURCES

JANUARY 2024

USACE TULSA DISTRICT | THE PORT OF SAN FRANCISCO

US Army Corps of Engineers

PORT OF SAN FRANCISCO

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SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY, CA

DRAFT APPENDIX D-1 ENVIRONMENTAL AND CULTURAL TECHNICAL APPENDIX

JANUARY 2024

USACE TULSA DISTRICT | THE PORT OF SAN FRANCISCO

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1.0 Introduction

The U.S. Army Corps of Engineers, Tulsa District, (USACE) prepared this draft environmental impact statement (EIS) for the San Francisco Waterfront Coastal Flood Study (SFWCFS) feasibility study. It is a requirement of USACE planning policy and the National Environmental Policy Act (NEPA) of 1969 to make a report available for public review that describes analysis, risks, assumptions, and decisions made by the Study team during the planning process. NEPA requires federal agencies, including USACE, to consider the potential environmental impacts of their proposed actions and any reasonable alternative plan before undertaking a major federal action, as defined by 40 Code of Federal Regulations (CFR) 1508.1(q). To evaluate potential environmental impacts, USACE prepared a draft integrated feasibility report and environmental impact statement (DIFR/EIS). An EIS is a supporting document that is the most thorough and comprehensive level of NEPA documentation used to assist in making decisions. Based on recent guidance to the Study team, the DIFR/EIS was condensed for public readability, thus, the EIS could not be fully incorporated into the main report. Instead, the technical details were reserved for this appendix to divulge the full range of environmental conditions and potential impacts to the natural and human environment as a result of proposed actions. As such, the summaries provided in the main report are supported by the detailed information provided throughout this technical environmental and cultural resources appendix.

This technical appendix provides detailed descriptions of the existing conditions and analyses of the environmental consequences for the natural and human environment of the study area. Information detailed herein was used to develop the summaries provided in the DIFR-EIS. This appendix is structured in the following manner:

Chapter 1: Provides an introduction to the technical appendix.

Chapter 2: Describes the array of alternatives considered for the SFWCFS Project.

Chapter 3: Details the affected environment for natural and human resources in the study area.

Chapter 4: Analyzes and describes the environmental consequences of alternative plans for the SFWCFS study, including a brief explanation of alternatives being analyzed. It is organized similarly to Section 3.

Chapter 5: Provides an overview of compliance status with various environmental laws.

Chapter 6: Lists references cited.

Natural and physical resource sections, such as climate change, geology, hydrology and hydraulics, aquatic and upland resources, etc. are provided in this main technical appendix. Additionally, cultural resources, utilities, recreation and access, aesthetics, and public health and safety are also included. The sub-sections of regional air quality, noise and vibration, socioeconomics and community, environmental justice, transportation, and land use are provided in separate sub-appendices to this technical appendix. The sub-appendix is referenced in the appropriate sections of this report. Each sub-appendix is structured to describe the affected environment and the environmental consequences for each resource.

1.1 Study Overview

Low-lying assets and economic activity along the San Francisco Waterfront are at risk of flooding from coastal storms and extreme high tides. As well as at risk from potential failure of the century-old San Francisco seawall, which could result from structural instability, land subsidence, or an earthquake. Without Federal action, it is expected that future sea level change (SLC) will increase the frequency and depth of tidal flooding along the shoreline, thereby increasing economic damages and coastal storm risk to one of the nation’s most iconic waterfronts.

This study is being conducted under the authority of Section 110 of the Rivers and Harbors Act of 1950 and Section 142 of Water Resources Development Act (WRDA) 1976, as amended by Section 705 of WRDA 1986, and Section 203 of WRDA 2020. The purpose of the study is to investigate and identify ways to reduce coastal flood risk along 7.5 miles of the San Francisco Waterfront by evaluating alternatives to meet current and future coastal flood risk management (CFRM) needs.

The non-federal sponsor (NFS) for the study is the Port of San Francisco (Port). The Port oversees the administration of the public trust for the State of California under the Burton Act, ensuring that public trust uses such as maritime, public access, historic resources, visitor-serving uses, and water-related and dependent uses are preserved and maintained along the waterfront.

1.1.1 Study Area

The study area extends approximately 7.5 miles from Aquatic Park in the northeast to just past Heron’s Head Park in the south. The study area is divided into four reaches and fifteen sub-reaches for conducting and evaluating coastal process and economic analyses (Figure 1-1). These reaches were selected based on hydrologic separability, identified geographic references, specific wave action within each reach, and major differences in physical structure inventory within the reach.

Figure 1-1. Study Area

1.1.2 Study Scope

The study scope includes an assessment of existing and future without project conditions under a range of relative sea level change (RSLC) scenarios for a 100-year period of analysis (2040 to 2140). The study will evaluate alternatives that meet current and future coastal flood risk management needs. The Study Team is using a 100-year period of analysis because of the long-lived infrastructure, the sensitivity to RSLC, the level of disruption that may be required for adaptation in a highly urbanized locale, and the need for flexibility, adaptability, and scalability in the alternatives to address uncertain timing of increased flood risk due to RSLC.

2.0 Alternatives Considered

Plan formulation in response to the study authority was conducted in two broad phases. An initial planning iteration considered distinctly different conceptual approaches to manage the coastal flood risk in the region. The USACE San Francisco District PDT conducted an initial screening of the conceptual approaches including a deployable water management structure at the Golden Gate Bridge, an offshore wave attenuator, several scales of offshore barriers, perimeter plans along the Bay coastline and two forms of retreat.

The USACE Tulsa District completed the second and most significant phase of plan formulation where the perimeter and retreat plans were further developed, and measures were identified at the reach level and are known as the focused array of alternatives. The Study Team formulated an array of alternatives that would reduce the risk of flooding along the waterfront by considering the three USACE sea level rise curve scenarios (low, intermediate and high), alignment of the line of defense relative to the existing shoreline, and adaptability of the scale of alignment of the measures to address higher sea levels if certain risk thresholds are reached after construction. The array of alternatives are distinctly different alternatives and formulated using three strategies – accommodate, defend, or combination of accommodate and defend/hybrid – to address the problems. The defend strategy is designed to minimize risk at the current shoreline or set back slightly from the shoreline, while accommodate would include measures that allow flood waters to enter the area and people and assets at risk would be moved out of the way of water. The hybrid plans include a combination of the two. The alternatives each include structural, non-structural, and Natural and Nature-Based Features (NNBFs). The adaptability of each measure was considered to establish the first increment of scale and timing of construction to ensure performance over the period of analysis.

NNBFs were included where appropriate and possible, to address the study problems by maximizing natural processes to deliver project benefits in lieu of or to enhance performance of more traditional "gray" infrastructure. An extensive array of NNBF was formulated for each of the alternatives as well as separately (Appendix I) since they can be added to most of the plans in the focused array.

The Focused Array of Alternatives included:

- Alternative A: No Action
- Alternative B: Nonstructural
- Alternative C: Defend, Scaled for Lower Risk
- Alternative D: Defend, Scaled for Low-Moderate Risk
- Alternative E: Defend Existing Shoreline, Scaled for Higher Risk
- Alternative F: Manage the Water, Scaled for Higher Risk

- Alternative G: Partial Retreat, Scaled for Higher Risk

Each alternative in the focused array was assessed for costs and benefits, with a high-level consideration for any impacts to the natural or human environment and took into consideration the ability to mitigate impacts and be compliant with the various environmental laws. Consistent with study guidance, the alternative plans were evaluated under three USACE RSLC scenarios. Since coastal flood events have little variation in water surface elevation from small to extreme events, flood risk is primarily driven by RSLC in combination with coastal storms. The variation of scale and type of actions across alternatives was a strategic approach to assess the difference in performance under uncertain timing of RSLC.

Alternatives D, E, F, and G were all designed to be adaptive, with a second action assumed to be needed in 2090, although the actual timing of implementation would be dependent on RSLC monitoring and thresholds. This second action both increased the finished elevation of the structural measure, thereby providing a higher level of risk management, but also, in some cases, changed the alignment. The Second Action alignments similarly followed the strategies as the first action by defending at the shoreline, accommodating or a combination of the two.

For the purposes of this study, broad assumptions were made regarding adaptation of the finger piers in Reaches 1, 2, and 3. For the purposes of preliminary cost estimates and analysis, the alternatives assume keeping finger piers at their current elevation and either dry floodproofing or a perimeter wall to reduce flood risk to pier sheds, occupants, and contents. The Non-Federal Sponsor will continue to study potential pier adaptation options and configurations to support future decision-making.

After the focused array was evaluated, the final array was identified and included development of a total net benefits plan (TNBP) and identification of a National Economic Development (NED) Plan. The TNBP was developed by varying plan features and alignments by reach to achieve benefits across four benefit categories including national and regional economics, environmental quality, and other social effects and includes risk reduction strategies that do not maximize net NED benefits, but that support adaptability under uncertain timing of RSLC. The NED Plan only looked at which reaches maximized economic benefits and again the focused array alternative that maximized economic benefits was selected for that reach. In addition to the final array, a list of “independent measures” were developed that represent a series of measures that were included (or were similar to a measure included) in one or more focused array alternatives, but the given alternative as a whole was not proposed for inclusion in the final array. The independent measures would be additive to the alternative selected for implementation.

The final array of alternatives, or the range of alternatives that are being seriously considered by the decision maker and that were thoroughly analyzed in the EIS include:

- No Action (NED Low Curve):
- **Alternative B (NED Intermediate Curve)**: Proposes nonstructural measures such as relocation, raise in place, floodproofing, and zoning in areas identified with frequent flooding.
- **Alternative F**: Uses a combination of structural, nonstructural, and NNBFs to defend at the existing shoreline, except for some managed retreat inland along the southern waterfront and tide gates at the mouths of Islais and Mission creeks. Additional retreat and adaptations are proposed as the rate of SLR increases.
- **Alternative G (NED High Curve)**: Uses a combination of structural, nonstructural, and NNBFs to defend against the high rate of SLR. This alternative concedes the largest area for managed retreat and incorporates more nonstructural and NNBF measures.
- **Total Net Benefits Plan:** Hybridized plan that relies on defend measures, scaled to perform under a lower initial risk and to adapt to risk of a higher rate of RSLC as a potential end point. Initial actions are proposed to delay expenditures and add height or adapt measures as risk increases over later years. This alternative hybridizes nonstructural, structural, and NNBF from multiple action alternative.
- **Independent Measures for Consideration:** Potential considerations for TSP refinement to further reduce coastal flood and seismic risks, reduce costs and impacts, and gain community benefits. Addresses geographically specific areas with structural and NNBF.

The following list of "independent measures" represents a series of measures included in the NEPA analysis separately. Each measure was included (or was similar to a measure included) in one or more alternatives, but the given alternative as a whole was not proposed for inclusion in the TSP. These measures include:

- **Living Seawalls:** textured concrete bolted onto the existing seawall in portions of reaches 1, 2, and 3 to reduce wave hazards while supporting nearshore ecology wherever current maritime uses and pier configurations allow.
- **2A) Robust Coastal Defense of Ferry Building and Agriculture Building**: realigns the coastal flood defense structure adjacent to the bayside edge of the Ferry Building and Agriculture Building (i.e., existing wharf would be moved further into the bay).
- **2B) Coarse Beach at Rincon Park connecting to Pier 14:** Coarse beach would be integrated into the design of the flood defense where space constraints require bay fill. This measure is similar to the measure for this location included in Alternative F (1st action).
- **3A) Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves from Bay Bridge to the mouth of Mission Creek:** raise the current shoreline and redesign of the northbound lanes of the Embarcadero roadway (in collaboration with SFMTA and the Embarcadero Enhancement Project), and the approach is intended to be designed to avoid reconstruction of the light rail track. This is comparable to Alternative G (1st action) for this site.

- **3B) McCovey Cove North Curb Extension:** raises the shoreline in line with the current shoreline edge on the north side of McCovey Cove (along the ballpark). This is comparable to Alternative G (1st action) for this site.
- **3C) Planted Naturalized or Embankment Shoreline on Mission Bay south of Pier 50:** integrates NNBF into the flood defense structure design to reduce wave hazards, support nearshore ecology, and provide public water access. This is comparable to Alternative F (1st action) for this site.
- **4A) Inland Coastal Flood Defense at Southwest Islais Creek:** Gradual area of retreat where the line of defense falls more landward and would convert some industrial and other public lands to open space allowing for more long-term flood defenses. This is comparable to Alternative G (2nd action) between 3rd Street Bridge and the inland extent of the channel.

From the final array, the Tentatively Selected Plan (TSP) or agency's preferred alternative, was selected. The TNBP was identified as the TSP.

Additional details on the plan formulation process, alignments and measures developed for the action alternatives can be found in Appendix A.

2.1 Avoidance and Minimization Measures

The TNBP avoids a significant amount of unavoidable adverse impacts to ecological habitats by placing the line of defense at or landward of the existing shoreline and designing the project to avoid bayfill to the greatest extent practicable and integrating engineering with nature where feasible. The following is a brief assessment of the avoidance and minimization measures by reach and action.

2.1.1 Reach 1

2.1.1.1 First Action

All measures are considered nonstructural, meaning the measure attempts to reduce the flood risk and the damages associated with flooding rather than focusing on reducing or modifying how the water moves through the area. By design, the nonstructural measures realize impacts at the immediate site of the measure which is often isolated to the structure itself (e.g. floodproofing, building demolition) and do not involve disturbance of ecological habitats. Construction of the 2-foot wall around the piers involves minimal construction efforts that would be completed from the pier and would not involve any in-water work which avoids impacts to any aquatic habitats.

Three of the five measures in this reach would provide long-term ecological benefits. Approximately 1.7 acres of land would be allowed to flood and be overtaken by RSLC from implementation of the retreat measure (1.6 acres) and building demolition (0.1 acres). In these locations, it is anticipated that intertidal habitat would be naturally created. Additionally, demolition of two piers would remove approximately 1.0 acre of piles, bayfill, and decking and allow the area to restore to higher quality open water and subtidal habitat.

2.1.1.2 Second Action

For the second action measures, the seawall alignment and associated seismic ground improvements are landward of the existing shoreline and behind the existing seawall where one currently exists. This design would not require any bayfill or in-water work to construct the features. To maintain the aesthetic quality and accessibility of the waterfront, a gradual slope has been incorporated into the design that will promote unity throughout waterfront that would generally be unnoticeable to the average visitor when the pre-construction and post-construction conditions are compared. The design allows accessibility to all (i.e. fewer steps and gentle slopes) and incorporates and maintains the historic features unique to the waterfront buy ensuring the architectural design and materials are consistent with the surrounding environment. This design creates more transportation impacts to achieve the target slope and seawall elevation but fully avoids any impact to aquatic habitats.

With the increase in ground elevation, approximately 3.25 acres of existing wharf would need to be rebuilt to the higher elevation resulting in temporary localized impacts to the aquatic environment during construction. Because of the design, there would be no increase in the footprint of the wharf, all existing wharf material would need to be removed and replaced with new, more eco-friendly materials, and fewer piles would be necessary per square foot than currently exists. Overall long-term benefits to the aquatic environment are expected from the net decrease in bay fill and removal of old materials (e.g. creosote piles) that contribute to poor water quality.

Other adaptive measures are nonstructural and would not impact any location except at the immediate structure. An additional 1.0 acre of building demolition would be completed that would result in similar beneficial impacts to the those described for the first action.

2.1.2 Reach 2

2.1.2.1 First Action

Similar to the second action in Reach 1, the first action in reach 2 involves constructing a seawall landward of the existing seawall and rebuilding approximately 6.3 acres of wharf. The design and construction methodology would be identical to Reach 1 second action and all the same avoidance and minimization efforts and long-term benefits described above would be applicable here. The difference here is that the action would be completed as a first action and not a second action.

2.1.2.2 Second Action

The TNBP does not include a second action in this reach since the first action is being constructed at a higher initial scale, unlike the other three reaches. By completing the 3.5-foot target elevation in the first action, the significant disturbance to the Embarcadero including transportation, recreation and cultural resource impacts and costs associated with reworking the same area twice are avoided.

2.1.3 Reach 3

2.1.3.1 First Action

In reach 3, all measures are constructed landward of the existing shoreline and would not require any in-water work, thus avoiding the need for bay fill and adverse impacts to aquatic habitats. Additionally, all impacts from construction have been avoided on approximately 7,500 linear feet of shoreline because the design was aligned to take advantage of existing high ground to avoid unnecessary construction of additional features. Instead of raising the bridges, deployables are proposed which avoids a significant amount of in-water work and disturbance associated with replacing two bridges.

2.1.3.2 Second Action

The first action measures have each been designed to be adaptable to future design modifications to address SLC conditions. Based on the designs at this time, the second action would not abandoned the first action structures and thereby avoids the need for construction or conversion of lands to impervious surfaces outside the first action construction footprint. As with the other measures, the designs and construction methodology avoid all aquatic impacts.

2.1.4 Reach 4

2.1.4.1 First Action

Like the other reaches, all measures are constructed landward of the existing shoreline and would not require any in-water work, thus avoiding the need for bay fill and adverse impacts to aquatic habitats. Additionally, all impacts from construction have been avoided on approximately 6,500 linear feet of shoreline because the design was aligned to take advantage of existing high ground to avoid unnecessary construction of additional features. Similar to reach 3, the impacts of raising of existing bridges would be avoided by relying on deployables for flood defense. Similar to reach 1 first action, approximately 0.75 acres of building demolition would occur allowing these areas to convert to intertidal or sub-tidal habitat, while an additional 2.0 acres of building demolition would occur and be converted to open space.

2.1.4.2 Second Action

The second action avoidance and minimization measures described for reach 3 also apply in reach 4. Additionally, NNBF features have been incorporated into the designs that allow for ecological enhancements while supporting and enhancing the performance of the flood defense structures.

2.1.5 Independent Measures for Consideration

All NNBFs (living seawalls, 2B, and 3C) minimize the long-term adverse impacts of the engineered structure despite some temporary aquatic impacts during construction. By incorporating NNBF into the design, natural processes and materials are used to reduce wave hazards, support nearshore ecology, and provide public water access in lieu of more traditional engineered designs and materials such as concrete, rip rap, or monoculture turf grass, which do not provide any long-term ecological or recreational benefits and are generally less visually desirable. Additionally, implementation of the NNBF avoids conversion of existing habitats into impervious surfaces.

For 3A, similar to other shoreline raises, this measure would be constructed entirely landward of the existing shoreline and avoids any impacts to aquatic habitats. Approximately 4.5 acres of wharf would also need to be rebuilt which would involve some temporary impacts, but overall result in long-term benefits from removal of old construction materials and a reduction in bay fill as described for reach 1 second action. The footprint would not be increased and therefore long-term changes from a footprint increase have been avoided. As well, the modified design in this location avoids disruptions and reconfiguration of the light rail system.

For 3B, this modification aligns the flood defense with the current shoreline edge on the north side of McCovey Cove (along the ballpark) and avoids needing to add fill or extend the shoreline into the creek, thus avoiding any aquatic impacts.

For 4A, the modification incorporates a small area of gradual retreat along the creek, resulting in long-term ecological benefits and avoidance of engineered structures and permanent impacts at or near the existing shoreline. These areas would be allowed flood and be overtaken by RSLC, which is expected to convert to marsh, intertidal or sub-tidal habitat. Long-term conversion of existing habitats into impervious surfaces would be avoided. As well, this conversion of some industrial lands and public facilities would provide public water access and additional open space.

3.0 Affected Environment

This chapter describes the existing condition of resources in the study area as of the date of the Notice of Intent (NOI) published July 27, 2023.

The structure of this chapter includes two important components including:

Regulatory Framework: This section describes the applicable federal, state, and local laws, regulations, and policies that apply to the topic being discussed. Details of federal and state regulations which require permits or other approvals or are relevant to several categories are briefly mentioned in this section and discussed in greater detail in Annex D-1-8: Regulatory Framework. Some resources will not have a regulatory framework but are described for a more complete understanding of the study area.

Existing Condition: This section describes the local and regional conditions that provide the baseline condition and sufficient context for evaluating effects of the alternatives.

3.1 General Overview of the Study Area

The affected environment for all natural resources includes the San Francisco Bay area and San Francisco Bay watershed located in San Francisco County. The timing and ability to know what changes would occur from existing conditions to the 50- and 100-year project condition (2040 and 2090) with SLR are difficult to predict, thus, it was assumed environmental conditions are likely to worsen overtime (i.e., result in habitat loss or degradation). This section focuses on describing existing conditions expected within the first 50 years of the study period.

Under the existing conditions and No Action Alternative, the measures proposed to protect against SLR would not be constructed. Rather, smaller-scale measures would be implemented that are likely to be inefficient at providing adequate protection from flooding to existing features along the San Francisco waterfront.

3.2 Air Quality

Air Quality affected environment is addressed in appendix D-1-1.

3.3 Climate Change

Climate refers to the long-term weather conditions that describe a region, whereas weather relates to short-term changes in the atmosphere (NOAA 2020).

3.3.1 Regulatory Framework

3.3.1.1 Federal

Executive Order (E.O.) 13990, Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis

EO 14008, Tackling the Climate Crisis Home and Abroad

3.3.1.2 State

CEQA

Bay Conservation and Development Commission (BCDC) – state commission dedicated to protection, enhancement, and responsible use of San Francisco Bay; requires climate assessment for any actions that may impact the Bay

Assembly Bill 1279 outlines the State's GHG reduction goals for achieving a 40 percent reduction below 1990 emissions levels by 2030 and an 85 percent reduction in anthropogenic emissions below 1990 emissions levels, as well as net-zero GHG emissions, no later than 2045.

3.3.1.3 Local

Climate Action Plan – sets goal to achieve net-zero GHG emissions.

Bay Area Air Quality Management District (BAAQMD) – develops the local elements of the State Implementation Plan for San Francisco Bay Area Air Basin

3.3.2 Existing Condition

San Francisco is straddled by sharp topography and marine environments that create a unique variety of microclimates. The San Francisco Bay area climate is classified as Mediterranean and is characterized by relatively dry, cool summers and mild winters (Null 1995). In the summertime, San Francisco experiences cool marine air and persistent coastal stratus and fog, with average temperatures between 60- and 70-degrees Fahrenheit (Null 1995). The cool marine air is influenced by the upwelling of cold water along the California coast, driven by oceanographic conditions that cause a net transport of surface water away from the shore that are consequently replaced by cold, upwelled water (Null 1995, Ahrens 1991). Winter temperatures are temperate with highs between 55- and 60-degrees Fahrenheit and lows between 45- to 50-degrees Fahrenheit (Null 1995).

Air temperature data from the National Center for Environmental Information demonstrate stable temperature over the last century with a slight positive trend in daily lows and highs (<0.02°F) (Figure 3-1). The Bay area is also defined by dense sea fogs, most frequent in the summer months, that occur due to the interaction of colder nearshore sea temperatures and warmer offshore waters. In effect, the dominant, warmer west winds cause condensation in the coastal regions, creating sea fog. On average, water temperatures within the bay range from 51 degrees Fahrenheit in the winter to 66 degrees Fahrenheit in late summer (Null 1995).

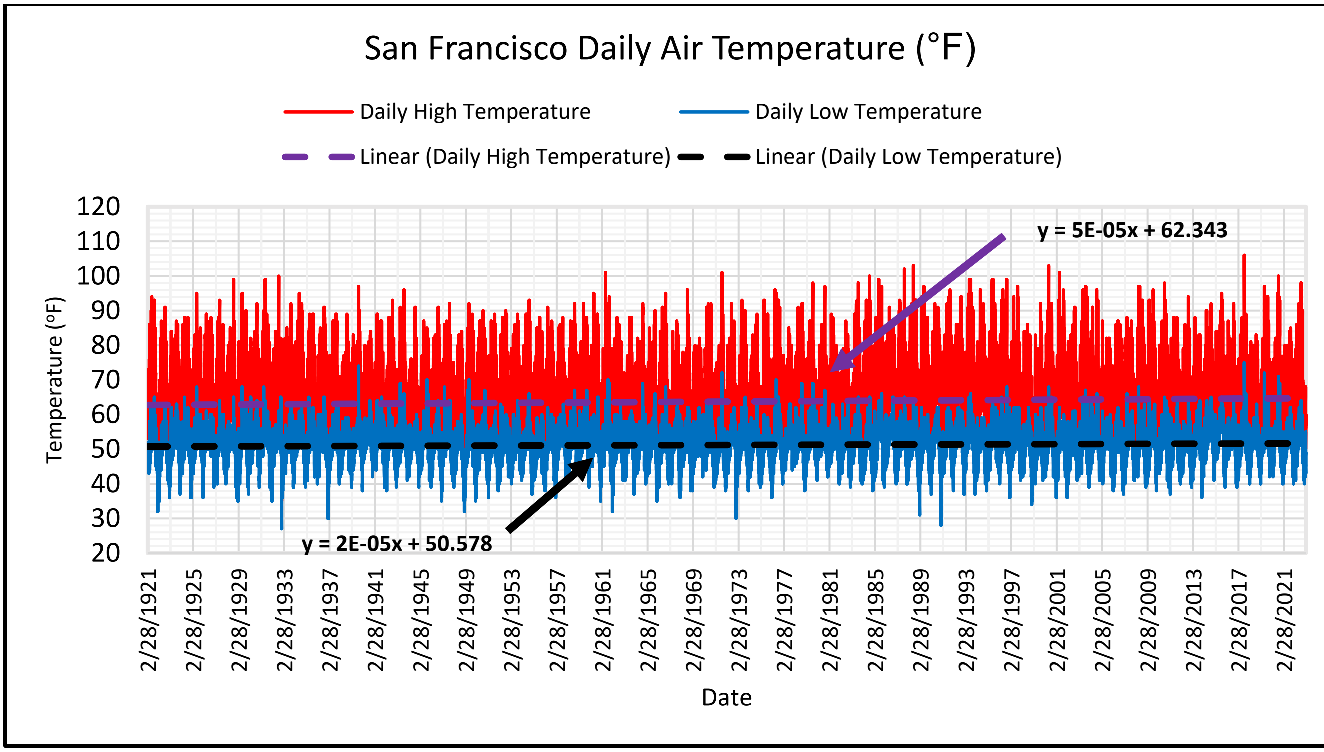

Figure 3-1: Daily ambient air temperature with daily highs (purple hashed) and lows (black hashed) highlighted (NCEI Station USW00023272, Downtown San Francisco)

Rainfall in San Francisco is seasonal, with over 80 percent occurring between November and March (Null 1995). Winter rains typically occur because of fronts primarily from the west-northwest and occasionally from the Gulf of Alaska. Spring and fall rain are infrequent, with most storms producing light precipitation during these periods (Null 1995). In general, hydrometeorological patterns in California are often associated with phenomena known as atmospheric river events. Atmospheric rivers (ARs) are narrow bands of low-level systems with high precipitable water content that extend from the tropics into the mid-latitudes (Climate 2015). In general, California's hydrometeorological data indicate robust patterns of AR events promote heavy rains and flooding. Conversely, drought conditions prevail when ARs are persistently low or weak (Climate 2015). Annual precipitation has been cyclical in the Bay area, varying from approximately 5 inches to 37 inches over the last century, but on average the region receives 20 to 23 inches of rain annually (Figure 3-2).

Droughts are also common in the San Francisco Bay Area, which can be tracked in the U.S. Drought Monitor. The U.S. Drought Monitor categorizes drought by intensity, ranging from D0 (abnormally dry) to D4 (exceptional drought), corresponding to the Palmer Drought Severity Index (PDSI). The PDSI is a standardized index ranging from -

10 (dry) to +10 (wet) used to quantify long-term drought (NCAR 2023). In the U.S. Drought Monitor, D0 corresponds to a PDSI of -1.0 to -1.9 and is characterized by short-term dryness that slows planting, crop growth, and may have some lingering water deficits, while a D4 indicates a PDSI of -5.0 or less with exceptional and widespread loss of crops or pastures, and water shortages in reservoirs and streams (Fuchs 2023). Over the last two decades, drought intensity has become more prevalent in the San Francisco Bay area with D3 (PDSI = -4.0 to -4.9) and D4 conditions spanning multiple years (Figure 3-3).

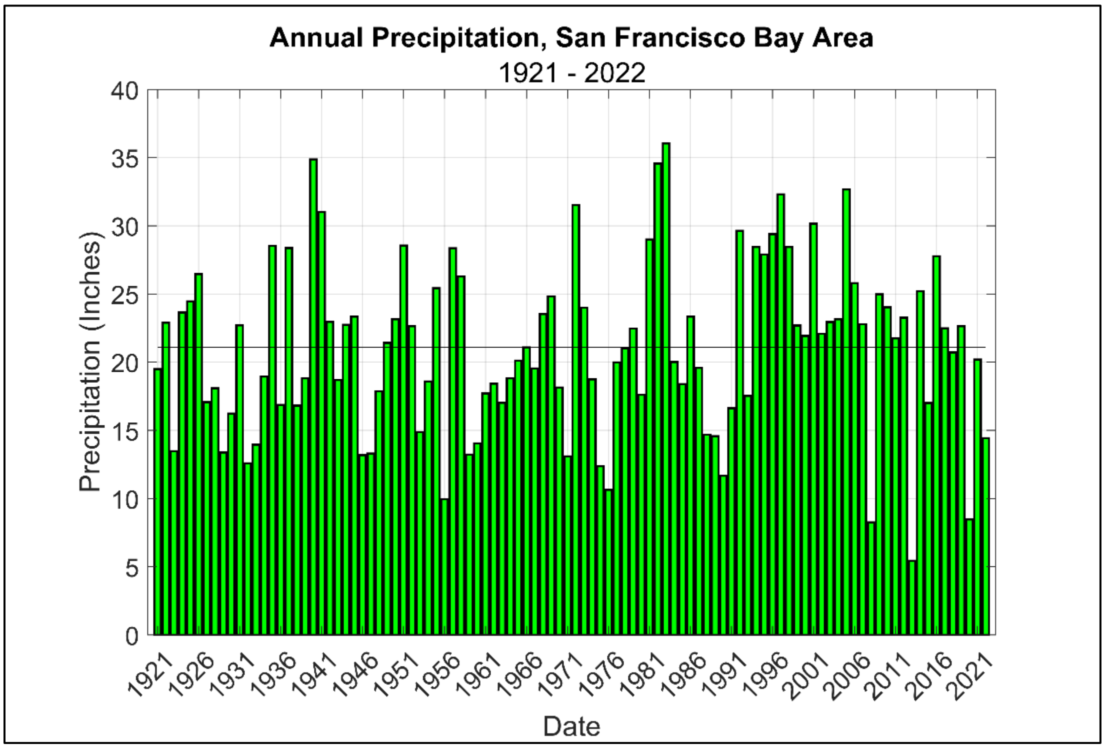

Figure 3-2: Annual Precipitation (inches) in the San Francisco Bay area from 1921 to 2021 (NCEI Station USW00023272, Downtown San Francisco)

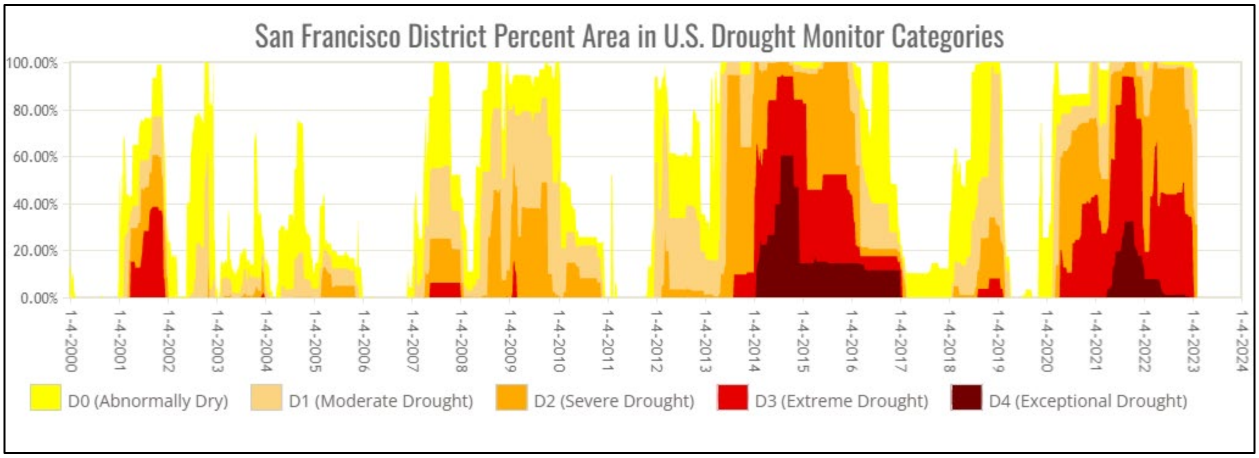

Figure 3-3: San Francisco district percent area in U.S. Drought Monitor categories from 2000 to 2023 (Fuchs 2023)

The San Francisco Bay is a large estuary with varying salinity, influenced by seasonality, local bathymetry, proximity to the Pacific Ocean, precipitation, and river discharge. Near downtown San Francisco, or Central Bay, the salinity profile is highly dependent on freshwater inflows from the northern tributaries, the Sacramento and San Joaquin Rivers, and the interaction with the Pacific Ocean (Figure 3-4). Winds and spring-neap tidal variations act as secondary drivers to the salt field (Hericks et al. 2017). Furthermore, during seasons of low precipitation and riverine discharge, controlled release efforts from the Central Valley Project and State Water Project work to stabilize salinity by manually releasing freshwater into the bay (Hericks et al. 2017).

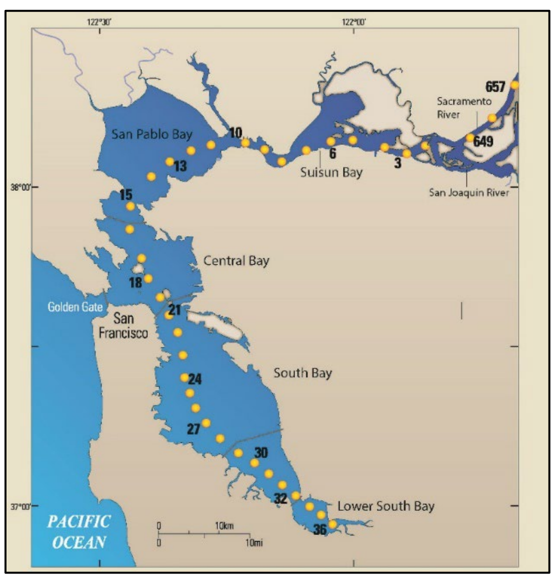

Figure 3-4: Map of U.S. Geological Survey water sampling sites in San Francisco Bay (Cloern and Schraga 2016)

In 2016, the U.S. Geological Survey released water quality data including water temperature and salinity measurements sampled from discrete locations across the San Francisco Bay over the course of nearly 47 years (1969 – 2016). Data from station 18 (Figure 3-4) were used to illustrate water temperature and salinity over approximately 30 years near San Francisco (Figure 3-5). Water temperatures have been recorded in the range of roughly 48.5 to 67.5 degrees Fahrenheit (Figure 3-5). Salinity at this location is most often in the range of 25 – 33 parts per thousand (ppt), though significant riverine discharge events have dropped the salinity to less than 10 ppt occasionally (Figure 3-5).

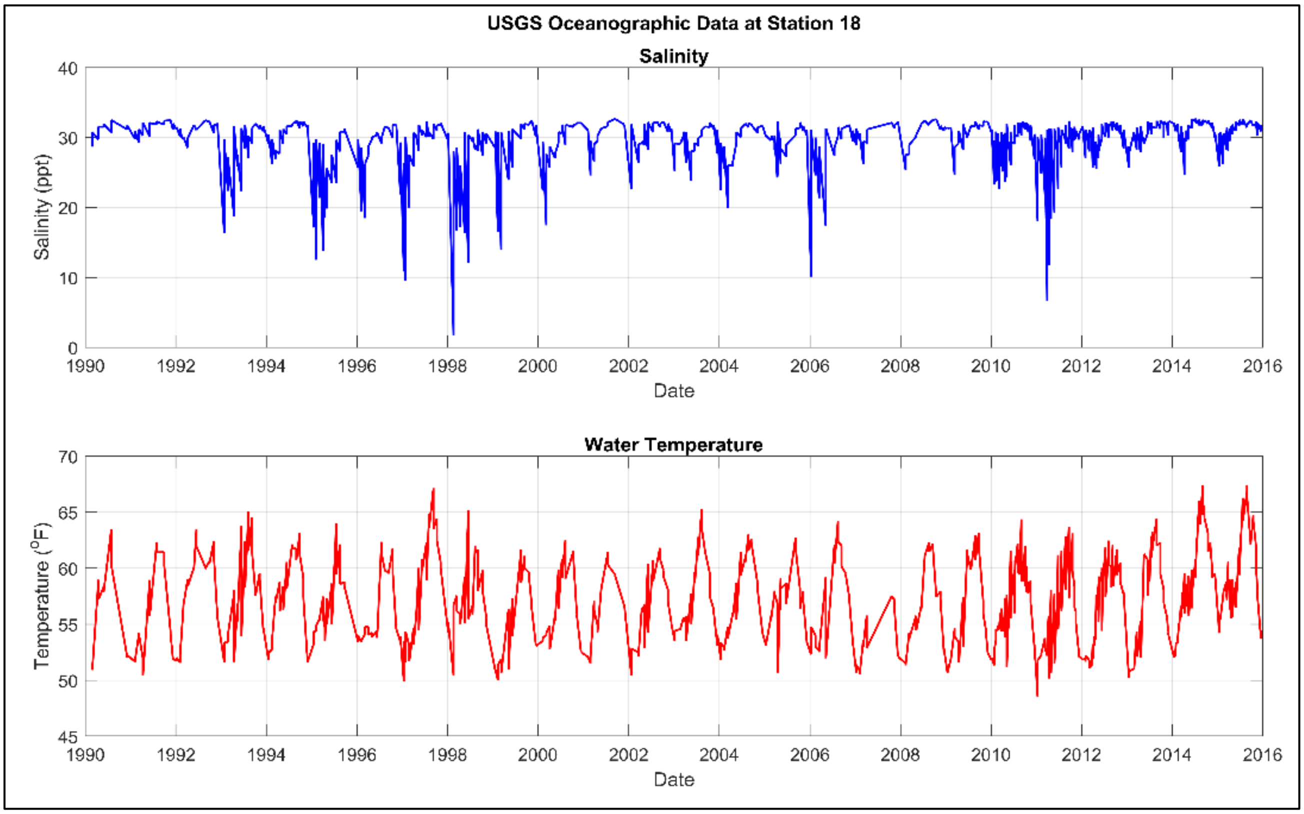

Figure 3-5: Temporal water quality parameters of salinity and temperature from Station 18 in San Francisco Bay (Cloern and Schraga 2016))

Sea level rise (SLR) is a primary impact of global climate change (Knowles 2010) and is a present and future risk to the U.S. (Hall et al. 2019). This combined with land subsidence, and other coastal flood factors such as storm surge, waves, rising water tables, river flows, and rainfall are likely to result in a dramatic net increase in the exposure and vulnerability of coastal populations (USGCRP 2017; Sweet et al. 2022). It is generally accepted that global climate warming will increase rates of SLR; however, the range in projected rates is wide due mainly to uncertainty in the amount of meltwater from land-based ice in Greenland and Antarctica (Knowles 2010).

The National Oceanic and Atmospheric Administration's (NOAA) Office for Coastal Management provides a web mapping tool to visualize community-level impacts from coastal flooding and SLR. The present day mean higher high water (MHHW) conditions were compared to 3 ft and 7 ft of SLR for the study area (Figure 3-6) using the NOAA SLR viewer (https://coast.noaa.gov/slr/).

Figure 3-6. NOAA SLR inundation viewer of the study area for MHHW conditions for present day (a), 3 ft of SLR (b), and 7 ft SLR (c).

Comparatively, the USACE has three SLR scenarios (low, intermediate, and high) that are predicated on data from the National Research Council and Intergovernmental Panel on Climate Change (IPCC). The USACE SLR scenarios with the 1% Annual Exceedance Probability (AEP) was mapped to contrast the NOAA SLR Viewer (Figure 3-7 through Figure 3-9).

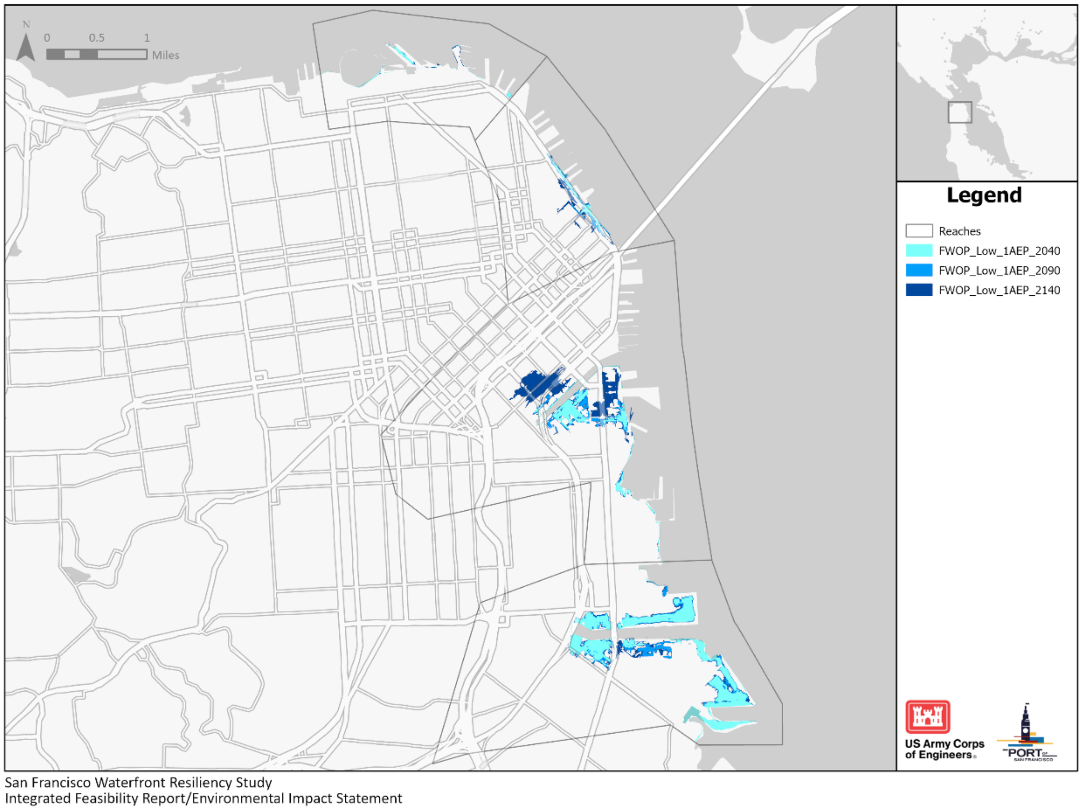

Figure 3-7. USACE Low RSLC and 1 percent AEP for 2040 (light blue), 2090 (blue), and 2140 (dark blue)

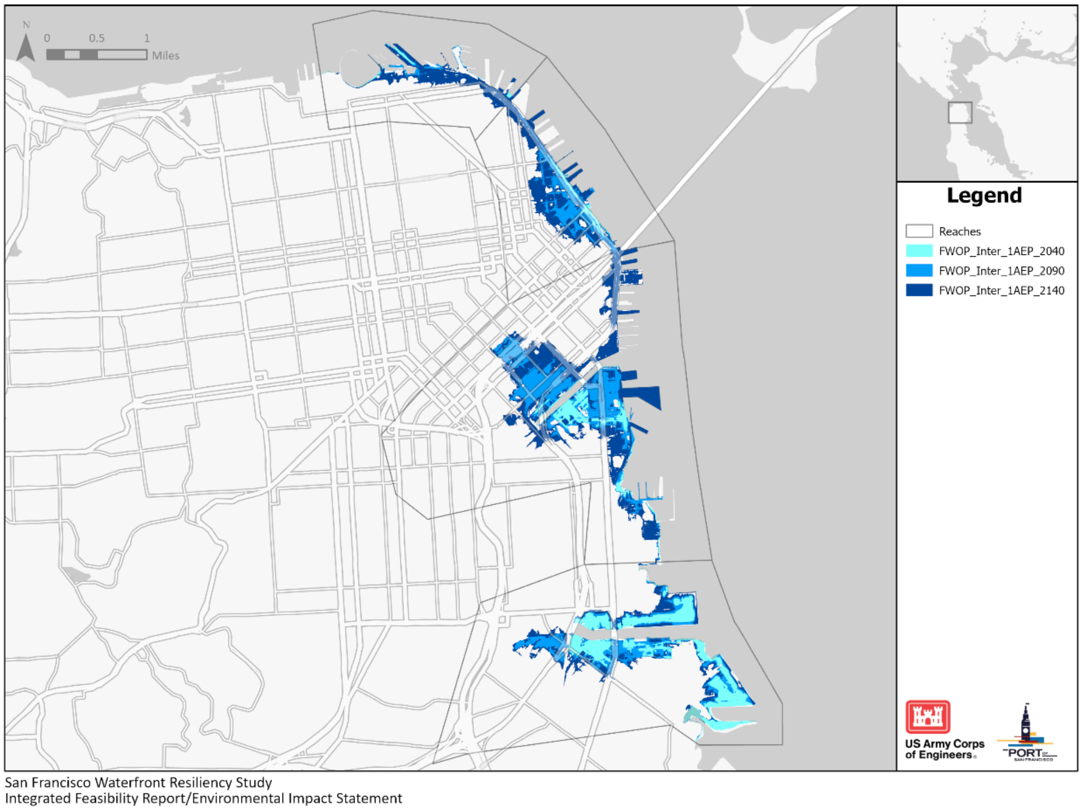

Figure 3-8. USACE Intermediate RSLC and 1 percent AEP for 2040 (light blue), 2090 (blue), and 2140 (dark blue)

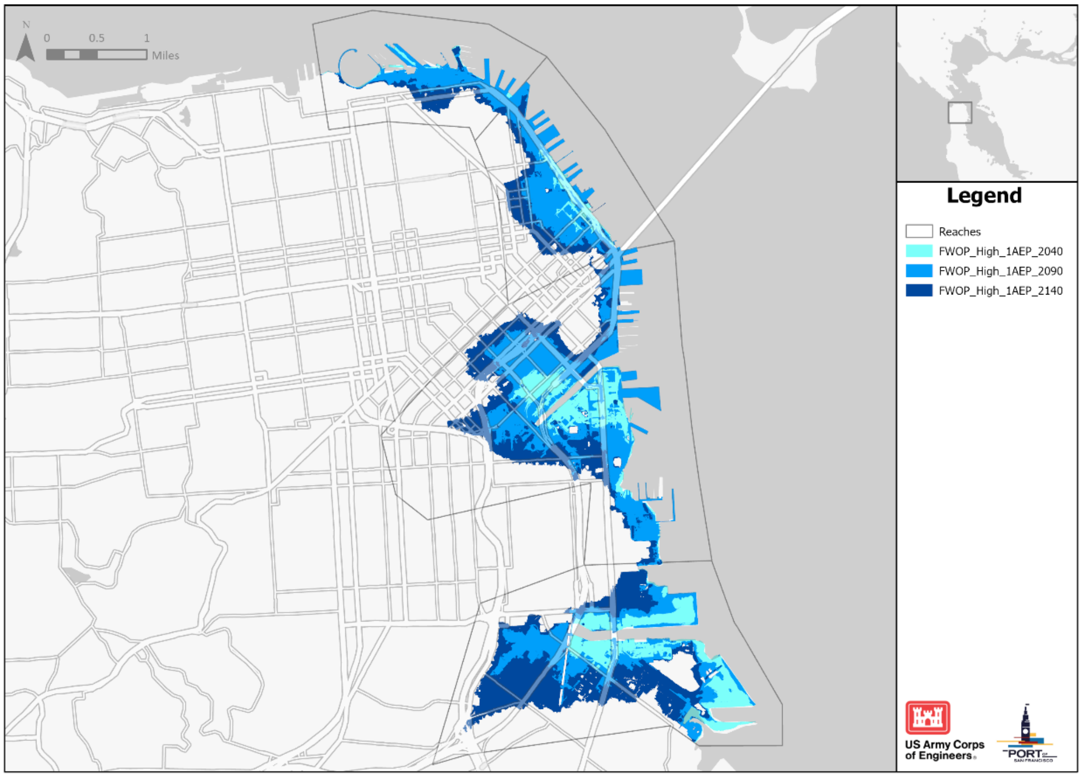

Figure 3-9. USACE High RSLC and 1 percent AEP for 2040 (light blue), 2090 (blue), and 2140 (dark blue)

3.4 Geology and Geomorphology

Geology is the study of the structure, evolution, and dynamics of Earth and its natural mineral and energy properties (USGS 2022a), while geomorphology is the study of the physical features of the Earth's surface and their relation to the geological structure (Stetler 2014). San Francisco is part of the California Coast Ranges geomorphic provinces and is characterized by a series of northwest-trending ridges and valleys that run nearly parallel to the San Andres fault zone (Norris and Webb 1990). The San Francisco Bay lies within a depression created by an expansion between the San Andres and Hayward fault systems. Much of the province is composed of marine sedimentary deposits and volcanic rocks (Norris and Webb 1990). Within this province, the Northern Coast Ranges, where project activities would occur, the geologic structure contains the Alcatraz terrane. The Alcatraz terrane is an amalgamation of semi coherent blocks that consists of shale, greenstone, basalt, chert, sandstone, graywacke, and serpentine. Much of these units originated from ancient seafloor sediments that were displaced and deformed through tectonic forces (CCSF 2017).

3.4.1 Regulatory Framework

3.4.1.1 Federal

No federal regulations or laws pertain to geology and geomorphology.

3.4.1.2 State

California Building Code – provides minimum standards for building design in the state

Seismic Hazards Mapping Act of 1990 – requires review of any proposed land use management, construction, etc. to encourage safety elements that reduce seismic hazards

3.4.1.3 Local

Port of San Francisco Building Code – provides minimum standards for building design and construction on Port property

San Francisco General Plan – provides standards to reduce structural and nonstructural hazards to life safety and minimize property damage resulting from future disasters, including considering geologic hazards

3.4.2 Existing Condition

3.4.2.1 Sediments

The sediments within San Francisco Bay originate from erosion of surrounding hills or from later marine and riverine deposits. Generally, the upper several feet of the sediment profile in San Francisco Bay consists of more recently deposited marine and riverine sediments. The thickness of various underlying historic sediment formations varies throughout the San Francisco Bay/Delta Estuary and it can be several hundred feet thick. Large areas of San Francisco Bay contain Bay Mud, a marine clay-silt deposit, that lie beneath softer, more recently deposited muds (USACE 2015). Because bay mud was not placed with modern engineering compaction techniques, it has less resistance to liquefaction (see below) and is more vulnerable to becoming unconsolidated during a seismic event (Hicock et al. 2008). Bay mud can be divided into younger and older, varying in engineering properties, dependent on thickness and consolidation (CCSF 2017).

San Francisco Bay surficial sediments have been deposited since industrialization began in California, and, thus, may have been exposed to anthropogenic sources of pollutants. Recent sand deposits may also be exposed to anthropogenic sources of pollutants but typically do not accumulate significant pollutant concentrations.

3.4.2.2 Seismicity

Several active faults traverse the San Francisco Bay watershed, including the Hayward fault zone, and the San Andres, San Gregorio, Concord-Green Valley, and Calaveras faults, which are the most likely sources of future earthquakes (e.g., CCCARTO 2022, CCSF 2017, Fialko 2006, Field & Milner 2008). The are no fault zones directly within the study area.

The U.S. Geological Survey (2015) predicted the San Francisco region had, on average, a 100 percent likelihood of experiencing a 5.0 magnitude or greater earthquake every year. The probability of experiencing a 7.0 magnitude earthquake decreases to 51 percent every 50 years. The Hayward-Rodgers Creek and Calaveras faults are the most likely to contribute to a large magnitude earthquake in the San Francisco region (USGS 2015).

The Federal Emergency Management Agency's (FEMA) Seismic Design Category ratings define the potential effects of shaking in the study area as follows:

D_1, D_2: very strong shaking – damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures.

E: strongest shaking – damage considerable in specially designed structures; frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. Shaking intense enough to completely destroy buildings.

Shaking intensity generally declines moving eastward from the study area, with the highest shaking potential centered on the Hayward and Green Valley fault zones (FEMA 2020).

3.4.2.3 Seismically induced Liquefaction

Liquefaction is a process in which saturated, loosely packed, coarse-grained soils transform from a solid to a near-liquid state as a result of seismic ground shaking (USGS 2022b). Liquefaction can cause slope instability, lateral spreading, loss of foundation bearing capacity, and ground settlement. An area can be susceptible to liquefaction (i.e., saturated sandy-to-silty Quaternary material is present) or it may raise to the level of a hazard (i.e., soil material is present, and it is likely a seismic event could displace sediment triggering liquefaction). Figure 3-10 presents a high-level overview of liquefaction susceptibility for the study area.

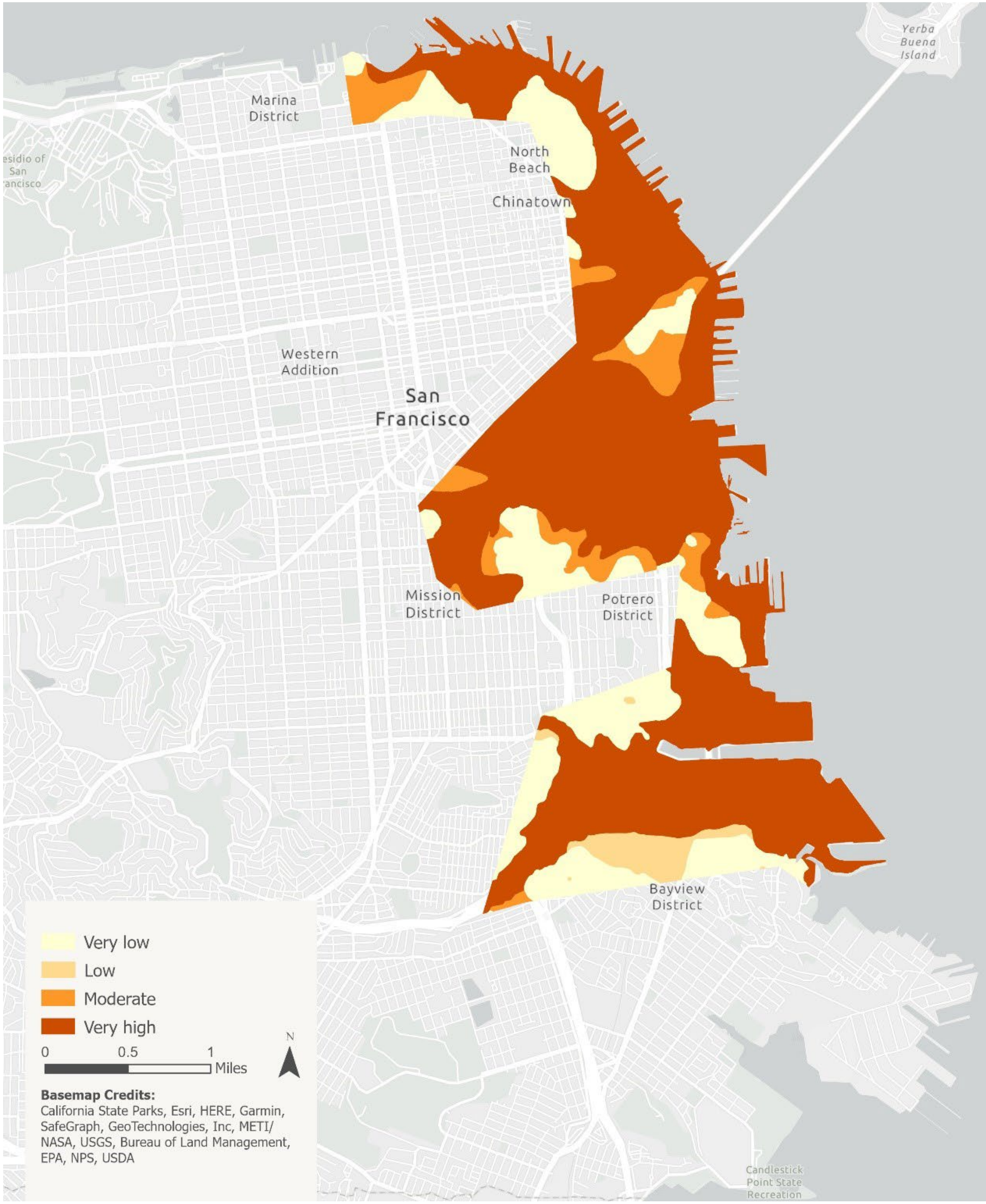

Figure 3-10. Earthquake Liquefaction Susceptibility. Source: USGC 2006, accessed via MTC/ABAG Hazard Viewer Map (MTC/ABAG 2021)

3.4.2.4 Upland geologic hazards

Upland areas may be susceptible to lateral spreading, subsidence, settlement, and erosion which may be caused or exacerbated by seismic activity. Comprehensive maps for these hazards have not been developed for the study area. Site susceptibility to these hazards is dependent upon their specific location, which has not been determined at this time.

3.4.2.5 Tsunamis and Seiches

Seismic activity has the potential to result in tsunamis or seiches, presenting a hydrologic hazard. Low-lying coastal areas, such as tidal flats, marsh lands, and former bay margins that have been artificially filled, but are still at or near sea level, are generally the most susceptible to tsunami inundation. The shoreline in the study area is within tsunamic inundation areas as delineated on the State's tsunami inundation maps (CEMA 2020).

A seiche is caused by oscillation of the surface of an enclosed water body, such as San Francisco Bay, resulting from an earthquake or large wind event. Seiches can result in long-period waves that cause run-up (i.e., uprush on the shoreline or structures above the still water level or overtopping of adjacent landmasses). The primary tsunami threat along the California coast is from distant earthquakes along subduction zones elsewhere in the Pacific basin.

3.5 Soils and Minerals

Soils are dynamic and diverse natural systems comprised of five components – minerals, soil organic matter, living organisms, gas, and water. Minerals are divided into three size categories – clay, silt, and sand (Needelman 2013) and can be composed of a number of different materials with a variety of origins. Soil formation is dominated by one of five factors – climate, vegetation, topography, parent material, or time – which contributes to different mineral assemblages within the soil (Heckman and Rasmussen 2018).

3.5.1 Regulatory Framework

3.5.1.1 Federal

No federal regulations or laws pertain to soils and minerals.

3.5.1.2 State

No state regulations or laws pertain to soils and minerals.

3.5.1.3 Local

No local regulations or laws pertain to soils and minerals.

3.5.2 Existing Condition

3.5.2.1 Soils

The San Francisco Bay area is comprised of a combination of residual (i.e., have formed in place) and depositional (i.e., transported from somewhere else) soils that are predominately clay, sand, loam, and peat-like organic matter (Hayes 2005). Much of the residual soil is fine in texture and formed from sedimentary rocks which over-time weathered to clay minerals and clay-like soils rich in nutrients. Many of the depositional soils occur along the wetlands where fine, clay-sized sediments were transported via marine currents or streams, and large-particle sand that were deposited by streams or carried by wind. Loamy soils are an optimal blend of sand, silt, and clay and are typically found in alluvial or depositional valley and bay fronts around the bay. Soils along the California coast contain approximately four percent organic material, while this lowers with inland soils to about one to two percent (Hayes 2005).

3.5.2.2 Mineral Resources

California hosts a diversity of mineral resources that can be categorized into metals, industrial minerals, and construction aggregate. Metals include gold, silver, iron, and copper. Industrial minerals include boron compounds, rare-earth elements, clay, limestone, gypsum, salt, and dimension stone. Construction aggregate is comprised of sand, gravel, and crushed stone (CGS 2019). San Francisco County historically produced mineral commodities such as boron, borate, and soapstone; however, the most recent record was 1969 (CGS 2022).

3.6 Hydrology and Hydraulics

Hydrology and hydraulics help with understanding and quantifying the flow magnitude, frequency, duration, timing, and variability of water flow and behavior (GeoEngineers 2023).

3.6.1 Regulatory Framework

3.6.1.1 Federal

Clean Water Act (CWA) – regulates point-source pollutant discharges into waters of the United States through effluent limits and establishing water quality standards on a water-body specific basis.

E.O. 11988, Flood Plain Management – directs Federal agencies to avoid, to the best extent practicable, long- and short-term adverse effects associated with the occupancy or modification of the base flood plain (1 percent annual event), and to avoid direct and indirect support of development in the base flood plain where practicable

3.6.1.2 State

Bay Area Stormwater Management Agencies Association – focuses on regional challenges and opportunities to improve the quality of stormwater flows in creeks, the Delta, San Francisco Bay, and the Pacific Ocean

Bay Conservation and Development Commission (BCDC)

3.6.1.3 Local

San Francisco Public Utilities Commission

3.6.2 Existing Condition

3.6.2.1 Surface Water

3.6.2.1.1 Tides and Currents

San Francisco Bay is characterized by broad narrow shoals and narrow channels that result in a complex tidal system with a complex bathymetry that contribute to large spatial variability in flow properties. The interactions among tidal processes, bathymetric complexities, and shoreline orientation amplify tidal ranges, with tides increasing with the spatial distance from the Golden Gate inlet (Conomos 1979). The elevation of tidal ranges along the study area varies by approximately 0.5 ft between Aquatic Park and Heron's Head (Figure 3-11).

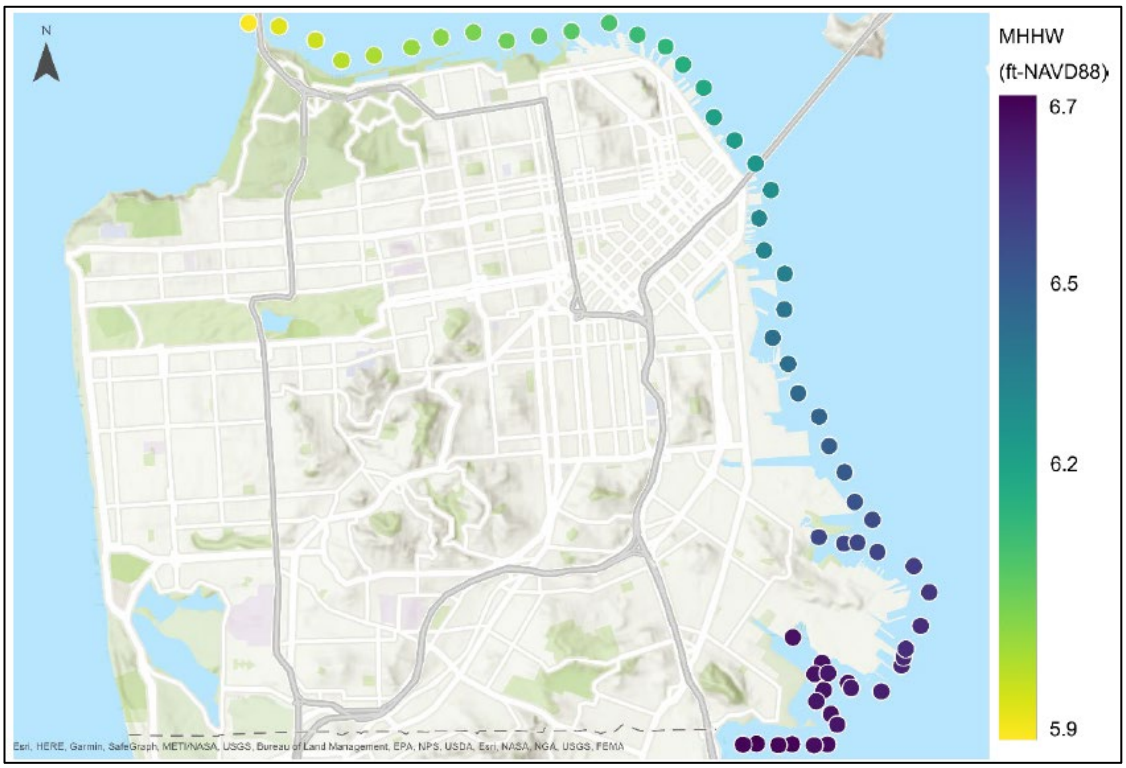

Figure 3-11. Variation in MHHW in the study area. Source: May et al. 2023.

The bay in the study area is a partially to well mixed estuary with substantial longitudinal density gradients (Walters et al. 1985) dominated by seasonally varying river inflow (Conomos et al. 1985). Tidal currents are generated by mixed semi-diurnal and diurnal tides with the bay experiencing two tidal cycles daily with two high and two low tides of unequal height. Additionally, the bay experiences pronounced spring-neap tidal variability (Rajasekar 2016). The NOAA tidal gauge near the Presidio (Station ID: 9414290) report a mean tidal range of 4.09 ft and diurnal range of 5.84 ft (NOAA 2023b). Freshwater inflows are highest during the winter and generate strong estuarine circulation. Tidal currents mix the water column, and combined with the river inflow and basin geometry, determine circulation patterns in the bay (Conomos et al. 1985). Winds are strongest during summer and winter storms and exert stress on the bay's water surface thereby creating large waves that contribute markedly to the transport of water mass throughout the estuary (Conomos et al. 1985). Water level variations in the bay are driven primarily by five tidal and oceanic cycles including the mixed semidiurnal tidal cycle, two week spring-neap cycle, seasonal spring/summer (low levels) and fall/winter (higher levels) cycles, El Nino and La Nina, and the Pacific Decadal Oscillation (atmospheric shift on decadal time scale).

3.6.2.1.2 Waves

The wave climate in San Francisco Bay is predominantly driven by wind and ocean swells from the Pacific Ocean. The steep topography, hills, and valleys throughout the San Francisco Bay Area drive complex wind patterns and because of the large size of the Bay, those winds can sufficiently generate wind-driven waves ranging from 3 to 5 ft high in vulnerable (i.e., exposed) areas of the shoreline. The most impactful waves to the study area shoreline are those driven by easterly (i.e., offshore; Ferry building and southward), north and northeasterly (northern waterfront), and southeasterly winds (southern waterfront; May et al. 2023). The strongest winds occur during the spring, lowest are typically experienced in the fall, while the winter produces the most variable wind directions. In general, wind-driven waves can impact shorelines across the study area (May et al. 2023).

Ocean-driven swell is another predominant driver of waves in the San Francisco Bay Area, which create longer-period waves that develop in the Pacific Ocean that can span thousands of miles. The occurrence of these waves is heightened in the fall when storms over the Pacific Ocean become stronger and more frequent that result in ocean swells penetrating through the Golden Gate. As the ocean swell propagates through the Golden Gate Channel, the swell waves quickly dissipate energy and decrease in height as they enter the San Francisco Bay, by as much as 69% in the northern waterfront. The ocean swell waves can elevate offshore Bay water levels in the study area, but do not directly travel to the shoreline, rather contribute to the wind-driven wave climate (May et al. 2023). Ocean-driven swells can develop into damaging waves along the study area.

3.6.2.2 Flooding

Climate change is likely to increase extreme flooding events (Seneviratne et al. 2012), particularly in low-lying coastal areas (Wong et al. 2014). Rapid urbanization, as within the study area, further increases flood risk with growing concentrations of people and assets in the city (Revi et al. 2014). Coastal flooding events occur when extreme water levels develop following storm surges, tides, seasonal cycles, interannual anomalies, or a combination of these, driven by large-scale climate variability and SLR (Kasmalkar et al. 2020). Additional details about flooding can be found in Appendix B.1.

3.6.2.3 Stormwater

In San Francisco, stormwater runoff is generated predominantly from rain events that flow over land or impervious surfaces (e.g., paved streets, parking lots). Stormwater runoff can capture pollutants, chemicals, oils, and sediment that if deposited in the San Francisco Bay and other surface waters (e.g., rivers, streams, lakes) can have negative effects on water quality. Most of San Francisco is served by a combined storm sewer system, where stormwater, along with residential and commercial sewage, is directed to treatment plants prior to being released to the San Francisco Bay or Pacific Ocean (SFPUC 2021b).

3.7 Water Quality

Water quality describes the condition of water, including chemical, physical, and biological characteristics typically with its respect to suitability for a purpose, such as drinking or swimming. Water quality is measured by several factors including salinity, turbidity, bacteria, dissolved oxygen, contaminants, etc. (NOAA 2023a).

3.7.1 Regulatory Framework

3.7.1.1 Federal

Clean Water Act (CWA) – regulates point-source pollutant discharges into waters of the United States through effluent limits and establishing water quality standards on a water-body specific basis.

National Pollutant Discharge Elimination System (NPDES) – permit program addresses water pollution by regulating point sources that discharge pollutants to waters of the U.S.

Rivers and Harbors Act of 1899 – regulates development and use of nation’s navigable waterways

Oil Pollution Act of 1990 – governs oil spills into the nation’s waterways

Ports and Waterways Safety Act of 1972 – provides authority for the U.S. Coast Guard's program to increase vessel safety and protect the marine environment in ports, harbors, waterfront areas, and navigable waters

Estuary Protection Act of 1968 – focuses on improving waters, habitats, and living resources of estuaries of local significance

Coastal Zone Management Act of 1972 – preserves, protects, develops, restores, or enhances the resources of the Nation's coastal zone

3.7.1.2 State

California Water Code

California Health and Safety Code

California State Water Resources Control Board

3.7.1.3 Local

San Francisco Bay Regional Water Quality Control Board (Water Board) – maintains a basin plan that contains Section 303 water quality standards and prepares CWA Section 401 water quality certifications

3.7.2 Existing Condition

The study area encompasses shoreline along the Central and South San Francisco Bay. Water quality in the San Francisco Bay Region of the study area is saline and predominated by ocean influences; however, substantial runoff from freshwater during heavy rains are also prevalent. The freshwater inundation can temporarily reduce salinity in the study area (Bay Institute 2003). Physical barriers, such as the Golden Gate Bridge, influence sedimentation and water quality characteristics by altering the behavior of currents which affect circulation, flushing, and water exchange.

Suspended sediments are a key component of the estuarine system, which tend to have higher levels of turbidity or suspended sediment loads due to discharges from rivers, drainages, and their shallow nature. Suspended sediment concentrations are variable in San Francisco Bay and strongly correlate to season and water depth (Buchanan and Ganju 2006; Buchanan and Ganju 2005; McKee et al. 2006), ranging from 1,000 milligrams per liter (mg/L) near the bottom to 10 mg/L near the surface (Buchanan and Ganju 2006). The study area is located nearshore and is relatively shallow water that is strongly influenced by discharges, vessel traffic, and wind- and wave-generated sediment disruption.

Contaminants are prominent in the bay and are transported by a variety of sources including, but not limited to, urban uses, industrial outfall, municipal wastewater outfalls, municipal stormwater, upstream farming, upstream historic and current mining discharges, and legacy pollutants. Approximately 40 percent of California drains into

San Francisco Bay including point and non-point source pollutants that distribute up to 40,000 metric tons of at least 65 different pollutants (BCDC 2020). The study area is listed as an impaired water body by the San Francisco Water Board. Under Section 3030(d) of the CWA, impaired waters are defined as those that do no meet water quality standards, even after point and non-point sources of pollution have had pollution control technologies implemented. The pollutants recorded in the Central San Francisco Bay, including the study area, are chlordane, dichlorodiphenyltrichloroethane (DDT), dieldrin, hydrogen sulfide, lead, mercury, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), selenium, silver, furans, and dioxins. Pollutant concentrations vary seasonally and annually, dependent on the source and degradation characteristics. Some contaminants such as ammonia, copper, and legacy pesticides have decreased due to cleanup efforts and natural attenuation (SFEI 2010; Bay Institute 2003).

The Regional Monitoring Program for Water Quality, within the San Francisco Estuary Institute, has collected water quality data annually since 1993 in San Francisco Bay. The monitoring effort measures parameters including nutrients (e.g., ammonia, dissolved organic carbon, silicates, nitrate, nitrite, phosphate), temperature, salinity, conductivity, turbidity (suspended solids), pH, hardness, dissolved oxygen (DO), trace elements (e.g., aluminum, arsenic, copper, lead, mercury), trace organics (e.g., PAHs, PCBs, pesticides), and toxicity. Pollutants in the bay that are recorded at detectable levels include trace metals, pesticides, PCBs, PAHs, algal blooms and low DO, and sediment contamination.

The San Francisco Bay is typically well oxygenated with DO concentrations ranging from 9 to 10 mg/L during high freshwater inflow, 7 to 9 mg/L during moderate flow, and 6 to 9 mg/L during low flow (typically summer months).

3.8 Groundwater

Groundwater exists as water underground in saturated zones beneath the land surface (USGS 2023). Groundwater moves and stores in natural aquifers and is one of the U.S.'s most important natural resources. It provides approximately 37% of the water for public supply and drinking water for more than 90% of rural populations (USGS 2023).

3.8.1 Regulatory Framework

3.8.1.1 Federal

- CWA
- Safe Drinking Water Act – regulates the nation's public drinking water supply
- NPDES

3.8.1.2 State

- Sustainable Groundwater Management Act – requires groundwater-dependent regions to halt overdraft and develop plans to bring basins into balanced levels of pumping and recharge through local planning efforts. Directs local agencies to work together to create a plan to balance the amount of water pumped in and out of the basin.

3.8.1.3 Local

- SFPUC

3.8.2 Existing Condition

The study area overlies seven small groundwater basins. Local groundwater supply comes from the Westside Basin, a series of aquifers extending from Golden Gate Park southward to San Bruno. Groundwater is pumped from the Westside Groundwater Basin from depths of approximately 400 feet below the surface, blended with surface water supplies from San Francisco, treated, and distributed to the city for drinking water (SFPUC 2021a). Most of the groundwater supplies in the study area are confined between two substantial layers of clay that act as aquitards. Aquitards have low permeability which allow groundwater to be confined and under high pressure.

Groundwater closest to the surface is shallow groundwater or the “water table” and is not constrained by an overlying aquitard and is thus unconfined. Unconfined aquifers are at atmospheric pressure, so water levels rise and fall in response to surface recharge, tidal changes, and underflow. Deeper unconfined aquifers, like Westside Basin, are used for public water supply and shared by various municipalities.

Shallow groundwater in the study area is poor quality and is not used for supplying drinking water. Young Bay Mud acts as an aquitard, separating shallow groundwater from deeper aquifers used for municipal water supply and generally acts as a barrier to the vertical migration of contaminants. Shallow groundwater levels are influenced by seasonal variations in precipitation, tidal levels, local irrigation, groundwater pumping, and other factors, and vary across the study area.

Existing groundwater conditions were evaluated using an empirical mapping and numerical modelling techniques in previous studies (May et al. 2019, Plane et al. 2019, Befus et al. 2020). Both techniques indicated the presence of emergent and shallow groundwater within the study area; however, the majority is more than 9 feet below the surface (Figure 3-12). Additional details and maps can be found in Appendix B1.5.

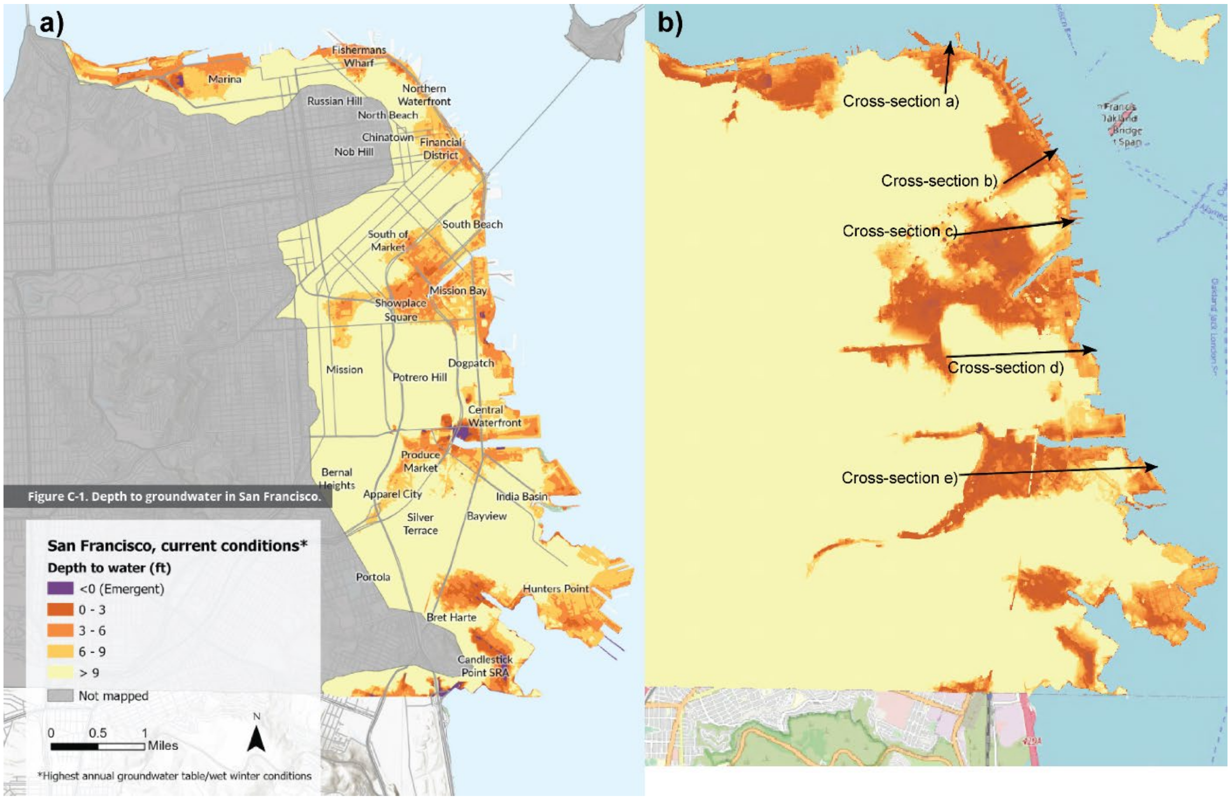

Figure 3-12. Existing depth to groundwater for the study area. Source: May et al. 2022, Befus et al. 2020

3.9 Aquatic Resources

Aquatic resources refers to a range of habitats and natural water resources that are of potential use to humans including, but not limited to, wetlands, streams, lakes, rivers, springs, seeps, reservoirs, ponds, and groundwater (Britannica 2023). Coastal habitats can be complex systems comprised of marsh zones, intertidal, and subtidal areas (Figure 3-13).

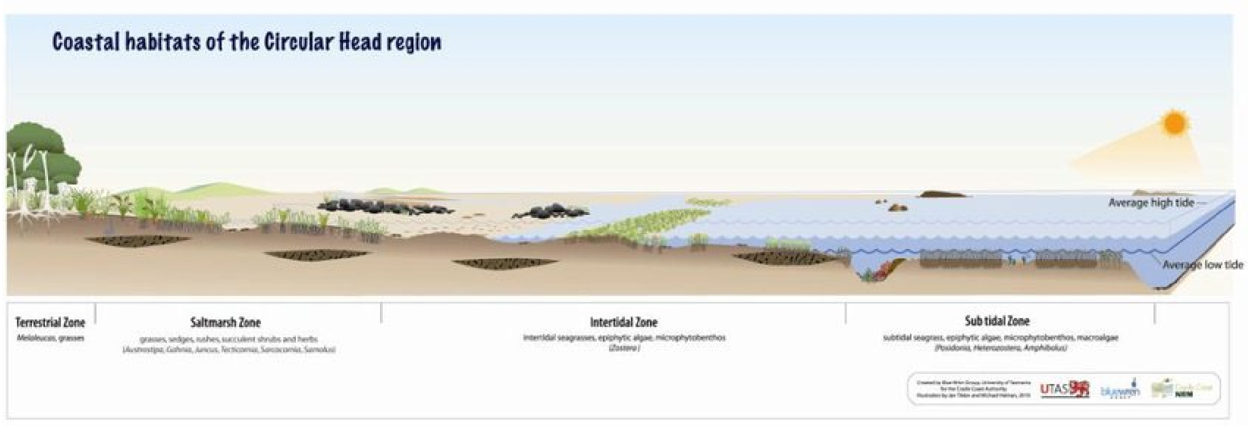

Figure 3-13. Cross section view of coastal complex. Source: Prahalad and Pearson 2013.

3.9.1 Regulatory Framework

3.9.1.1 Federal

- Estuary Protection Act of 1968 – focuses on improving waters, habitats, and living resources of estuaries of local significance
- Fish and Wildlife Coordination Act – requires Federal agencies to first consult with USFWS and in some instances NMFS, as well as state fish and wildlife agencies regarding potential impacts on fish and wildlife resources, and measures to mitigate these impacts.
- Executive Order (EO) 13112 on Invasive Species – directs Federal agencies to prevent the introduction and control the spread of invasive species. Invasive species are defined by the EO as “an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.”
- EO 11990, Protection of Wetlands – directs Federal agencies to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agencies’ responsibilities

3.9.1.2 State

- San Francisco Bay Regional Water Quality Control Board – implements the requirements of CWA
- San Francisco Bay Conservation and Development Commission (BCDC) – regulates fill, extraction of materials, and substantial changes in land use, water, and structures within the bay, and within 100 feet of the bay shoreline
- Marine Life Management Act (MLMA) – requires the development of fishery management plans for all of the State’s major recreational and commercial fisheries

3.9.1.3 Local

3.9.2 Existing Condition

3.9.2.1 Intertidal Habitats

Intertidal habitats are the regions of the bay that lie between low and high tides (NOAA 2022b). The Central Bay basin includes natural and artificial intertidal habitats such as sandy beaches, natural and artificial rock (quarried rip-rap), concrete bulkheads, concrete, composite, and wood pier pilings, and mud flats. These habitats provide highly diverse locations for marine flora and fauna to forage, rest, reproduce, and refuge. The Central Bay basin's proximity to the Pacific Ocean has resulted in an intertidal zone inhabited by many coastal and estuarine species.

Rip-rap that has been placed for shoreline protection in the Central Bay basin along the study area provide numerous havens in which assorted marine species survive and flourish. Typical invertebrate and algae species inhabiting these zones include sea lettuce (*Ulva* spp.), rockweek (*Fucus gardener*), the red algae species (*Polyneura latisima* and *Gigartina* spp.), and the non-native brown algae species (*Sargossum muticum*; AMS 2009).

The study area includes limited areas of sandy beaches (e.g., Aquatic Park) and mudflats (e.g., Heron's Head), which are mainly composed of sandy substrates and other soft-bottom material (SFPUC 2014). These habitats support benthic fauna including amphipods, polychaetes, and flies of the intertidal zone, providing food for shorebirds. Other common invertebrates within the intertidal environment included balanoid barnacles (Balanidae) in the high and middle intertidal zones; limpets (Patellidae, Fissurellidae), saltwater mussels (*Mytilus* spp.), and native Olympia oysters (*Ostrea lurida*) in the lower middle and low intertidal zones. Shorebirds that frequent intertidal habitats during migration or overwinter within the terrestrial study area include sanderling (*Calidris alba*), willet (*Tringa semipalmata*), marbled godwit (*Limosa fedoa*), and whimbrel (*Numenius phaeopus;* GFNMS and FMSA 2006). Spotted sandpiper (*Actitis macularius*) and black oystercatcher (*Haematopus bachmani*) may forage along the rocky shoreline during low tide within the intertidal zones of the study area.

3.9.2.2 Subtidal Habitats

Subtidal habitats are submerged areas beneath the San Francisco Bay water surface and include mud, shell, sand, rocks, artificial structures, shellfish beds, eelgrass beds, macroalgal beds, and the water column above the bay bottom (Cosentino-Manning et al. 2010). Soft substrate comprises the majority of the bay's bottom (approximately 90%) and ranges between soft mud with high silt and clay content and areas of coarser sand. These latter tend to occur in locations subjected to high tidal or current flow. Soft mud locations are typically located in areas of reduced energy that enable deposition of sediments that have been suspended in the water column, such as in protected slips, under wharfs, and behind breakwaters and groins. Exposure to wave and current action, temperature, salinity, and light penetration determine the composition and distribution of organisms within soft sediments. Muddy-sand sediments consists of a diverse polychaete community represented by several subsurface deposit-feeding capitellid (segmented worms) species, a tube-dwelling filter-feeding species (*Euchone limnicola*), a carnivorous species (*Exogone lourie*), and the maldanid polychaete (*Sabaco elongates*).

Minimal hard substrate occurs naturally in the bay. Rock habitat includes boulders, bedrock (rock not normally moved by currents), shellfish beds, and some algal beds (Cosentino-Manning et al. 2010). Submerged hard bottom substrate is typically covered with a mixture of turf organisms dominated by hydroids, bryozoans, tunicates, encrusting sponges, encrusting diatoms, and anemones. In the intertidal and subtidal zones, barnacles (*Balanus glandula, Amphibalanus amphitrite, A. improvises*), Bay mussel (*Mytilus trossulus/galloprovincialis*) and Olympia oyster are commonly present on hard substrate, as well as the invasive Asian mussel (*Musculista senhousia*). Barnacles can also be found on subtidal pier pilings, exposed rock outcropping, and debris. Pacific rock crab (*Cancer antennarius*) and the red rock crab (*C. productus*) inhabit rocky, intertidal and subtidal areas in the Pacific Ocean, and likely use the Bay as an extension of their coastal habitats (Hieb 1999). Shellfish beds are hardbottom locations where shellfish species occupies more than 50% of an area of more than a few square meters. Five species of shellfish occur in the Bay including native Olympia oysters, California mussels, hybridized Bay mussels, and non-native ribbed horsemussel (*Geukensia demissa*) and green bagmussel (*Musculista senhousia*).

Artificial structures include a variety of man-made objects designed to protect shorelines and shoreline structures, for transportation, recreation, and restoration (oyster shell and artificial reefs; Cosentino-Manning et al. 2010). Red and brown algae are found attached to submerged intertidal hard substrate, including pier pilings.

Submerged aquatic vegetation (SAV) refers to all underwater flowering plants. In San Francisco Bay SAV includes sago pondweed (*Stuckenia pectinata*), eelgrass (*Zostera marina*), surfgrasses (*Phyllospadix torreyi* and *P. scouleri*), and widgeongrass (*Ruppia maritima*). Eelgrass is the most extensive SAV in San Francisco Bay (Cosentino-Manning et al. 2010), albeit very few beds are documented or known to occur within the study area (Merkel and Associates 2014). Small, isolate beds are known to occur along the southern extent of the study area, such as Heron's Head Park. All SAV in the Central Bay basin is considered critical essential fish habitat (EFH) for spawning Pacific herring, which attach their egg masses to eelgrass, seaweed, and hard substrates.

Subtidal habitats provide diverse structure and function as an important habitat in the bay for various wildlife including fish (herring and salmon), vegetation (eelgrass, seaweed), shellfish, invertebrates, marine mammals, and birds (diving ducks, shorebirds) that forage, rest, refuge, and reproduce in the subtidal areas (Cosentino-Manning et al. 2010). The harbor and main channel areas are characterized by a mix of benthic communities from surrounding areas, including deep and shallow-water and slough marine communities. The most common large mobile benthic invertebrate organisms in the Bay include blackspotted shrimp (*Crangon nigromaculata*), the bay shrimp (*C. franciscorum*), Dungeness crab (*Metacarcinus magister*), and the slender rock crab (*Cancer gracilis*). All of these mobile invertebrates provide an important food source for carnivorous fishes, marine mammals, and birds in San Francisco Bay's food web.

3.9.2.3 Open water (Pelagic) Habitat

The open water (pelagic) environment of the San Francisco Bay is near the Pacific Ocean and is very similar to the open water coastal environment. Pelagic habitat is the predominant marine habitat in the Bay and includes the area between the water surface and the seafloor, which can be further subdivided into shallow water/shoal and deep-water/channel areas. The water column is predominantly inhabited by planktonic organisms that float or swim in the water, fish, marine birds, and marine mammals.

Marine birds regularly inhabiting or using the open waters of the study area include cormorants [double-crested and Brandt's cormorants (*Phalacrocorax auratus* and *P. penicillatus*)], pigeon guillemot (*Cepphus columba*), gulls [herring gull (*Larus argentatus*), mew gull (*L. canus*), Western gull, California gull (*L. californicus),* ring-billed gull (*L. delawarensis*)], greebes [eared greb (*Podiceps nigricolis*), western and Clarke's grebe (*Aechmophorus occidentalis* and *A. clarki*), common loon (*Gavia immer*), California brown pelican (*Pelecanus occidentalis californicus*), and terns [Caspian tern (*Hydroprogne caspia*), least tern (*Sternula antillarum*)]. Common diving benthivores (animals that feeds on benthic prey) are canvasback (*Aythya valisineria*), greater scaup (*A. marila*), lesser scaup (*A. affins*), and surf scooter (*Melanitta perspicillata*).

Few marine mammal species occur in the San Francisco Bay within the study area. Pacific harbor seals (*Phoca vitulina richardsi*) are the only resident in the Bay year-round with the highest numbers sighted during the pupping (March to May) and molting (June to July) seasons (SFBAWT 2022). Harbor seals congregate on "haul-out" terrestrial sites annually, which are typically located in areas with easy access to the water, proximity to food, and experiences minimal disturbances. Haul-out sites can be used annually or seasonally, with some being important for providing shelter during pupping and molting (SFBAWT 2022).

California sea lions (*Zalophus californianus*) use the Bay for foraging but breed elsewhere. Pier 39 in the study area is a common haul-out site for California sea lions where they are often observed loafing. The greatest number of sea lions are observed in the Bay during the winter herring run (December to February). Sea lions are opportunistic feeders and will prey mostly on schooling species, but have also been known to consume leopard sharks, shrimp, and crabs (SFBAWT 2022).

Harbor porpoises (*Phocoena phocoena*) are sighted year-round in harbors, bays, and estuaries of the San Francisco Bay. The porpoise is elusive and typically solitary, or may travel in small pods of two to five individuals (MMC 2022). Individuals traditionally feed on schooling fish (herring, capelin, hake) and will occasionally eat squid or octopus. They were believed to have disappeared from the San Francisco Bay in the 1940s during World War II and because of environmental contaminants from industrialization; however, returned in the 1990s following restoration attributed to the Clean Air and Water Act (MMC 2022).

Most cetacean sightings occur in the Central Bay basin, outside of the study area. Marine mammal presence is predominantly dependent on distribution and presence of prey species and foraging habitat (SFBAWT 2022).

3.9.2.4 Wetlands

Formal delineation of water of the U.S., including wetlands, occurred in 2015 along the Port of San Francisco waterfront between the open water basin north of Pier 40 and Heron's Head Park at Pier 98. The delineation excluded Mission Creek, the Pier 70 Mixed-Use District Project area between Mariposa and 23rd streets, Pier 94 Wetlands, and Heron's Head Park. Federal potentially jurisdictional wetlands were documented within Warm Water Cove, and on the north and south banks of Islais Creek (Coast 2015). To be considered federally jurisdictional, wetlands generally must exhibit a defined bed and bank and an ordinary high-water mark or be subject to the ebb and flow of tides. Existing wetlands occur at Pier 94 and Heron's Head Park.

3.9.2.5 Other Waters

The study area is adjacent to navigable waters of the U.S., which are regulated by the federal Clean Water Act (CWA) and are defined under the CWA, title 33 Code of Federal Regulations (CFR) 329.4 as "waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce". Examples of other waters of the U.S. include rivers, creeks, intermittent, and ephemeral channels, ponds, lakes, and the ocean. Waters of the State of California are defined in the California Water Code section 1305(e) as "any surface water or groundwater, including saline waters, within the boundaries of the State" and include all federally jurisdictional waters. Waters of the State are broadly construed to include public and private waters in natural and artificial channels.

3.9.2.6 Fisheries

Fisherman's Wharf is the central hub of Northern California's commercial and recreational fishing fleets, while Pier 45 is the West Coast's largest concentration of commercial fish processors and distributors (POSF 2022). The San Francisco Bay, adjacent to the study area, once supported several commercial fisheries including salmon, sardines, herring, halibut, sturgeon, oysters, crabs, and shrimp; however, presently only the Pacific herring (*Clupea pallasii*) fishery has survived (Mann n.d.). Annual herring landings have ranged up to 11,000 metric tons (mt) since 1980 (Thayer et al. 2020). Herring is found offshore in California during the spring and summer foraging in the open ocean and then forms spawning aggregations starting in the fall. San Francisco Bay hosts the largest spawning aggregation, along with Tomales Bay, for Pacific herring with the greatest concentrations between October and April (CFW 2022). Many of the once productive commercial fisheries collapsed due to overharvesting and a myriad of environmentally damaging practices such as water consumption and diversion, modification of the sediment supply, introduction of nonnative species, and sewage input, as well as climate shifts and environmental policy that did not effectively protect the resources (Cloern and Jassby 2012).

The bay supports a variety of important recreational fisheries including groundfish, salmon, sharks, sportfish, shellfish, and kelp. Although recreational fisheries are popular in San Francisco Bay, many of the fish are under a consumption advisory from the California Office of Environmental Health Hazard including sharks, white sturgeon, surfperches, striped bass (do not eat), and California halibut and white croaker (limit consumption to one serving per week; (OEHHA 2018).

3.9.2.7 Macroinvertebrates

Olympia oysters are native oysters to most of western North America and was a key component of the San Francisco Bay marine ecosystem prior to overharvesting and increased siltation from hydraulic mining in the mid-nineteenth century (NOAA 2008). The oysters were thought to be extinct in San Francisco Bay but have been observed slowly recovering since 2000. However, the current extent of Olympia oysters is estimated to be 1% of historic levels (Wasson et al. 2015). The National Marine Fisheries Service (NMFS) and California Department of Fish and Wildlife (CDFW) have prioritized restoring and reestablishing the Olympia oyster in San Francisco Bay because of its importance as a keystone species.

Olympia oysters are predominantly estuarine, with the greatest abundances in Central California found at the 0-feet tide mark, mean lower low water, but can be found up to approximately 33 feet (Baker 1995; Wasson et al. 2015). In order to settle, the oysters require a hard substrate such as intertidal or shallow subtidal rocks (Wasson et al. 2015). Olympia oysters form sparse to dense beds and are known to provide high biodiversity habitat because they create physical habitat structure for juvenile fish, crustaceans, worms, and foraging fish and birds (NOAA 2008). They stabilize sediment, reduce turbidity, improve light penetrations, and in some instances help modulate plankton blooms, thereby improving the physical conditions that encourage the establishment of SAV, such as eelgrass beds.

Naturally occurring populations of native oysters can be found throughout the San Francisco Bay on natural and artificial hard substrate. Oysters have successfully established on human-made habitats such as marina floats and in tidally restricted ponds, lagoons, and saline lakes (Cosentino-Manning et al. 2010). Olympia oysters are expected in rocky intertidal, subtidal habitats in the marine regions of the study area.

Other macroinvertebrates that may occur in the study area include a variety of amphipods, copepods, fish, gastropods, isopods, crustaceans (e.g., Ostracoda), annelids, polychaetes, etc. (Hartman et al. 2019). Macroinvertebrate communities can differ significantly seasonally, regionally, and locally, thus conditions of populations would be expected to change throughout the year (Howe et al. 2014).

3.10 Upland Resources

3.10.1 Regulatory Framework

3.10.1.1 Federal

CZMA

Endangered Species Act (ESA) – designates plants and terrestrial animals as threatened or endangered, protects, and prohibits take

3.10.1.2 State

California Native Plant Protection Act (NPPA) – designates plants as rare or endangered, protects, and prohibits take

3.10.2 Existing Condition

A vegetation community is a recognizable collection of plant species that interact with each other and the elements of their environment and are distinct from adjacent vegetation communities (Holland 1986). The San Francisco waterfront is primarily developed with limited areas of landscape plantings (e.g., parks), California annual grassland, ruderal vegetation, coastal scrub, and tidal marshes.

3.10.2.1 Developed/Barren

The study area is largely composed of developed urban land that includes buildings, paved streets, sidewalks, parking lots, docks, and piers. These areas provide limited habitat opportunities for wildlife and do not include natural vegetation communities. Paved roads, parking lots, buildings and empty lots can generally act as habitat for striped skunk (*Mephitis mephitis*), racoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), and killder (*Charadrius vociferus*) that may use these areas for foraging, shelter, nesting, and as corridors to move between barren/developed property to undeveloped areas (e.g., parks). Abandoned buildings can also support bats such as the Mexican free-tailed bat (*Tadarida brasiliensis*) and pallid bat (*Antrozous pallidus*). Bats can also adapt to living in urban areas near water and roost in structures that provide adequate thermal regulation. Vacant buildings can serve as roosting sites for local bats or as nesting sites for common urban birds such as barn owl (*Tyto alba*), cliff swallow (*Petrochelidon pyrrhonota*), rock pigeon (*Columba livia*), and house sparrow. High rises and bridges are often breeding grounds for peregrine falcons (*Falco peregrinus*). Marine mammals are observed using piers and docks as resting sites. For example, California sea lions (*Zalophus californianus*) are well-known for resting on the K-docks at the Pier 39 Marina in San Francisco.

3.10.2.2 Landscape

Landscape plantings can provide cover, foraging, and nesting habitat in an urban environment for a variety of bird species, reptiles, and small mammals, particularly those tolerant of human disturbance and presence. Birds commonly found in such habitat include native birds such as house finch (*Haemorhous mexicanus*), California scrub jay (*Aphelocoma californica*), mourning dove (*Zenaida macroura*), Brewer's blackbird (*Euphagus cyanocephalus*), and Anna's hummingbird (*Calypte anna*), as well as non-native species like house sparrow (*Passer domesticus*) and European starling (*Sturnus vulgaris*). Other common wildlife to landscape areas include striped skunk, raccoon, Virginia opossum, and non-natives such as Norway rat (*Rattus norvegicus*), black rat (*Rattus rattus*), and feral cat (*Felis catus*).

Landscape vegetation is present in the study area adjacent to buildings and within public parks including, but not limited to, Levi's Plaza, Mission Creek Garden, Mission Bay Commons Park, Warm Water Cove Park, Islais Creek Park, and India Basin Shoreline Park. Mature ornamental landscape trees and shrubs in the study area can provide cover, foraging, and nesting habitat for a variety of bird species, as well as reptiles and small mammals, especially those that are tolerant of disturbance and human presence.

3.10.2.3 California Annual Grassland

The California annual grassland community, also known as non-native grassland, is typically composed of a dense cover of introduced annual grasses and ruderal (woody) forbs (broad-leaved plants) adapted to colonizing and persisting in disturbed upland habitats. Non-native grasses typically include wild and slender oats (*Avena barbata*), barley (*Hordeum vulgare*), soft chess (*Bromus hordeaceus*), foxtail barley (*Hordeum murinum* ssp. *Leporinum*), red brone (*Bromus madritensis* ssp. *Rubens*), Medusahead (*Elymus caput-medusae*), and an array of associated annual and perennial forbs. California annual grassland is present at Heron's Head Park and Pier 94 where it is interspersed with scattered shrubs such as coyote brush (*Baccharis pilularis*).

California annual grassland community can provide cover, foraging, and nesting habitat for a variety of bird species, as well as reptiles and small mammals. Reptiles inhabiting this community may include western fence lizard (*Sceloporus occidentalis*), California alligator lizard (*Elgaria multicarinata multicarinata*) and Pacific gopher snake (*Pituophis catenifer catenifer*). Bird species may include western meadowlard (*Sturnella neglecta*), white-crowned sparrow (*Zonotrichia leucophrys*), cliff swallow, western bluebird (*Sialia Mexicana*), and northern mockingbird (*Mimus polyglottos*). Mammals common to annual grasslands include California ground squirrel (*Otospermophilus beecheyi*), black-tailed jack rabbit (*Lepus californicus*), and Botta's pocket gopher (*Thomomys bottae*).

3.10.2.4 Coastal Scrub

Coastal scrub is present only at the easternmost portion of the study area, within India Basin Open Space. Coastal scrub commonly includes buckwheat (*Eriogonum* spp.), sage (*Salvia* spp.), bush monkeyflower (*Mimulus aurantiacus*) and poison oak (*Toxicodendron diversilobum*). Typical wildlife found in scrub habitat include mammals such as Botta's pocket gopher, house mouse (*Mus musculus*), California vole (*Microtus californicus*), raccoon, and striped skunk. Reptiles common to these areas include California kingsnake (*Lampropeltis californiae*), Pacific gopher snake, and western fence lizard. These species attract larger predators and scavengers, particularly to scrub edges and nearby grassland clearings. Birds inhabit and forage for insects in coastal scrub including wrentit (*Chamaea fasciata*), California scrub jay, spotted towhee (*Pipilo maculatus*), white-crowned sparrow, and northern mockingbird.

3.10.2.5 Coastal Saltmarsh

Coastal saltmarsh is a wetland type flood and drained by saltwater between high and low tides, and is composed of a variety of terrestrial and aquatic species (NOAA 2022c). Coastal saltmarshes can be fully tidal, or brackish if they occur near the mouth of a freshwater source. Vegetation associated with this habitat include pickleweed (*Salicornia pacifica*), marsh jaumea (*Jaumea carnosa*), alkali heath (*Frankenia salina*), cordgrass (*Spartina* sp.), salt grass (*Distichlis spicata*), alkali bulrush (*Bolboschoenus maritimus*), and cattail (*Typha* sp.). Coastal saltmarsh is present in the Southern Waterfront subarea, including at the Pier 94 Wetlands and Heron's Head Park. The saltmarsh at Heron's Head is interspersed with areas of unvegetated salt panne (water retaining depressions). Salt panne's are often seasonally inundated, and because of this, can inhibit the establishment of vegetation, leavening a barren area.

Coastal saltmarshes in the Central and South Bay are remnants of their former extent. Where salt marshes are still present, they support high densities and high diversity of wildlife. Additionally, they provide habitat for the Ridgway's rail (*Rallus obsoletus*) and salt marsh harvest mouse (*Reithrodontomys raviventris*), both of which are federally and state-endangered and state fully protected species. However, the salt marshes within the study are small, narrow, and scattered, providing marginal habitat for these species.

3.10.2.6 Wildlife Corridors

Wildlife corridors are vital passage routes for birds, fish, and mammals that travel during their life cycle (USFWS 2022). Wildlife movement corridors are considered important ecological resources by CDFW and the U.S. Fish and Wildlife Service (USFWS). The movement corridors provide favorable locations for wildlife to travel amongst different habitats such as foraging sites, breeding sites, cover areas, and preferred seasonal range locations. They can also function as dispersal corridors allowing animals to move between various locations within their range. Topography, natural factors, and urbanization can fragment large open-space areas and impede wildlife movement between areas of suitable habitat. This fragmentation can create isolated “islands” of vegetation that may not provide sufficient accommodations to sustain populations, and can adversely affect genetic and species diversity. Integrated wildlife corridors into urban and developed areas mitigates the effects of this fragmentation by allowing animals to move between remaining habitats, which in turn allows depleted populations to replenish and promotes genetic exchange between populations.

The study area is too urbanized to provide a terrestrial wildlife corridor between two core habitat areas. However, the San Francisco Peninsula is an important migratory stopover for birds along the Pacific Flyway, one of the four major avian migratory routes in North America. During fall and spring migrations, birds of prey, songbirds, shorebirds, and waterbirds stop to forage and rest in suitable habitat along this route such as Golden Gate Park, the Presidio, Mount Sutro, Lake Merced, and coastal and bayside beaches. Migrating birds that forage in intertidal and marine environments may use San Francisco Bay during migration.

Central Bay serves as a migration corridor for anadromous fish between the Pacific Ocean and spawning habitat, in a few of the tributaries to San Francisco Bay. The study area does not fall within the wildlife corridor for these anadromous fish which are typically confined to deeper channels during migration.

3.11 Special status species

Special-status species are plant and wildlife species considered sufficiently rare, such that they require special consideration and/or protection and should be, or currently are, listed as rare, threatened, or endangered by the federal and/or state governments. Such species are legally protected under the federal and/or state ESA or other regulations listed below, or are species considered sufficiently rare by the regulatory and scientific community to qualify for protection.

3.11.1 Regulatory Framework

3.11.1.1 Federal

Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) – governs management and conservation of commercial and recreational fisheries in U.S. federal waters (three to 200 nautical miles [nm] from shore)

ESA – establishes protections for fish, wildlife, and plants listed as threatened or endangered

Marine Mammal Protection Act (MMPA) – establishes protections for marine mammals

Migratory Bird Treaty Act – prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species

- Bald and Golden Eagle Protection Act – prohibits any take of bald or golden eagle, alive or dead, or any part (including feathers), nests, or eggs
- Federal Regulation of Wetlands and other waters – federal government regulates waters, including wetlands, in the CWA

3.11.1.2 State

- California Endangered Species Act (CESA) – conserves and protects plant and animal species and their environments
- California Native Plant Protection Act (NPPA) – designates plants as rare or endangered, protects, and prohibits take
- California Fish and Game Code (CFGC) – protects and regulates state listed species
- State Regulation of Wetlands and other waters – regulations activities in wetlands reside primarily with the State Water Resources Control Board

3.11.1.3 Local

- San Francisco General Plan – policies that protect biological resources
- San Francisco Public Works Code – protects street trees, significant trees, and landmark trees under San Francisco Public Works jurisdiction
- San Francisco Planning Code Section 139 – standards that guide the use and types of glass and façade treatments, wind generators and grates, and lighting treatments that can be used during construction projects to create bird-safe buildings and reduce bird-related hazards
- San Francisco Bay Plan – specifies goals, objectives, and policies for existing and proposed waterfront land use and other areas under the jurisdiction of BCDC

3.11.2 Existing Condition

3.11.2.1 Federally-listed Threatened and Endangered Species

The ESA was enacted to provide a program for the preservation of endangered and threatened species and to provide protection for the ecosystems upon which these species depend for their survival. The U.S. Fish and Wildlife Service (USFWS) is the primary agency responsible for implementing the ESA and oversees protection of non-marine species (i.e., birds, terrestrial species, freshwater species), while the National Marine Fisheries Service (NMFS) protects marine species. An endangered species is one in danger of extinction throughout all or a significant portion of its range. A threatened species is likely to become endangered within the foreseeable future throughout all or a significant portion of its range, while proposed species are those that have been formally submitted to Congress for official listing. The USFWS's Information for Planning and Consultation (IPaC) database lists the threatened and endangered species and trust resources that may occur within the study area boundary (Appendix D-5). NMFS provided a letter documenting species anticipated in the study area (Appendix D-6). Based on the IPaC report and NMFS letter, there are 23 USFWS listed species (threatened, endangered, or candidate), five additional NMFS listed species, and two designated critical habitats (CH) found to potentially occur within the study area (Table 3-1).

Table 3-1. Federal threatened, endangered, or candidate species identified by USFWS and NMFS that may occur in the study area. Sea turtle jurisdiction is shared jointly by USFWS (inland waters and nesting beaches) and NMFS (offshore marine environment). A superscript "CH" indicated critical habitat for the species. Information sourced from USFWS and NMFS species pages and Calflora (www.calflora.org)

Common Name ***Scientific Name***	**Federal Status**	**Jurisdiction**	**Habitat Requirements**	**Potential to occur in the study area**
MAMMALS				
Salt marsh harvest mouse *Reithrodontomys raviventris*	Endangered	USFWS	Generally restricted to saline or subsaline marshes, particularly dense stands of pickleweed, adjacent to upland, salt-tolerant vegetation	Minor to moderate – suitable habitat at Heron's Head and Pier 94 wetlands
BIRDS				
California Ridgeway's Rail *Rallus obsoletus obsoletus*	Endangered	USFWS	Resident of San Francisco Bay area; lives in dense vegetation in saltwater marshes, freshwater marshes, and mangrove swamps	Moderate – likely to occur in Heron's Head Park; have been previously observed
California least tern *Sterna antillarum browni*	Endangered	USFWS	Breeds along the immediate coast of California on unfrequented sandy beaches or abandoned salt flats close to estuaries and coastal embayment's; feeding occurs nearshore in open water;	Moderate – likely to occur, but not likely to be nesting
Marbled murrelet *Brachyrampuhus marmoratus*	Threatened	USFWS	Spends most time on the ocean, resting and foraging in near-shore marine waters; nest in old-growth forests with large trees, multiple canopy layers and moderate to high canopy closure	Moderate – may occur feeding
Western snowy plover *Charadrius nivosus nivosus*	Threatened	USFWS	Winters along the California coast resting and foraging on sand spits and dune-backed beaches, in urban areas they are found in bluff-backed beaches; nests along shores, peninsulas, offshore islands, bays, estuaries, and rivers of the U.S. Pacific Coast	Unlikely; lacks suitable habitat

Common Name *Scientific Name*	**Federal Status**	**Jurisdiction**	**Habitat Requirements**	**Potential to occur in the study area**
REPTILES				
Alameda whipsnake *Masticophis lateralis euryxanthus*	Threatened	USFWS	Prefer coastal sage scrub and northern coastal scrub, but can also inhabit grasslands, oak savanna, oak-bay, and open woodlands; rock outcrops and talus; use small burrows, rock, and soil crevices, brush, and debris for refuge	Unlikely; outside known range; no suitable habitat
San Francisco garter snake *Thamnophis sirtalis tetrataenia*	Endangered	USFWS	Prefer densely vegetated ponds near open hillsides; hunt in shallow water 2 inches deep or less; aquatic habitats with shallow water edges are essential habitat; require adjacent upland habitat for basking, and burrows or thick grass mats for shelter and hibernacula	Unlikely; lacks suitable habitat
Green sea turtle *Chelonia mydas*	Threatened	USFWS	Shallow habitats such as lagoons, bays inlets, shoals, estuaries, and other areas with abundant marine algae and seagrass; high-energy beaches with deep sand for nesting, usually coarse to fine grain sizes, with little organic content	Unlikely; lacks suitable nesting and foraging habitat
AMPHIBIANS				
California red-legged frog *Rana draytonii*	Threatened	USFWS	Requires aquatic breeding habitat – low-gradient freshwater bodies (ponds, marshes, lagoons) that hold water for at least 20 weeks; non-breeding aquatic habitat – provides shelter, forage, refuge, and dispersal for juveniles and adults (springs, plunge pools); upland habitat – located within 300 feet of aquatic/riparian habitat, comprised of grasslands, woodlands, and/or vegetation that provides shelter, forage, and refuge; and dispersal habitat – accessible upland or riparian haitats between occupied locations allowing for movement between sites;	Unlikely; lacks suitable habitat

Common Name *Scientific Name*	**Federal Status**	**Jurisdiction**	**Habitat Requirements**	**Potential to occur in the study area**
FISH				
Delta smelt *Hypomesus transpacificus*	Threatened	USFWS	Endemic to California; only occurs in the Sacramento-San Joaquin estuary; spawns in freshwater in the spring, migrates to low salinity area in the summer for rearing, matures in the fall in low salinity water, migrates upstream to freshwater in winter	Unlikely; outside of known range
Tidewater goby *Eucyclogobius newberryi*	Endangered	USFWS	Brackish water lagoons, estuaries, and marshes along the California coast; shallow, still water	Unlikely; outside of known range
Sacremento River Chinook salmon [CH], winter-run Evolutionary Significant Unit (ESU) *Oncorhynchus tshawytscha*	Endangered	NMFS	Spend early life growing and feeding in freshwater streams, estuaries, and wetlands; transition to open ocean and estuaries, then return to freshwater to spawn	Likely; migrate through San Francisco Bay from December through July with peak occurrence in March
Central Valley Chinook salmon, spring-run ESU *O. tshawytscha*	Threatened	NMFS	Spend early life growing and feeding in freshwater streams, estuaries, and wetlands; transition to open ocean and estuaries, then return to freshwater to spawn	Likely; migrate through San Francisco Bay in summer months before returning to spawn mid-August through early October
Central California Coast Steelhead trout, Distinct Population Segment (DPS) *Oncorhynchus mykiss*	Threatened	NMFS	Occupy gravel-bottom, fast-flowing, well-oxygenated freshwater streams and rivers for spawning and when hatched, migrate to the ocean and return to freshwater to spawn; use aquatic vegetation, boulders, and wood as refuge; spend most of the year in estuaries or open ocean	Likely; temporary as transition through open water adjacent to study area during migration

Common Name *Scientific Name*	**Federal Status**	**Jurisdiction**	**Habitat Requirements**	**Potential to occur in the study area**
California Central Valley Steelhead trout DPS *O. mykiss*	Threatened	NMFS	Occupy gravel-bottom, fast-flowing, well-oxygenated freshwater streams and rivers for spawning and when hatched, migrate to the ocean and return to freshwater to spawn; use aquatic vegetation, boulders, and wood as refuge; spend most of the year in estuaries or open ocean	Likely; temporary as transition through open water adjacent to study area during migration
North American Green sturgeon, southern DPS [CH] *Acipenser medirostris*	Threatened	NMFS	Spawn and rear as juveniles in freshwater streams and rivers, migrate to saltwater to feed, and return to freshwater for spawning; require fast-flowing, well oxygenated streams for spawning	Likely; juveniles reside in San Francisco Bay and adults migrate to their spawning grounds through the bay
INSECTS				
Monarch butterfly *Danaus plexippus*	Candidate	USFWS	Require milkweed and flowering plants for foraging during breeding and migration. Lay eggs on milkweed plants	Unlikely; limited suitable habitat
FLOWERING PLANTS				
California seablite *Suaeda californica*	Endangered	USFWS	Margins of coastal salt marshes on Morro Bay in upper intertidal zones	Likely; suitable habitat at Heron's Head, endemic to California coastal zones
Franciscan manzanita *Arctostaphylos franciscana*	Endangered	USFWS	Bluffs and hills surrounding San Francisco Bay, northern coastal scrub	Unlikely; outside of known range
Marin dwarf-flax *Hesperolinon congestum*	Threatened	USFWS	Endemic to California; serpentine soils in Marin, San Francisco, and San Mateo counties	Unlikely; outside of known range

Common Name ***Scientific Name***	**Federal Status**	**Jurisdiction**	**Habitat Requirements**	**Potential to occur in the study area**
Marsh sandwort *Arenaria paludicola*	Endangered	USFWS	Freshwater-marshes, swamps, and areas that are wet year-round	Unlikely; lacks suitable habitat
Presidio clarkia *Clarkia franciscana*	Endangered	USFWS	Serpentine bluffs and serpentine grasslands	Unlikely; outside of known range
Presidio manzanita *Arctostaphylos hookeri var. ravenii*	Endangered	USFWS	Serpentine outcrop of the San Francisco Presidio in maritime chaparral-coastal prairie plant communities	Unlikely; outside of known range
Robust spineflower *Chorizanthe robusta var. robusta*	Endangered	USFWS	Endemic to California; grows in dunes, coastal areas, and meadows	Moderate – suitable habitat at Heron's Head
San Francisco lessignia *Lessingia germanorum*	Endangered	USFWS	Restricted to vegetation gaps on remnant sand dunes and related sandy soils	Unlikely; outside of known range
Showy Indian clover *Trifolium amoenum*	Endangered	USFWS	Endemic to California; occurs typically in wetlands or grassland areas	Unlikely; outside of known range
Sonoma sunshine *Blennosperma bakeri*	Endangered	USFWS	Occurs in Sonoma County in vernal pools and wet grasslands	Unlikely; outside of known range
White-rayed pentachaeta *Pentachaeta bellidiflora*	Endangered	USFWS	Found only in San Mateo County in grasslands with serpentine soil	Unlikely; outside of known range and lacks suitable habitat

3.11.2.1.1 Critical Habitat

Critical habitat is defined by NMFS as "specific areas…occupied by a species…that contain physical or biological features essential to conservation of the species and that may require special management considerations or protection". Once critical habitat has been designated, a federal agency is required to consult with NMFS to "ensure actions they fund, authorize, or undertake are not likely to destroy or adversely modify" the critical habitat. Two critical habitat occur within the study area – green sturgeon and chinook salmon.

Green sturgeon critical habitat spans approximately 320 miles (mi) of freshwater river habitat, 897 square miles (mi^2) of estuarine habitat, 11,421 mi^2 of marine habitat, 487 mi of the Sacramento-San Joaquin Delta, and 135 mi^2 of the Yolo and Sutter bypasses in the Sacramento River (50 CFR 226). All of San Francisco Bay adjacent to the study area is considered critical habitat for green sturgeon (Figure 3-14).

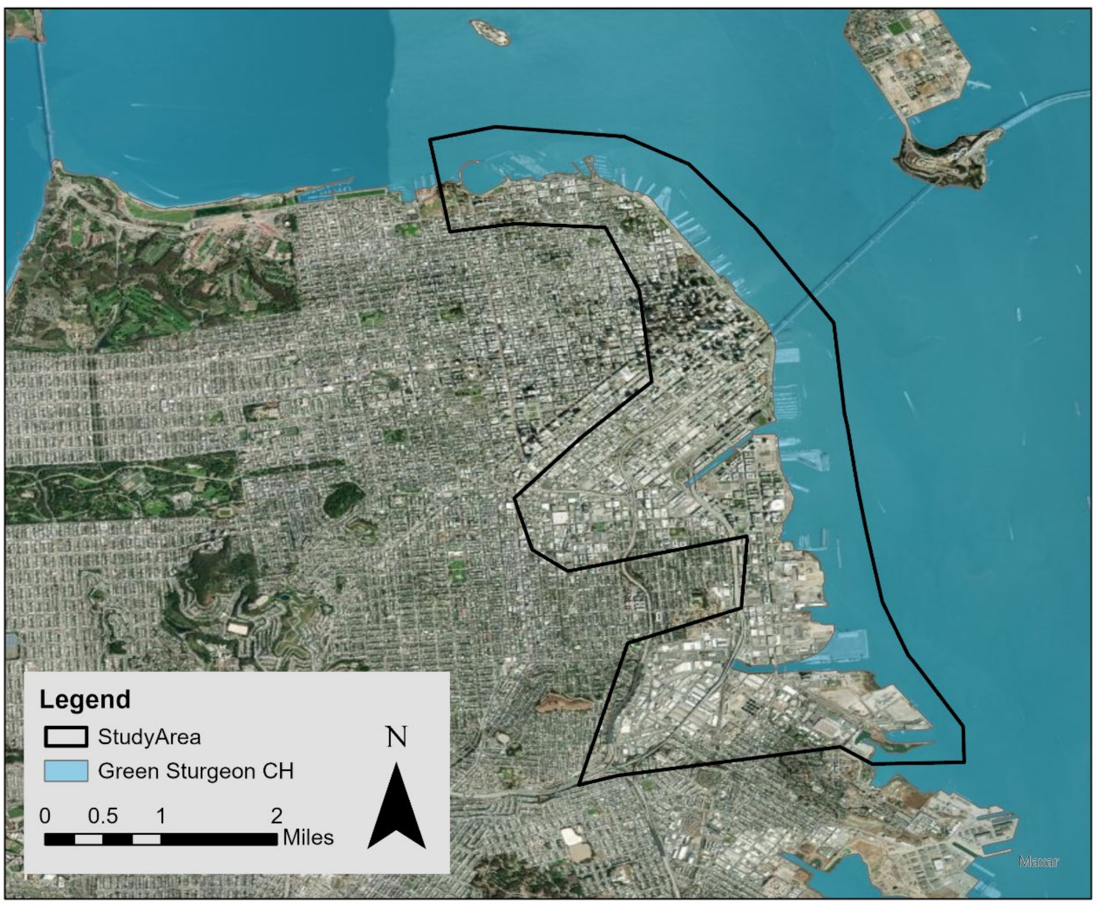

Figure 3-14. Green sturgeon critical habitat within the study area. Source: NMFS 2021.

There are several chinook salmon critical habitats throughout California; however, only one intersects the study area – the Sacramento River winter-run chinook salmon. The critical habitat includes the Sacramento River from Keswick Dam, Shasta County (river mile 302) to Chipps Island (River Mile 0) at the westward margin of the Sacramento-San Joaquin Delta; all waters from Chipps Island westward to Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay from San Pablo Bay to the Golden Gate Bridge (50 CFR 226). Chinook salmon critical habitat includes waters in the northern two reaches of the study area (Figure 3-15).

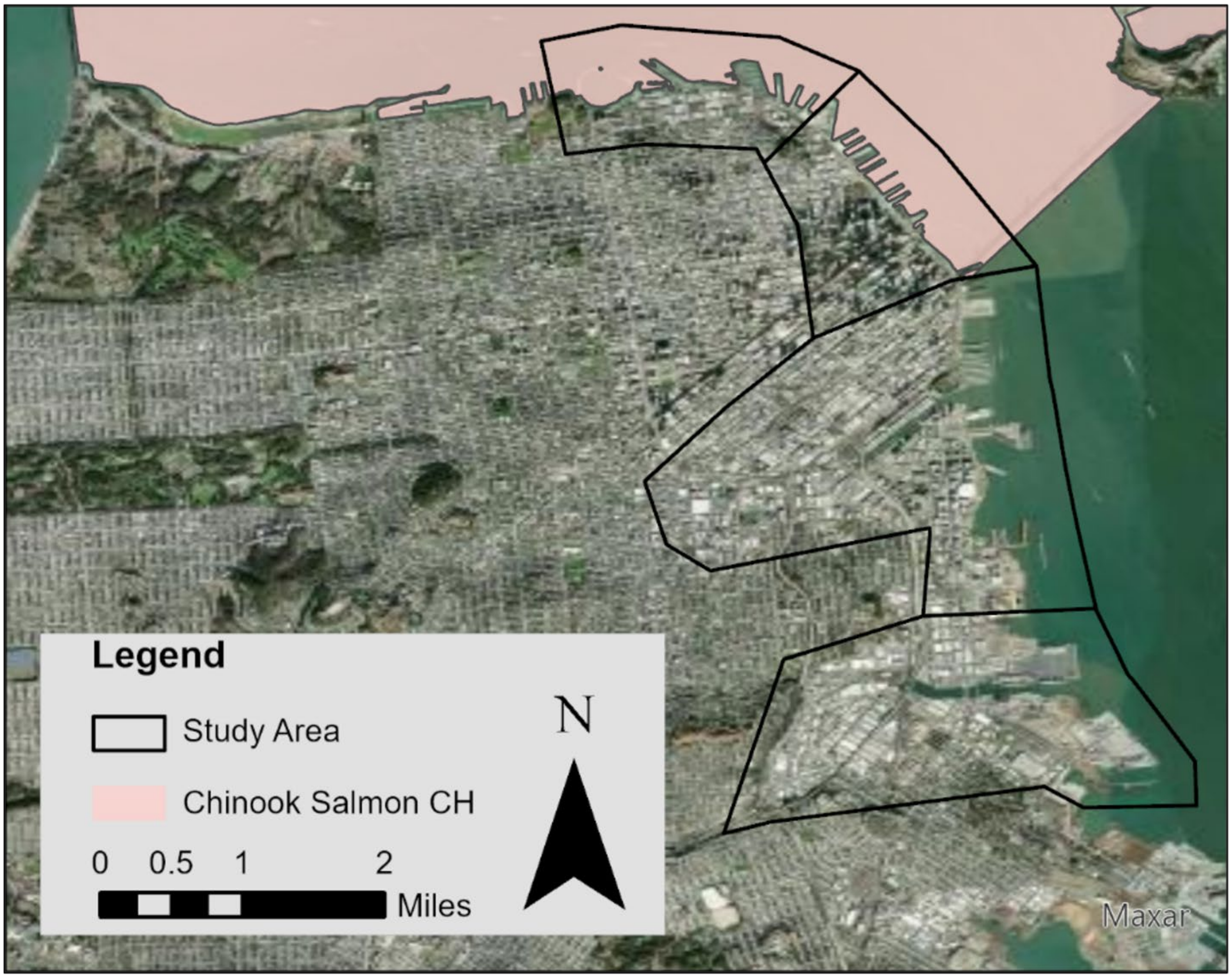

Figure 3-15. Chinook salmon Sacramento River winter-run critical habitat within the study area. Source: NMFS 2021.

3.11.2.2 State-listed Threatened and Endangered Species

In California, animal or plant species of conservation concern may be listed as threatened or endangered under the authority of the California Endangered Species Act of 1984 (CESA; Cal. Code Regs. tit. 14, §§ 783.0-787.9). State-listed species may also be protected federally under the ESA, or strictly listed as state protected. California has 54 animals listed as endangered, 43 animals as threatened, 137 plants as endangered, and 21 plants as threatened (CNDDB 2023a; CNDDB 2023b).

After reviewing a description of each species provided by the California Natural Diversity Database (CNDDB) and consulting with resource agencies, the PDT concluded that the focused study area is outside the known range or does not provide suitable habitat for 92 of the animals and 156 of the plants. The CNDDB online BIOS Quicktool was used to evaluate the state-protected threatened and endangered species likely present in the study area. Data are reported on a quad basis; thus species were pulled for the San Francisco North and Hunters Point Quad to incorporate the entire study area, and beyond.

The study area does provide suitable habitat for seven CESA protected animal and plant species (Table 3-2). Of these, two of the animal and plant species, respectively, also are federally listed. The longfin smelt is not federally listed yet, but is a candidate species.

Table 3-2. California state-listed threatened and endangered species likely to occur in the study area.

Common Name ***Scientific Name***	***State status***	***Federal status***	***Habitat requirements***
BIRDS			
California Ridgeway's rail *Rallus obsoletus obsoletus*	*Endangered*	*None*	*Resident of San Francisco Bay area; lives in dense vegetation in saltwater marshes, freshwater marshes, and mangrove swamps*
Bank swallow *Riparia riparia*	*Threatened*	*None*	*Breed in open lowland areas near bodies of water; avoid forests, woodlands, or areas that lack appropriate nesting*
California black rail *Laterallus jamaicensis coturniculus*	*Threatened*	*None*	*Lives in tidal and freshwater marshes in California*
FISH			
Longfin smelt *Spirinchus thaleichthys*	*Threatened*	*Candidate*	*Reside in San Francisco estuary; uses a variety of habitats including nearshore waters, estuaries, lower portions of freshwater streams*
Chinook salmon - Central Valley spring-run *Oncorhynchus tshawytscha*	*Threatened*	*Threatened*	*Spend early life growing and feeding in freshwater streams, estuaries, and wetlands; transition to open ocean and estuaries, then return to freshwater to spawn*
PLANTS			
Marsh sandwort *Arenaria paludicola*	*Endangered*	*Endangered*	*Freshwater-marshes, swamps, and areas that are wet year-round*
Marin western flax *Hesperolinon congestum*	*Threatened*	*Threatened*	*Endemic to San Francisco county; occurs in serpentine soils, in dry native bunch grasses*

3.11.2.3 Migratory Birds

San Francisco Bay is a migration highway for over 250 species of birds, many of which are small songbirds (e.g., warblers, thrushes, tanagers, sparrows) and some threatened species (GGAS 2023). A variety of birds use this area to forage in the many microclimates while others use the Bay area as a resting stop-over. The San Francisco Bay is the largest estuary on the Pacific Coast, thus, is an ideal refuge for shorebirds, raptors, and songbirds. Some of the prominent species include, but are not limited to (Karlenzig 2013):

- Songbirds: varied thrush (*Ixoreus naevius*), red-winged blackbird (*Agelaius phoeniceus*), golden-crowned sparrow (*Zonotrichia atricapilla*), and black-throated blue warbler (*Setophaga caerulescens*);
- Hawks: ferruginous hawk (*Buteo regalis*), Cooper's hawk (*Accipiter cooperii*), red-shouldered hawk (*Buteo lineatus*);
- Waterfowl: lesser scaup (*Aythya affinis*), greater scaup (*A. marila*), wood duck (*Aix sponsa*), mallard (*Anas platyrhynchos*);
- Shorebirds: whimbrel (*Numenius phaeopus*), long-billed curlew (*Numenius americanus*), marbled godwit (*Limosa fedoa*), willet (*Tringa semipalmata*), black-bellied plover (*Pluvialis squatarola*), American avocet (*Recurvirostra americana*), and black-necked stilt (*Himantopus mexicanus*).

3.11.2.4 Bald and Golden Eagles

The Bald and Golden Eagle Protection Act was enacted in 1940 and prohibits the take and/or disturbance of bald or golden eagles without a permit issued by the Secretary of the Interior (16 U.S.C. 668-668d; 50 CFR 22.6). Bald eagles (*Haliaeetus leucocephalus*) are the national symbol that was in danger of extinction throughout most of its range in North America. In 2007, bald eagle populations had recovered to such as state that they were delisted from the ESA (USFWS 2023a). Bald eagles are solely native to North America and may be found throughout most of California at lakes, reservoirs, rivers, and some rangelands and coastal wetlands. Most breeding occurs in northern California, but scattered nesting also occurs in the central and southern Sierra Nevada mountains and foothills, inland southern California, and Santa Catalina Island (CDFW 2023a).

Golden eagles are global species, with the western U.S. comprising 80% of the species' range in the contiguous U.S. (USFWS 2023b). Most golden eagles in California are resident, though some can be migratory, and inhabit forests, canyons, shrub lands, grasslands, and oak woodlands. Nests are constructed on platforms on steep cliffs or in large trees (CDFW 2023b).

Populations of bald and golden eagles are found in the less urbanized areas of San Francisco Bay and coastal range. While individual eagles may migrate through the area, the project area does not support nesting habitat for eagles as it generally lacks large mature trees. If nesting were to occur, the nest would need to be placed on man-made structures which would present its own set of challenges to survival, although not unheard of in other parts of the county. The chance of this occurring is relatively low since more suitable nesting habitat is available throughout the Bay or in more vegetated areas of the City.

3.11.2.5 Marine Mammals

The Marine Mammal Protection Act was passed in 1972 in response to concerns about significant declines in marine mammal species caused by human activities. As such, the MMPA established a national policy to prevent marine mammal species and population stocks from declining beyond that in which they cease to be significant functioning elements of ecosystems. Three federal entities share responsibility for implementing MMPA, NOAA Fisheries, USFWS, and the Marine Mammal Commission (MMC). NOAA is responsible for protecting whales, dolphins, porpoises, seals, and sea lions; USFWS protects walrus, manatees, sea otters, and polar bears; and MMC provides oversight of domestic and international policies and actions of federal agencies addressing anthropogenic impacts on marine mammals and their ecosystems.

There are two pinniped and four species of cetaceans likely to occur in or near the study area, which include harbor seals (*Phoca vitulina richardii*), California sea lion (*Zalophus californianus*), harbor porpoise (*Phocoena phocoena*), common bottlenose dolphin (*Tursiops truncatus*), California gray whale (*Eschrichtius robustus),* and humpback whale (*Megoptera noveangliae*), respectively.

3.11.2.5.1 Harbor seals

Harbor seals are widely distributed in the North Pacific, with two subspecies, western and eastern. The eastern subspecies inhabits coastal and estuarine areas from Mexico to Alaska on the western coast of the U.S. Harbor seals have fairly strong site fidelity and do not make extensive pelagic migrations but can travel a few hundred kilometers to find food or suitable breeding areas (Herder 1986; Harvey and Goley 2011). California supports 400 to 600 harbor seal haul out sites widely distributed along the mainland and offshore islands, intertidal sandbars, rocky shores, and beaches (Hanan 1996; Lowery et al. 2008). Three stocks are recognized along the west coast, California, outer coasts of Oregon and Washington, and inland waters of Washington. The harbor seal population estimate for California includes nearly 31,000 individuals (Caretta et al. 2019). Historically, harbor seals were commercially harvested prior to state and federal protection, but now face threats of mortality or injury from commercial gillnetting, shootings, ship/vessel strikes, entrainment in power plants, recreational fisheries, human-induced abandonment of pups or harassment, marine debris entanglement, stabbing/gaff wounds, and research-related deaths (Carretta et al 2014; Caretta et al. 2019). California harbor seals are not considered endangered or threatened under the ESA or CESA nor designated as depleted under the MMPA. Harbor seals are likely to be present in the study area swimming, loafing, or feeding.

3.11.2.5.2 California sea lions

California sea lions have five genetically distinct populations in the Pacific, the U.S. stock is the Pacific Temperate, while the other four reside in or near Mexico (Schramm et al. 2009). The U.S. population includes rookeries within U.S. waters and the Coronados Islands just south of the U.S. and Mexico border. Along the U.S. west coast, population has been estimated at nearly 258,000 animals (Lowry et al. 2017; DeLong et al. 2017; Laake et al. 2018). Over four decades (1975 – 2014), the California sea lion populations have increased, nearly reaching their expected carrying capacity (Laake et al. 2018; Caretta et al. 2019). Historically, California sea lions were exploited for food, oil, and hides, but that has since ceased (Stewart et al. 1993). Current threats to the species include mortality and injury from a variety of commercial and recreational fisheries along the U.S. west coast (Barlow et al. 1994; Caretta and Barlow 2011; Carretta et al. 2018a, 2018b; Julian and Beeson 1998; Jannot et al. 2011), shootings, power plant entrainment, marine debris entanglement, oil exposure, vessel strikes, and dog attacks (Caretta et al. 2018b). California sea lions are not listed as endangered or threatened under ESA or CESA or depleted under the MMPA (Caretta et al. 2019). This is the most likely marine mammal to be present in the study area as Pier 39 in the northern waterfront is an important haul out site.

3.11.2.5.3 Harbor porpoise

Harbor porpoises are found in coastal and inland waters of the Pacific Ocean and exhibit fairly restricted movement along the western coast of the United States, with regionalized populations among California, Washington, British Columbia, and Alaska (Calambokidis and Barlow 1991; Rosel et al. 1995). Recently, genetic studies reported four separate stocks of harbor porpoise along the Central California coast (Chivers et al. 2002, 2007). The study area is likely to include individuals from the San Francisco-Russian River stock, which based on 2007-2011 aerial surveys, supports nearly 9,900 porpoises (Forney et al. 2013). Harbor porpoises can be sensitive to fishery related strandings or injuries; however, within the more recent NOAA Fisheries survey period, no fishery-related mortality or injury within the San Francisco-Russian River stock were reported (Caretta et al. 2019). Harbor porpoises are not listed as threatened or endangered under ESA, MMPA, or CESA. Harbor porpoises are likely to be observed in San Francisco Bay near the study area and may occasionally transit through the study area, though they are not expected to remain there for any extended period.

3.11.2.5.4 Common bottlenose dolphin

Bottlenose dolphins are globally distributed and, in many regions, including California, have separate coastal and offshore populations (Walker 1981; Ross and Cockcroft 1990; Van Waerebeek et al. 1990). The California coastal stock is genetically distinct from the offshore population (Perrin et al. 2011; Lowther-Thielking et al. 2015) and are found within 1 km of the shore (Hansen 1990; Carretta et al. 1998; Defran et al. 1999). Bottlenose dolphins can be highly migratory, as with the coastal California population, in which 80% of identified individuals have been observed as far south as Ensenada, Mexico (Defran et al. 1999; Feinholz 1996; Defran et al. 2015). The California coastal population is estimated to have remain stable over two decades (1987 – 2005; Dudzik et al. 2006), while more recent surveys (2009 – 2011) suggest an increase (Weller et al. 2016). This could reflect population growth or may be an artifact of dolphins moving north from Mexican waters (Carretta et al. 2019). Common bottlenose dolphins are highly susceptible to fishery-related mortalities given their exclusive use of coastal habitats. Bottlenose dolphins are not listed as threatened or endangered under ESA or

CESA, nor as depleted under the MMPA (Carretta et al. 2019). Bottlenose dolphins are likely to occur regularly near the study area but may not be as common within the study area given its proximity to an urban shoreline.

3.11.2.5.5 California gray whale

Gray whales are commonly found in the North Pacific Ocean, with two genetically distinct populations – Eastern North Pacific and Western North Pacific (LeDuc et al. 2002; Lang et al. 2011a; Weller et al. 2013). Gray whales that may frequent San Francisco Bay would be from the Eastern North Pacific stock. A small number of these whales feed along the Pacific coast in California during summer months (Darling 1984; Gosho et al. 2011; Calambokidis et al. 2017). The Eastern North Pacific population frequenting California was most recently estimated at 26,960 individuals (Durban et al. 2017). The stock overall has increased through recent decades (Durban et al. 2017). One of the most common threats to gray whales include entanglement in commercial fishery equipment, in both the drift gillnets and pot and trap fisheries (Carretta et al. 2018a, 2018b). Ship strikes are another source of mortality and serious injury to gray whales (Carretta et al. 2018a). Gray whales may occur near the study area in the San Francisco Bay but may not be as common within the study area given its proximity to an urbanized shoreline.

3.11.2.5.6 Humpback whale

North Pacific humback whales comprise a distinct subspecies compared to the North Atlantic humpback whales (Jackson et al. 2014). Currently, NMFS recognizes one humpback whale stock on the west coast with two separate feeding groups, a California and Oregon feeding group and a northern Washington and southern British Columbia feeding group (Calambokidis et al. 2008; Barlow et al. 2011; Wade et al. 2016). The California and Oregon stock abundance was most recently estimated at 2,374 whales (Calambokidis et al. 2017). This stock has shown a long-term increase for the last several decades, but as early as 2010 the population was likely leveling off (Calambokidis et al. 2017). Humpback whales have incurred serious injuries, non-serious injuries, and mortality involving pot/trap fisheries, fishery interactions, vessel strikes, gillnet fisheries, and marine mooring interactions (Carretta et al. 2018a). Humpback whales may occur near the study area in the San Francisco Bay but are not likely to occur directly within the study area given its proximity to an urban shoreline.

3.11.2.6 Essential Fish Habitat

Essential Fish Habitat (EFH) includes “waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity” (NMFS 2021; GMFMC & NMFS 2016). Specific habitats include all estuarine water and substrate (mud, sand, shell, and rock) and all associated biological communities, such as subtidal vegetation (seagrasses and algae) and the adjacent intertidal vegetation (marshes). Of the fish species considered by NMFS to potentially occur within the study area, EFH habitat for these species consists of all waters and substrate from mean higher high water (MHHW) to 3,500 water depth, seamounts, and areas designated as Habitats of Particular Concern (HAPC). HAPC are identified based on one or more of the following considerations:

- Importance of the ecological function provided by the habitat;
- Extent to which habitat is sensitive to human-induced environmental degradation;
- Extent to which development activities are or will be stressing the habitat; and
- Rarity of habitat (50 CFR 600.815(a)(8)).

There are four HAPCs within the study area, including the San Francisco Estuary (estuary HAPC), seagrass, rocky reef, and marine and estuarine SAV HAPC. Estuary HAPCs are defined as “MHHW, or the upriver extent of saltwater intrusion, upstream and landward to where ocean-derived salts measures less than 0.5 ppt during the period of average annual low flow”. Seagrasses HAPC include “those waters, substrate, and other biogenic features associated with eelgrass species (*Zostera* spp.), widgeongrass (*Ruppia maritima*), or surfgrass (*Phyllospadix* spp.).” The rocky reef HAPC includes “those waters, substrates, and other biogenic features associated with hard substrate (bedrock, boulders, cobble, gravel, etc.) to MHHW” (NOAA 2022a). Marine and estuarine SAV includes kelps (floating and submerged) and eelgrass (NOAA 2014). The study area includes 0.29 acres of seagrass HAPC, and the entire in-water study area is considered salmon EFH and estuary HAPC (Figure 3-16; Hanshew 2019, NOAA 2016).

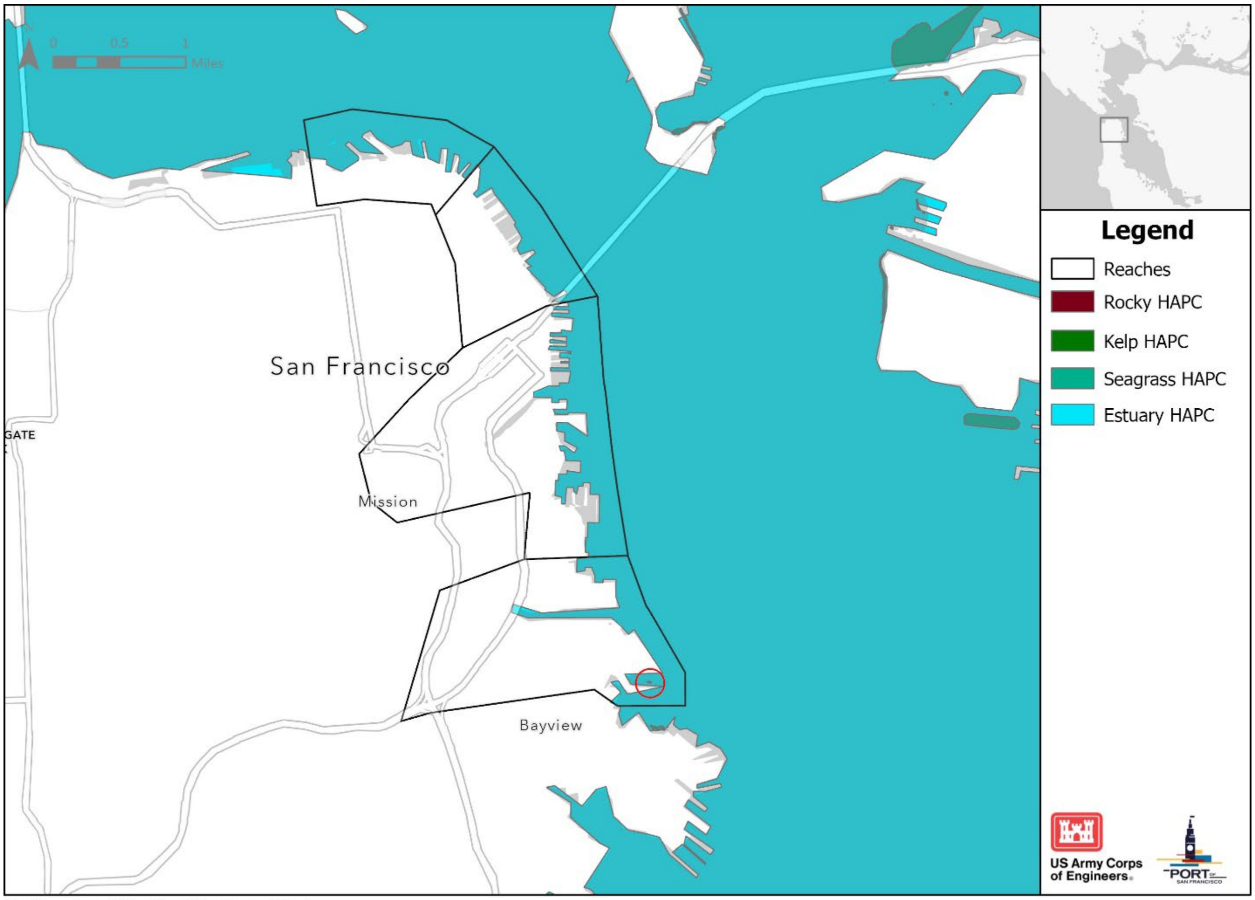

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Figure 3-16. HAPC within the study area. Source: Hanshew 2019.

The study area falls within EFH for 20 species of commercially important fish and sharks managed under three federal fisheries management plans (FMP):

- Pacific Groundfish FMP
- Coastal Pelagic FMP
- Pacific Coast FMP.

3.11.2.6.1 Coastal Pelagic EFH

The Coastal Pelagic FMP is designed to protect habitat for fish species associated with open coastal waters. Fish managed under this plan include planktivores (aquatic organism that feeds on planktonic food) and their predators. Those found in the study area include Northern anchovy (*Engraulis mordax*), Pacific sardine (*Sardinops sagax*), and jack mackerel (*Trachurus symmetricus*).

3.11.2.6.2 Pacific groundfish EFH

The Pacific groundfish FMP is designed to protect habitat for more than 90 species of fish including rockfish, flatfish, roundfish, some sharks and skates, and other species associated with underwater substrate. Fifteen species are reported present in the study area including English sole (*Parophyrs vetulus*), sand sole (*P. lascaris*), curlfin sole (*Pleuronichthys decurrens*), Pacific sanddab (*Citharichthys sordidus*), starry flounder (*Platichthys stellatus*), lingcod (*Ophiodon elongatus*), brown rockfish (*Sebastes auriculatus*), Pacific whiting (*Merluccius productus*), kelp greenling (*Hexagrammos decagrammus*), leopard shark (*Triakis semifasciata*), spiny dogfish (*Squalus acanthias*), skates (*Raja* spp.), soupfin shark (*Galeorhinus galeus*), bocaccio (*Sebastes paucispinis*), and cabezon (*Scorpaenichthys marmoratus)*.

3.11.2.6.3 Pacific salmon EFH

The Pacific Salmon FMP is designed to protect habitat for commercially important salmonid species. Sacramento Chinook salmon (*Oncorhynchus tshawytscha*) is the only one of these species that may be seasonally present in the study area, though coho salmon (*O. kisutch*) was historically common in San Francisco Bay.

Table 3-3 identifies the fish species covered by the FMP's listed above as utilizing the study area, along with the life stage and relative occurrence.

Table 3-3. Managed fish species in the study area under the MSFMA. Life stage is indicated with A = adult, J = juvenile, L = larvae, and E = egg. Abundance is recorded as A = abundant, P = present, and R = rare.

FMP	Common name	Scientific name	Life stage	Abundance
Coastal Pelagic	Northern anchovy	*Engraulis mordax*	J, A	A
	Jack mackerel	*Sardinops sagax*	E, L	P
	Pacific sardine	*Trachurus symmetricus*	J, A	P
	English sole	*Parophyrs vetulus*	J, A	A
	Sand sole	*Psettichthys melanostictus*	L, J, A	P
	Curlfin sole	*Pleuronichthys decurrens*	J	R

FMP	Common name	Scientific name	Life stage	Abundance
Pacific Groundfish	Pacific sanddab	*Citharichthys sordidus*	E, L, J, A	P
	Starry flounder	*Platichthys stellatus*	J, A	P
	Lingcod	*Ophiodon elongatus*	J, A	P
	Brown rockfish	*Sebastes auriculatus*	J	P
	Pacific whiting	*Merluccius productus*	E, L	P
	Kelp greenling	*Hexagrammos decagrammus*	J, A	P
	Leopard shark	*Triakis semifasciata*	J, A	P
	Spiny dogfish	*Squalus acanthias*	J, A	P
	Skates	*Raja* spp.	J, A	P
	Soupfin shark	*Galeorhinus galeus*	J, A	R
	Bocaccio	*Sebastes paucispinis*	J	R
	Cabezon	*Scorpaenichthys marmoratus*	J	P
Pacific Coast Salmon	Chinook salmon	*Oncorhynchus tshawytscha*	J, A	Seasonally P
	Coho salmon	*O. kisutch*	J, A	Historically P

3.11.2.7 Rare and Unique Habitats

Eelgrass is a native marine plant found globally within soft-bottom bays and estuaries. It is typically found in healthy, shallow bays and estuaries where the depth of occurrence is a function of light penetration. In deeper water, light penetration is reduced below a level in which photosynthesis is able to meet the metabolic demands of the plant to sustain net growth. Eelgrass beds are dynamic, expanding and contracting seasonally and annually dependent on habitat quality. Importantly, eelgrass is considered an indicator community for the health of an estuary. It enhances water quality through sediment trapping and habitat stabilization, transforms nutrients, oxygenizes water, and serves as a primary producer, nursery habitat, and forage area for commercially and recreationally important fish, as well as migratory birds.

Eelgrass is sensitive to changes in water quality and turbidity and disturbances from shipping and boating that can disrupt seagrass beds directly through destruction of plants by propellers, anchors and anchor chains, dredging, and construction of facilities. Indirect impacts can occur through turbidity from dredging and boat wakes or shading from structures such as docks. Hardening of the shoreline can reflect waves that may increase wave action or limit or destroy eelgrass beds. Most of these threats are localized and have a limited spatial and temporal effect. However, eelgrass beds may be impacted by climate change through SLR, but may respond by establishing closer to the present-day shoreline and dying out at greater depths.

In San Francisco Bay eelgrass is afforded special management considerations by CDFW, USFWS, NMFS, U.S. Environmental Protection Agency (EPA), and BCDC. In the bay, eelgrass beds occur on soft bottom substrate in shallow areas and are most likely limited to the southern waterfront near Heron’s Head.

3.12 Noise and Vibration

The Noise and Vibration affected environment is available in Appendix D-1-2.

3.13 Cultural Resource

3.13.1 Regulatory Framework

3.13.1.1 Federal

National Historic Preservation Act (NHPA) – requires Federal agencies to consider the effects of funded or approved actions that have the potential to affect any district, site, building, structure, or object that is listed in, or eligible for listing in, the National Register of Historic Places

National Register of Historic Places (NRHP) – authoritative guides for federal, state, and local governments, private groups, and citizens to identify the nation’s cultural resources and to indicate what properties should be considered for protection from destruction or impairment.

3.13.1.2 State

California Environmental Quality Act (CEQA) – requires state and local agencies to identify and assess the impacts of their activities on historic resources. CEQA also established the California Register of Historical Resources (CRHR) and criteria for evaluating the significance of historic resources.

California Health and Safety Code 7050.5 and Public Resources Code 5097.98 – establishes a process for the treatment and repatriation of human remains that are discovered during the course of investigations.

3.13.1.3 Local

San Francisco General Plan – establishes policies for the preservation of notable landmarks, areas of historic, architectural, or aesthetic value, culturally significant landscapes, sites, buildings, structures, and objects.

San Francisco Planning Code – establishes the City's desire to preserve landmarks and historic buildings. It also establishes the San Francisco Historic Preservation Commission to provide recommendations to the San Francisco Board of Supervisors regarding historic resources and the review of projects subject to the NHPA and CEQA.

San Francisco Legacy Business Registry – provides policies for recognizing longstanding, community-serving businesses that serve as valuable cultural assets.

3.13.2 Existing Condition

The identification of historic properties included developing relevant criteria through context information such as environmental, precontact, historic, ethnography and ethnohistory, traditional, archaeological, and historical built environment. Detailed information about this process can be found in Section 4.18.

The study area is at the northern margin of the San Francisco Peninsula, a landform that is composed primarily of uplifted marine sedimentary rock, with local accumulations of Holocene-age alluvial (transported by the movement of water) and aeolian deposits (transported by wind). During a period that roughly coincides with the Holocene epoch (around 12,000 years ago), the study area underwent a series of geomorphic changes induced by sea-level rise, intertidal oscillation, wind, and anthropogenic filling, with the potential to affect archaeological resource preservation and visibility.

The precontact cultural chronology of the San Francisco Bay Area has been summarized by numerous reviewers (Beardsley 1948; Bennyhoff and Hughes 1987; Fredrickson 1974; Heizer 1958; Byrd et al. 2010; Groza et al. 2011). These summaries have divided the precontact cultural sequence into multiple phases or periods, which are delineated by changes in regional patterns of land use, subsistence, and tool types over time. The geologic time segments include Terminal Pleistocene (13,500–11,600 calibrated years before present [cal BP]), Early Holocene (11,600–7700 cal BP), Middle Holocene (7700–3800 cal BP), and Late Holocene (3800 cal BP onward), with further divisions of the Late Holocene based on research presented by Groza et al. 2011.

The San Francisco Bay Area was traditionally inhabited by the Ohlone people, who spoke various dialects of Costanoan languages. These languages are part of the Utian language family, which is part of a larger language family, Penutian, with languages and dialects spoken by Native Americans across California, Oregon, and Washington (Callaghan 1967). The territory of the Ohlone people extended along the coast, from the Golden Gate in the north to just below Carmel in the south, as well as through several inland valleys (Levy 1978). As with most other California groups, the Ohlone were primarily hunter-gatherers. Spanish colonization and subsequent rule by Mexico and the U.S. translated into dramatic disruptions in the traditional subsistence patterns, customs, and practices of the Ohlone. In addition, European diseases caused a rapid decline in the Ohlone population (Milliken 1995). Although they have yet to receive formal recognition from the federal government, the Ohlone persevered and are actively maintaining their ancestral heritage through political advocacy and education. Many Ohlone are active in maintaining their traditions and advocating for Native American issues.

The historical context covers the period from 1776 to the present and reviewed information about San Francisco’s early development (1776-1850), and the development of the waterfront (1850-present). The earliest European settlement in the vicinity of San Francisco occurred in 1776. Mexico seized California in 1822 (Kyle 2002; Woodbridge 2006) and the U.S. claimed the state during the Mexican-American War in 1846 (Bean and Rawls 2002; Sandos 2004). San Francisco was named in 1846 and the discovery of gold in 1848 lead to rapid population growth and expansion. San Francisco became a well-established port by the 1860s and was the second largest port in the U.S. during World War II (DOI 2006). Substantial commercial and industrial development on the waterfront began in the 1850s (San Francisco Planning Department 2011) and continued through the 1960s (City of San Francisco 1983).

Based on a records search of the California Historical Resources Information System (CHRIS) -Northwest Information Center, a total of 14 previously recorded archaeological resources are located in or adjacent to the study area. All 14 are historic-aged archaeological resources, and consist of remnants of historical maritime, commercial, residential, transportation infrastructure, and shipwrecks. Review of the *Geoarchaeological Assessment and Prehistoric Site Sensitivity Model for the City and County of San Francisco, California* (Meyer and Brandy 2019) reveals that much of the study area has moderate to high sensitivity for both buried and submerged archaeological resources and low sensitivity for precontact archaeological resources exposed on the ground surface before Gold Rush development and filling. Additionally, property parcel data was obtained from the San Francisco Planning Department’s Property Information Map to identify properties that are 45 years old or older.

A total of 2,846 parcels were identified in the study area. This includes resources listed in or eligible for listing in the NRHP as well as resources listed in or eligible for listing in the CRHR, as follows:

- 17 NRHP-listed properties, and nine NRHP-listed districts;

- Three NRHP-eligible structures (bridges), and five NRHP-eligible districts;
- Nine CRHR-eligible districts;
- 544 parcels with CEQA historical resources not yet evaluated for NRHP eligibility;
- 306 properties determined not eligible for the NRHP;
- 1,191 parcels that require further research to classify them among the preceding categories because they are of historic age (i.e., constructed in 1990 or earlier) and unevaluated;
- 214 parcels exempt because parcel data indicates that they are not recorded as historic age (i.e., constructed in 1990 or later);
- 528 parcels exempt because they are vacant; and
- Eight parcels that are unknown because their geospatial location could not be determined.

3.14 Socioeconomic, Community, and Environmental Justice

The Socioeconomic, Community, and Environmental Justice affected environment is addressed in Appendix D-1-3.

3.15 Transportation

The Transportation affected environment is addressed in Appendix D-1-4.

3.16 Utilities

3.16.1 Regulatory Framework

There are no federal or state regulatory standards for utilites; however, many of the state laws reference, support or emphasize the importance of maintaining or increasing public utilities.

3.16.1.1 Local

- SFPUC

3.16.2 Existing Conditions

3.16.2.1 Potable Water

Potable, or low-pressure water (LPW) is vital to the community's development and daily functions. All types of businesses—office buildings, hotels, restaurants, and industry—depend on potable water to stay open. The SFPUC Water Enterprise operates San Francisco's water distribution system, which includes reservoirs and storage tanks, pump stations, fire hydrants, distribution pipelines, isolation valves, and automatic air valves. In the study area, critical LPW assets include the Bay Bridge Pump Station, water mains, low pressure fire hydrants, and automatic air valves (CH2M/Arcadis, 2020h).

From a coastal flooding perspective, the Bay Bridge Pump Station is most vulnerable to flood damage (and service disruption) while underground pipes are vulnerable to rising ground water. The Bay Bridge Pump Station, located in Reach 3, is the sole provider of potable water to Treasure Island and Yerba Buena Island. If the facility is damaged, around 3,200 residential customers could lose potable water service (U.S. Census, 2020).

3.16.2.2 Combined Sewer System

Through the San Francisco Public Utilities Commission, the City operates and maintains a predominantly combined sewer system with major infrastructure including three treatment plants, 27 pump stations, 1,000 miles of sewer mains, 17 miles of transport/storage (T/S) structures and 36 combined sewer discharge structures and over 85 green infrastructure facilities.

The combined sewer system collects both wastewater and stormwater for most of the City. The wastewater is collected, stored, conveyed to, and treated at one of three treatment plants, two of which are located in the study area. The Southeast Treatment Plant is the City's largest wastewater treatment facility (43 million gallons per day (MGD) average dry weather capacity in 2022, 250 MGD peak wet weather capacity) and is located within the study area. The North Point Wet Weather Treatment Plant is also located in the study area, is used only during wet weather, and has a peak wet weather treatment capacity of 150 MGD. Local gravity sewers convey combined wastewater flows to T/S boxes, which meters to the treatment plants. Once system capacity is exceeded during wet weather events, discharges through one of the combined sewer discharge structures occur with equivalent to primary treatment. Generally, only during the most prolonged intense rainstorms is the combined capacity of the treatment plants and T/S boxes exceeded. Instead of allowing the excess water to back up through the sewers into homes and streets, water is discharged into either the Bay or Ocean through combined sewer discharge (CSD) structures.

Wastewater service is critical in supporting residents, commerce, and industries. In addition to providing wastewater service to SFPUC customers, the combined sewer system is also an essential stormwater drainage system for the City; together, the collection system and outfalls provide drainage for public streets, sidewalks, parks, and public/private facilities during wet weather events.

Some of the City's most critical wastewater conveyance and treatment facilities are in the waterfront area. This includes several miles of local gravity sewer systems, T/S boxes, tunnels, a force main, combined sewer gravity mains, CSD structures, pump stations, and two treatment facilities. These assets are arranged by Reach as follows:

- Reach 1 critical wastewater assets consist of the North Shore Pump Station, the North Point Wet Weather Facility, the North Beach Tunnel, a part of the Jackson T/S Box and one CSD outfall structure.
- Reach 2 includes the Jackson T/S Box, the North Shore Force Main, a part of the Channel T/S Box and three CSD structures.
- Reach 3 includes the Channel T/S Box, the Channel Pump Station, the Channel Force Main, the smaller Mission Bay, Berry Street, Harriet Street and Mariposa Pump Station, the Mariposa T/S Box and several CSD structures.
- Reach 4 encompasses part of the Channel Force Main, the Bruce Flynn Pump Station, the Booster Pump Station, the Southeast Bay Outfall, the Islais Creek T/S Box, the Southeast Treatment Plant and Bay Outfall, and several CSD structures.

3.16.2.3 Waste Management

Recology, or Recycle Central, is located on Pier 96 (Reach 4), and provides collection and sorting of recyclable materials including containers, mixed paper and carboard to commercial and residential customers in California. The facility, which opened in 2002, was designed and constructed in partnership with the City of San Francisco and is a key asset to the City's zero waste goal. Recology covers over 185,000 square feet and processes about 750 tons of material each day, employing over 180 people, many from the nearby Bayview Hunters point neighborhood.

3.16.2.4 Energy

The San Francisco Public Utilities Commission (SFPUC) and Pacific Gas and Electric Company (PG&E) provide energy to the study area and the City of San Francisco.

The SFPUC manages two retail electric service programs: Hetch Hetchy Power and CleanPowerSF. Together, these programs provide more than 70% of the electricity consumed in San Francisco today. For over 100 years, Hetch Hetchy Power has generated clean, 100% greenhouse gas-free electricity for San Francisco. It powers critical municipal services such as Muni and San Francisco General Hospital, affordable and public housing sites, and new developments like The Shipyard and Salesforce Transit Center.

Launched in 2016, CleanPowerSF is San Francisco's community choice aggregation program and serves more than 380,000 residential and commercial customers with clean, renewable electricity at competitive rates. CleanPowerSF's current resource portfolio includes solar, wind, hydroelectric, and geothermal power.

PG&E provides power through a combination of energy resources, including natural gas, nuclear, biomass and waste, geothermal, small and large hydroelectric, solar, and wind resources (PG&E 2019).Recreation and Access

3.17 Recreation and Access

3.17.1 Regulatory Framework

There are no regulatory standards for recreation and access; however, many of the state and local laws reference, support or emphasize the importance of maintaining or increasing the opportunities for recreation and access, even though those laws are not specifically for regulating recreation or access.

3.17.2 Existing Condition

The San Francisco Bay is a major destination for recreationists, including water-based activities such as cruising, wakeboarding, sailing, windsurfing, and kiteboarding as well as fishing both from land and boat, and land-based tourism and recreation at public parks and open spaces. In total, the City and County of San Francisco is home to approximately 5,890 acres of parkland and open space areas (San Francisco 2014).

The Port oversees public access, parks and open spaces, natural and cultural resources, and much of the City's last remaining critical industrial uses. The Exploratorium, Oracle Park, the Ferry Building, Chase Center, Heron's Head Park and EcoCenter, and Fisherman's Wharf are all within the study area.

The San Francisco Bay Trail (Bay Trail) runs along the entire study area. The Bay Trail is a planned 500-mile hiking and biking path that provides scenic recreation for hikers, joggers, bicyclists, skaters, and wheelchair users. It also offers a setting for wildlife viewing and environmental education and serves as a commute alternative for bicyclists (San Francisco Bay Trail 2020). The Embarcadero Promenade and the Blue-Greenway, both elements of the San Francisco Bay Trail, are significant recreation resources for the City. These are among the most heavily used trails for walking, jogging, and cycling in the City, providing miles of access along San Francisco Bay.

Aquatic Park contains a variety of open spaces, parks, and recreational activities for locals and visitors. It also houses the Maritime Museum, the oldest senior center in the U.S., and Aquatic Park Cove, a San Francisco Maritime National Historical Park that provides outdoor recreational opportunities. The San Francisco Maritime National Historical Park includes a fleet of historic ships, a visitor center, Maritime Museum, Maritime Research Center, and the Aquatic Park Historic District. In addition, a green open area overlooks Aquatic Park Cove and the beach. Views to north San Francisco, Alcatraz Island, the Golden Gate Bridge, and Sausalito in Marin County are also available (NPS 2016).

Fisherman's Wharf offers numerous water activities, including ferry and excursion boat tours, sport fishing trips, and kayak rentals.

The Ferry Building and surrounding area features a continuous pedestrian promenade, public market, public art, and landscaping. Neighbors and visitors can use the area's ferries, hovercraft, and excursion boats; visit the public market, conference facilities, and retail establishments; or enjoy other public-oriented activities (POSF 2023).

Embarcadero Plaza features local vendors as well as weekly farmers markets. The plaza is adjacent to multiple transit lines, including the San Francisco Bay Ferry, Bay Area Rapid Transit (BART), San Francisco Municipal Railway (Muni) buses, the Market Street Railway F-line and E-line, and cable cars.

Sue Bierman Park occupies 4.4 acres of land and includes a children's playground and lawns with trees and walking paths. The park is also popular with a non-native flock of parakeets that roost in the non-native trees in the park.

South Beach is a full-service marina with 700 slips with concrete docks, a 640-foot recreational and commercial guest dock, and the Pier 40 Maritime Center. Brannan Street Wharf is another public pier that offers a lawn area, waterside walkway with seating, shade structure, and a dock for small vessels displaying history exhibits of Pier 36. Recreationalists have access to South Beach Park, which features a playground, lawn, and picnic tables.

The Mission Bay Park system oversees park and recreational facilities in the Mission Creek, Mission Rock, and Mission Bay along the Port's southern waterfront. Several green open spaces and parks are located near Mission Creek. The 10-acre Mission Creek Park includes lawns and a tree-lined esplanade, walking and biking pathways, a small amphitheater for outdoor events, sports courts, a boat launch, and an off-leash dog play area (Mission Bay Parks 2017). Mission Bay Commons Park is a 2.2-acre open grass area that offers a walk/run sidewalk loop as well as benches. The Pier 52 boat launch is the only public motorized boat launch in San Francisco, providing public access to the Bay, and is used by Port maintenance crews for pier maintenance and emergency response activities.

Pier 70 is directly south of Mission Bay, in the Port's central waterfront. This pier area is included on the National Register of Historic Places because of more than 150 years of continuous ship building and repair operations, its role in the industrialization of the western U.S., the war efforts, and architectural and engineering feats. The Bay Trail is the only recreational feature onsite.

Pier 80, Islais Creek, Cargo Way, Pier 94/96, and Heron's Head contain the Maritime Eco-Industrial Center. The Maritime Eco-Industrial Center is as an area that co-locates maritime industrial uses to enable product exchange, optimizes the use of resources, incorporates green designs and green technologies, fosters resource recovery and reuse, provides economic opportunities that employ residents, minimizes environmental impacts, and incorporates public open space for enjoyment and habitat. The Blue Greenway, the main connecting vein of these sites, crosses Islais Creek. Other recreational resources within the Maritime Eco-Industrial Center include Warm Water Cove Park, Tulare Park, Islais Creek Park, Rosa Parks Skate Plaza, and Heron's Head Park.

Heron's Head Park is on the southernmost edge of the study area and is a 22-acre open space with habitat for plants and birds. Heron's Head Park is one of the few wetlands on the City's shoreline and home to more than 100 bird species annually. Thousands of birdwatchers, hikers, students, teachers, and others visit the open space habitat for recreational and educational purposes (POSF 2023). The park features walking paths, an environmental education center, benches, picnic tables, and a barbeque area.

3.18 Aesthetics

3.18.1 Regulatory Framework

3.18.1.1 Federal

CZMA

3.18.1.2 State

Scenic Highway Program – preserves and protect scenic highway corridors from change that would diminish the aesthetic value of lands adjacent to highways

California Green Building Code – composes mandatory requirements for exterior light sources to reduce the amount of light and glare that extends beyond a property

San Francisco Bay Plan

San Francisco Waterfront Special Area Plan – sets forth specific policies for uses, fill, public access, and design for piers and shoreline areas between Hyde St Pier in Fisherman's Wharf to India Basin

3.18.1.3 Local

San Francisco General Plan – provides general policies and objectives to guide land use decisions

San Francisco Planning Code – guides and regulates future growth and development; protects the character and stability of residential, commercial, and industrial areas within the city; provides adequate light, air, privacy, safety, and convenience of access to property; prevent land overcrowding; and regulations building locations and use of buildings and adjacent lands

Port of San Francisco Waterfront Plan – governs the use, design, and improvement of properties under its jurisdictions

San Francisco Bay Trail Plan – guides selections of the bay trail route and implementation of the trail system

3.18.2 Existing Condition

Port maritime and water-dependent uses stretch along the entire waterfront, preserving San Francisco's working waterfront character and heritage. The Port waterfront is distinctly urban in character. The Port's linear stretch of property extends through a diverse cross-section of San Francisco districts and neighborhoods that define much of the urban character and scale. Distinguishing features of the waterfront include the pier facilities and maritime operations that connect to the larger San Francisco urban landscape. San Francisco's street grid provides a direct connection from the City's neighborhoods to the network of historic piers, maritime facilities, and open spaces that extend along and over the Bay. This juxtaposition creates what is generally considered a unique and visually pleasing waterfront experience.

The Embarcadero and Terry A. Francois Boulevard form a break in the city landscape that creates two distinct identities: City neighborhoods on the west side and the Port waterfront features on the east side. The Bay and piers create visual contrasts to the city streets and upland neighborhoods that adjoin the Embarcadero and Terry A. Francois Boulevard. These contrasts help give the San Francisco waterfront its unique identity.

The Port waterfront has distinct land use and architectural characteristics. Fisherman's Wharf is characterized by many simply detailed one-story industrial buildings. The bulkhead buildings and piers along The Embarcadero, with the Ferry Building as the centerpiece, reflect the Port's historic civic significance. The South Beach and Rincon Hill neighborhoods and entertainment venues such as Oracle Park and Chase Center highlight the transformation of former industrial areas to new residential neighborhoods and City attractions. Mission Rock is an emerging new mixed-used neighborhood in Mission Bay with parks, commercial and residential uses. Pier 70 is an emerging mixed-use district in the Dogpatch neighborhood with parks, commercial and residential uses and is home to the Union Iron Works Historic District which showcases the architectural, maritime and labor history of the area. The Islais Creek area in the Bayview community is characterized by large industrial buildings and facilities.

The open spaces along the Port waterfront within the study area vary in character, largely related to the physical form of the waterfront's edge. From Fisherman's Wharf to just south of China Basin Channel, the waterfront is a built edge supported by the Embarcadero Seawall and pile-supported pier decks. The built seawall ends at the Mission Bay waterfront, transitioning to a solid landform that meets the water. The natural shoreline areas include those along Mission Creek, along the northeast shoreline of Pier 94, and at Heron's Head Park.

The Port waterfront includes public pedestrian and fishing piers at Pier 7, Pier 14, Pier 41, historic Pier 43, atop the South Beach Harbor breakwater, and at Agua Vista Park Pier. Each offers views across the Bay and back to the city along with opportunities for recreational fishing. Wharves are pile-supported spaces alongside the Embarcadero

Promenade, or behind some of the restaurants and historic fishing industry buildings in Fisherman’s Wharf, that often provide access to areas where one can view fishing boat activity, tugboats, ferries, and other vessels. It is visually defined by the commercial and tourist destinations that attract visitors to the study area. These locations combine to create a lively and visually appealing urban waterfront and include uses such as entertainment venues (Oracle Park and Chase Center), museums and cultural uses (Maritime Museum at Aquatic Park, The Exploratorium at Pier 15 and the World War II vessels typically harbored at Pier 45), and world-famous tourist attractions (Fisherman’s Wharf, Pier 39, and Alcatraz Landing). The commercial and tourist destinations integrate with, and highlight, the dynamic maritime setting while providing public access to views of the Bay. Views of the waterfront from adjacent streets are dramatic because of the City’s hilly topography, the compactness of adjacent districts, and the built character and maritime uses of the waterfront. The Port waterfront is a strong part of the City’s visual identity due to its maritime features, public access areas, historic resources, and encompassing views from various vantage points. Because of the density of the city, the openness of the Bay, and the open spaces, large numbers of people are attracted to the waterfront and its panoramic views.

Light pollution includes all forms of unwanted light in the night sky, such as glare, light trespass, sky glow, and overlighting (excessive use of artificial light). Sources of light and glare are abundant in the urban environment of the study area, including streetlights, parking lot lights, security lights, vehicular headlights, internal building lights, and reflective building surfaces and windows. On nights with sporting events or other events, Oracle Park and Chase Center are major sources of light along the waterfront because of field lighting, exterior stadium lighting, and emergency lighting.

3.19 Hazardous, Toxic, and Radioactive Waste

The Hazardous, Toxic, and Radioactive Waste affected environment is addressed in Appendix D-1-6.

3.20 Land Use Planning

Appendix D-1-7 discusses land use regulation, designations and zoning, and existing land uses found in the study area.

3.21 Public Health and Safety

3.21.1 Regulatory Framework

3.21.1.1 Federal

No federal regulations or laws pertain to public health and safety.

3.21.1.2 State

No state regulations or laws pertain to public health and safety.

3.21.1.3 Local

No local regulations or laws pertain to public health and safety.

3.21.2 Existing Condition

The San Francisco Fire Department (SFFD) and San Francisco Police Department (SFPD) provide fire protection and emergency services and public safety services, respectively, within the City and County of San Francisco and the study area. In addition, there are several other public services, including the University of California Mission Bay campus, schools, non-profit organizations and child centers, within the study area.. The SFPD, SFFD, and other public service facilities within the study area are detailed in Table 3-4.

Table 3-4. Public service facilities located in the study area. Aquatic Park, Pier 31-25, the northeast waterfront, Ferry building, South beach, Mission Creek, Mission Rock, Pier 70, Pier 80, Cargo Way, Pier 94-96, and Heron's head do not have critical facilities or public services within them.

Subarea	Public Service Facility	Location	Description
Fisherman's wharf	Police Department Marine Berths and Unit Headquarters	Hyde St. Harbor	Marine unit that responds to emergencies on the water or along the shoreline. Unit also assists in rescue operations in collaboration with the U.S. Coast Guard.
South beach	Fire Boat Station 35	399 The Embarcadero	SFFD's fireboat headquarters. The station houses the department's three fireboats: the *Phoenix*, Guardian, and *Saint Francis*.
Mission bay	Public Safety Campus	3rd St at Mission Rock	The Public Safety Campus houses the new Fire Station 4, SFPD headquarters, and the Southern District Police Station.

The SFPD, located on the first floor of the Public Safety Campus, provides public safety services for the study area and the City and County of San Francisco. The SFPD is the 11th largest police department in the U.S. and serves a population of approximately 1.5 million, comprising daytime commuters, tourists, and visitors (City and County of San Francisco 2020c). The SFPD has 10 districts, each with its own station. Three police districts, Bayview, Southern, and Central, cover the study area. SFPD headquarters, the

Southern Police District Station, and SFPD Marine Unit headquarters and berths are located within the study area.

The SFFD is responsible for fire protection and emergency medical services for the City and County of San Francisco, including the study area. In addition to the SFFD, several privately operated ambulance companies are authorized to provide advanced life support services. The SFFD consists of two divisions, divided into ten battalions and 45 active stations (City and County of San Francisco 2020b). Division 2 serves the northern and western regions of the city and San Francisco County, and Division 3 serves the eastern and southern regions (City and County of San Francisco 2020b). Fire Stations 4 and 35 are within the study area.

4.0 Environmental Consequences of the Alternative Plans

In this section, the potential direct, reasonably foreseeable indirect, and beneficial effects of the SFWCFS study Alternative Plans have been assessed based on the current level of design.

Like Section 3, this section is organized by resource topic with the impacts of each alternative described within each resource section. The following topics will be described within each resource section:

Significance Criteria: This section provides the criteria used to define the level at which an impact would be considered significant. Significance criteria is based on factual or scientific information and data; context and intensity of the action, as described above; and regulatory standards for Federal, state, and local agencies.

Impacts: This section describes the impacts of the alternative and are considered and evaluated as to whether they are direct, indirect, or cumulative. Each resource starts with a summary discussion of the overall potential impacts and benefits to the resource relative to the construction, operations, and maintenance assumptions, followed by an Alternative-specific discussion of potential impacts and benefits, reflected by numerical magnitude ratings.

Mitigation Need: This section describes measures taken to mitigate (i.e. avoid, minimize, or compensate for) adverse effects. For impacts that must be compensated, the amount of compensatory mitigation required, and type of mitigation proposed, is described. Mitigation applies to any adverse impact, even if the impact is not significant. However, mitigation is not required if the resource itself is not considered significant.

Conclusion: This section briefly summarizes the impacts described and rates the impact intensity in relation to significance, as described above.

4.1 Methodology for Describing Environmental Consequences

Impacts are described as either *beneficial* or *adverse*. *Beneficial* impacts result in a positive change in the condition of the resource when compared to the No Action Alternative. *Adverse* impacts result in a negative change in the condition of the resource when compared to the No Action Alternative.

All potential impacts, both beneficial and adverse, are described by their characteristics:

type (direct, indirect, cumulative),

duration (short-term, long-term, permanent),

geographic extent (localized or beyond project boundaries).

Note: The terms *consequences*, *impacts*, and *effects* are considered synonymous in this analysis.

4.1.1 Types of Potential Impact

The following definitions of potential impacts were applied to this analysis, consistent with the Council on Environmental Quality's (CEQs) regulations at 40 CFR § 1508.1(g). These categories are used to describe the nature, timing, and proximity of impacts on the affected resources:

Direct impact: A known or potential impact caused by the proposed action or project that occurs at the time and place of the action.

Indirect impact: A known or potential impact caused or induced by the proposed action or project that occurs later than the action or is removed in distance from it, but is still reasonably expected to occur.

Cumulative impact: A known or potential impact resulting form the incremental effect of the proposed action added to other past, present, or reasonably foreseeable future actions. The timeframe for the cumulative impact analysis is 5 to 10 years after project implementation.

4.1.2 Duration of Potential Impact

The duration of potential impacts is short-term, long-term, or permanent. This indicates the period during which the resource would be impacted. Duration considers the permanence of an impact and is defined as:

Short-term impact: A known or potential impact of limited duration, relative to the proposed action and the environmental resource. For this analysis, short-term impacts may be instantaneous or last from minutes up to five years.

Long-term impact: A known or potential impact of extended duration, relative to the proposed action and the environmental resource. For this analysis, long-term impacts are those lasting longer than five years.

Permanent impact: A known or potential impact that is likely to remain unchanged indefinitely.

4.1.3 Geographic Extent of Potential Impacts

The geographic extent of potential impacts are:

Localized: Impacts that are site-specific and generally limited to the area within the project boundaries.

Beyond proposed boundaries: Impacts that are unconfined or unrestricted to the project boundaries. These impacts may extend in the immediate vicinity of the project area or throughout the region.

4.1.4 Significance

Finally, impacts are described in relation to their significance. In considering whether the effects of the alternatives being considered are significant, the potential affected environment and degree of the effects of the action are analyzed (40 CFR 1501.3). Impacts on each resource can vary in degree or magnitude from a slightly noticeable change to a complete change in the environment.

The magnitude or intensity of the proposed action was qualitatively and quantitatively assessed by the degree to which each alternative would impact a particular resource. The following descriptors are used in the body of this chapter for consistency in describing impact intensity in relation to significance.

No or Negligible Impact*:* impact would cause no discernible change in the environment and does not require mitigation.

Less than Significant*:* impact would cause no substantial adverse change in the environment and would not require mitigation. Less than significant determinations also apply to impacts that are determined to be significant based on the significance criteria, but for which mitigation could be implemented to avoid or reduce the environmental effects to less than significant levels.

Significant and Unavoidable*:* impact would cause a substantial adverse change in the environment that cannot be avoided or mitigated to a less than significant level if the project is implemented.

Too Speculative for Meaningful Consideration*:* impact may have a level of significance that is too uncertain to be reasonably determined and would therefore be considered too speculative for meaningful consideration. Where some degree of evidence points to the reasonable potential for significant impacts, the section may explain that a determination of significance is undetermined, but is still assumed to be "significant", as described above. In other circumstances, after thorough investigation, the determination of significance may still be considered too speculative to be meaningful. This is an impact for which the degree of significance cannot be determined for specific reasons, such as unpredictability of the occurrence or the severity of the impact, lack of methodology to evaluate the impact, or lack of an applicable significance threshold.

Numerical scoring was used to quantitatively represent impacts to each resource, which is described in detail in sections below.

Significance varies with the setting of each alternative, and significance is dependent on the extent of the affected area and the extent of the impact. In considering the significance, the following are considered, as appropriate to the action:

Both short- and long-term effects.

Both beneficial and adverse effects.

Effects on public health and safety.

Effects that would violate Federal, State, Tribal, or local law protecting the environment.

4.1.5 Impact Score Ratings

An impact rating criterion was developed to assess the magnitude of adverse effects to natural and physical resources (Table 4-1). Anticipated benefits are not included numerically in the impact rating score; rather, benefits are described in the resource section and noted in the impact rating scorecard with a positive sign “+”. Note, it is possible for a resource to have both adverse impacts and benefits associated with the alternative measure assessed.

Table 4-1. Scoring methodology for Natural and Physical Environment Resources

Impact Rating and Numerical Score	Description
No impact (1)	There would be no impacts to the resource because the resource is unaffected.
Low (2)	Effects to the resource would either be negligible or, if detectable, have minor temporary impacts locally to the resource. The impacts would be below regulatory standards, as applicable, and mitigation measures may be implemented to sustain low to no impact to the resource.
Moderate (3)	Effects to the resource are expected to be moderate in the near-term and localized. Impacts would be within or below regulatory standards, as applicable, and the use of mitigation measures would manage potential adverse impacts, if applicable.
Moderate to High (4)	Effects to the resource would be locally and/or regionally significant. Impacts would be within regulatory standards, with or without compensatory mitigation; however, existing resource conditions are expected to be affected in the near-term, but not necessarily in the long-term. Mitigation measures to manage any potential adverse impacts would be necessary.
High (5)	Effects to the resource would have substantial consequences, locally and/or regionally. Impacts would exceed regulatory

Impact Rating and Numerical Score	Description
	standards even with compensatory mitigation and would not be environmentally acceptable.

Impact score tables are provided in each of the resource sections and follow the numerical and color coding criteria as described above.

4.2 Alternatives Analyzed

The alternatives evaluated in this chapter are described in Chapter 3 of the Draft Integrated Feasibility Report/Environmental Impact Statement (DIFR/EIS), and are listed below for ease of reference:

Alternative B/NED Intermediate Curve: Proposes nonstructural measures such as relocation, raise in place, floodproofing, and zoning in areas identified with frequent flooding.

Alternative F: Uses a combination of structural, nonstructural, and NNBFs to defend at the existing shoreline, except for some managed retreat inland along the southern waterfront and tide gates at the mouths of Islais and Mission creeks. Additional retreat and adaptations are proposed as the rate of SLR increases.

Alternative G/NED High Curve: Uses a combination of structural, nonstructural, and NNBFs to defend against the high rate of SLR. This alternative concedes the largest area for managed retreat and incorporates more nonstructural and NNBF measures.

Total Net Benefits Plan/TSP: Hybridized plan that relies on defend measures, scaled to perform under a lower initial risk and to adapt to risk of a higher rate of RSLC as a potential end point. Initial actions are proposed to delay expenditures and add height or adapt measures as risk increases over later years. This alternative hybridizes nonstructural, structural, and NNBF from multiple action alternative.

Independent Measures for Consideration: Potential considerations for TSP refinement to further reduce coastal flood and seismic risks, reduce costs and impacts, and gain community benefits. Addresses geographically specific areas with structural and NNBF.

4.3 Construction Techniques Common Amongst Alternatives

The following section describes construction techniques that are ubiquitous amongst all Action Alternatives. Note, this does not intend to suggest impacts from these techniques are uniformly distributed amongst alternatives, rather they are scaled based on the quantity and duration of the expected activity. The design details will be specified within each alternative; however, general descriptions have been provided here to eliminate redundancy in the alternative impact descriptions below. If additional details are warranted, they were included with the relevant alternative and resource impact.

Adverse impacts from these techniques are expected across several resources; however, those impacts are described below, and the magnitude of those impacts is reflected in the overall numerical score for each resource.

4.3.1 Building Demolition, Relocation, and Elevation

In some instances, the line of defense (LOD) moves landward of buildings along the waterfront. To protect these structures, the buildings would need to be dry floodproofed, demolished, relocated, or elevated as described below. This approach was applied to all Action Alternatives, additional details on the criteria used to determine applicability of each approach can be found in Appendix B.

4.3.1.1 Floodproofing

Floodproofing is assumed to be either dry-floodproofing or perimeter protection in the form of a ring-wall. Dry Flood Proofing involves sealing building walls with waterproofing compounds, impermeable sheeting, or other materials to prevent the entry of floodwaters into damageable structures.

4.3.1.2 Demolition

Buildings requiring demolition with no rebuild would need to be removed and disposed of. Demo of the structure would require heavy machinery such as wrecking balls, excavators, and bulldozers. Material would then need to be hauled offsite for disposal.

4.3.1.3 Relocation

Buildings requiring relocation would be lifted and placed on a floating barge or land-based truck and trailer system to another staging location (likely Port of San Francisco owned property) until the new site is ready for construction and placement. The new site would need to be prepped, which may include but is not limited to excavation, fill material, new concrete, etc. In some instances, buildings being relocated would require modifications for their new foundation and to retain the structural integrity. This is most likely to apply to historic structures that may require upgrades to make the building structurally sound.

4.3.1.4 Elevation

Elevation involves raising the buildings in place so that the structure sees a reduction in frequency and/or depth of flooding during high-water events. Elevation can be done on fill, foundation walls, piers, piles, posts or columns. Selection of proper elevation method depends on flood characteristics such as flood depth or velocity.

4.3.2 Cast-in-place concrete

Cast-in-place concrete is poured into removable forms (or castings) erected on site and cured in the concrete's finished position. Temporary forms or castings would be constructed on site and would be reinforced with steel. Most formwork would be composed of steel, aluminum, and wood. Ready mixed concrete would be delivered via large cement trucks and poured into the castings with a truck chute, bucket, or pump. The concrete is left to cure in the castings before removal. Once cured, casting materials would need to be removed and reused for another measure or hauled off and disposed of.

4.3.3 Cofferdam

A cofferdam is an enclosure that allows water to be pumped out to establish a dry working environment. A cofferdam would be constructed from steel sheet piles with interior bracing. Sheet piles would be driven into the sediment in the bay through hydraulic or pneumatic tools, braced internally with waler beams and compression struts to keep the wall from collapsing. Braces would be installed using heavy machinery from work barges in the bay. Inside of the cofferdam would be un-watered and dewatered with a combination of surface pumps/sumps and deep wells as necessary to create a dry and stable work environment. Once construction completes, the cofferdam would be disassembled and removed.

4.3.4 Ground improvements

Amongst the array alternatives, several measures would require existing soils to be improved to address both static and seismic loading conditions because of poor soil conditions and the increased weight of the new construction. This could consist of a variety of ground improvement techniques such as deep material mixing (DMM), jet grouting (JG), compaction grouting (CG), or vibro-replacement (VR) of the existing soils (Table 4-2).

Table 4-2. Description of ground improvement techniques that could be used during construction activities

Technique	Description
Deep Material Mixing (DMM)	Mechanically mixes soils with wet or dry cementitious binders. A high-speed drill advances a rod with radial mixing paddles located at the posterior of the drill into the ground to shear the soils. The cementitious binder is injected through the rod and mixed with the soil to produce individual or overlapped columns with improved strength and compressibility characteristics (Keller 2022a).

Technique	Description
Jet Grouting (JG)	Uses high-velocity fluid jets to construct cemented soil (soilcrete) with a grouting monitor attached to the end of a drill stem. The jet grout monitor is advanced to the maximum depth, then high-velocity jets are used to erode and mix in situ soil with grout as the drill stem and monitor are rotated and raised (Keller 2023a)
Compact Grouting (CG)	Involves injecting a low slump, mortar grout into the subsurface to densify loose, granular soils and stabilize voids or sinkholes. An injection pipe is inserted typically to the maximum depth and the grout is injected as the pipe is slowly removed in segmented lifts, creating a column of overlapping grout bulbs. As the mobility grout bulbs expand, they displace surrounding soils (Keller 2023b).
Vibro-Replacement (VR)	Constructs loadbearing columns from gravel or crushed stone with a vibrator to reinforce ambient soils and densify surrounding granular soils (Keller 2022b). A vibrator tool penetrates to the design depth using the vibrator's weight and vibrations, as well as water jets located at its posterior. Stone is then either added using a top-feed method from the ground surface where the stone is allowed to fall into the void created by the vibrator or using a bottom-feed method where the stone is added to a hopper for placement down an attached feed pipe. For either stone placement method, the vibrator is lowered into the placed stone in lifts to densify and displace the underlying stone. These steps are repeated until a dense stone column is constructed from the design depth to the ground surface (Keller 2022b).

4.3.5 Equipment and Access Routes

Material to construct the features/measures would be commercially sourced and shipped/transported to the construction site for installation. Fill material would require heavy machinery to move the sediment and facilitate construction, and could include bulldozers, front-end loaders, track-hoes, backhoes, etc. Any stone used for construction would be bought from a commercial quarry or excavated at the construction site and retained for reuse. Purchased stone would be transported by barge or truck to the construction site to be placed. Excavated stones would require heavy machinery (e.g., front-end loaders, backhoes) to remove the stone, and then would be stored onsite or on a barge. Various support equipment would be required such as crew and work boats, trucks, trailers, construction trailers, floating docks, and temporary access routes to facilitate loading and unloading of personnel and equipment. Additionally, temporary staging areas would be needed to store equipment and materials during active construction.

Identification of these areas would occur during the pre-construction, engineering, and design (PED) phase. Each disturbance for access and staging would be placed outside of environmentally sensitive areas to the greatest extent practicable and utilize areas already disturbed when possible (e.g., stage on existing concrete areas, existing roadways, or Port of San Francisco lands). All ground disturbance for access and staging areas would be temporary and fully restored to result in no permanent loss.

4.4 Description of Measures applied to Action Alternatives

Table 4-3 summarizes the measures applied to each of the alternatives and indicates at what implementation phase (2040 or 2090) those measures are expected for construction. Note, the 2040 measures are constructed to be adapted in 2090; thus, measures in 2090 are additive to those of 2040 rather than separable new elements. Additionally, 2040 and 2090 are used as placeholder time steps that correspond with RSLC; however, these years may interchangeably be noted as first action (2040) and second or subsequent action (2090) that is intended to describe a first construction action (first action, 2040) and any subsequent adaptive action that would occur as SLR triggers the need for additional protection (subsequent/second action, 2090). This theme continues throughout the resource impacts discussions. Alternative B is missing from Table 4-3 as it would be implemented in four stages and is non-structural. It is described in future sections.

Table 4-3. *Summary of measures proposed in each alternative and implementation year.*

Alternative Implementation Time Step	Bay Fill	Levee	Bridge Raise / Replacement	Bulkhead wall / Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	Tide Gate	T-wall	Vertical Wall / Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh enhancement*	Vertical Shoreline*
Alternative C 2040		●			●	●	●		●	●	●	●		●	●		
Alternative D 2040		●			●	●	●		●	●	●	●		●	●	●	
Alternative D 2090			●	●		●			●	●	●	●	●	●		●	
Alternative E 2040	●	●		●	●	●			●	●	●	●	●	●	●	●	●
Alternative E 2090	●	●	●	●		●			●	●	●			●	●	●	
Alternative F 2040	●	●		●		●		●	●	●	●	●	●			●	
Alternative F 2090		●				●				●	●					●	

Alternative Implementation Time Step	**Bay Fill**	**Levee**	**Bridge Raise / Replacement**	**Bulkhead wall / Seawall**	**Deployable Flood Gate**	**Roadway Impact**	**Sheetpile Wall**	**Tide Gate**	**T-wall**	**Vertical Wall / Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh enhancement***	**Vertical Shoreline***
Alternative G 2040		●	●	●		●			●	●	●	●		●	●	●	
Alternative G 2090		●				●				●			●			●	
TNBP 1st Action		●		●	●	●	●		●	●	●	●	●	●	●		
TNBP 2nd Action	●	●		●		●			●		●	●	●	●	●	●	

Note: An asterisk (*) indicates a NNBF. Vertical shoreline is synonymous with living seawall, as such, the terms are used interchangeably.

Construction impacts to resources are expected to be commensurate with the spatial extent (e.g., total linear feet) and duration (i.e., length of construction) of the measures proposed for each action. Table 4-4 and Table 4-5 show the anticipated disturbance each measure is likely to have based on the long-term footprints at each time step. Table 4-6 provides the long-term footprints of the independent measures for consideration (herein independent measures) It was assumed all construction would have a 100-foot buffer around the long-term footprint to assess for construction-related impacts, which is not captured in the table. Alternative B is unique in that implementation would occur over multiple time steps, as such it was not included in Table 4-4 and Table 4-5 because actions would be implemented differently. Please refer to Appendix A, Section A-7.3 for a description of Alternative B implementation.

It was assumed each alternative would require a total construction duration of 10 years. All alternatives assume 40-hour, 5-day work weeks with normal anticipated adverse weather days.

Table 4-4. Anticipated disturbance for the final array of alternatives for 2040 actions

Measure	F	G	TNBP
Bay Fill (ACRES)	25	-	-
Levee (LF; ACRES)	9,820 14	10,655 16	13,535 15
Bridge Raise/Replacement (LF)	-	3,340	-
Building Demolition (SQFT)	93,420	192,115	2,735
Building Move (SQFT)	604,500	604,500	326,435
Bulkhead wall/Seawall (LF)	13,115	14,540	7,620
Deployable Flood Gate (LF)	-	-	1,600
Floodproofing (SQFT)	922,780	2,012,785	558,905
Roadway Impact (ACRES)	24	49	22
Seismic Ground Improvements (ACRES)	44	70	71
Sheetpile Wall (LF)	-	-	2,165
Tide Gate (n; LF)	2; 2,415	-	-

Measure	F	G	TNBP
T-wall (LF)	4,250	13,280	7,735
Vertical Wall (LF)	52,615	58,345	65,800
Wharf (LF; ACRES)	15,790; 3	27,270; 8	n/a 14
EWN (ACRES)	15	40	12

*Note: acres are rounded to the nearest whole number, while LF and SQFT are rounded to the nearest five. A dash (-) indicates the measure is not included in the alternative. A "n/a" indicates the value was not available.

Table 4-5. Anticipated disturbance for the final array of alternatives for 2090 actions

Measure	F	G	TNBP
Bay Fill (ACRES)	-	-	5
Levee (LF; ACRES)	12,335 17	15,970 23	13,860 19
Bridge Raise/Replacement (LF)	-	-	-
Building Demolition (SQFT)	1,449,060	8,519,580	790,980
Building Move (SQFT)	-	-	272,020
Bulkhead wall/Seawall (LF)	-	1,160	22,610
Deployable Flood Gate (LF)	-	-	-
Floodproofing (SQFT)	-	-	21,540
Roadway Impact (ACRES)	9	22	21
Seismic Ground Improvements (ACRES)	1	19	12
Sheetpile Wall (LF)	-	-	-
Tide Gate (n; LF)	-	-	-
T-wall (LF)	-	-	4,215

Measure	F	G	TNBP
Vertical Wall (LF)	17,270	25,200	-
Wharf (LF; ACRES)	2,445 2	-	n/a 27
EWN (ACRES)	36	752	34

*Note: acres are rounded to the nearest whole number, while LF and SQFT are rounded to the nearest five. A dash (-) indicates the measure is not included in the alternative. A "n/a" indicates the value was not available.

Table 4-6. Anticipated disturbance for the Independent Measures for Consideration

Measure	2A	2B	3A	3B	3C	4A
Bay fill (ACRES)	4	5	-	-	-	-
Levee (LF; ACRES)	-	n/a 3	1,175 2	-	1,070 n/a	2,180 n/a
Building Demolition (SQFT)	-	-	-	-	-	575,765
Building Move (SQFT)	134,405	-	180,560	-	-	-
Bulkhead wall/Seawall (LF)	1,640	1,470	3,375	-	-	-
Roadway Impact (ACRES)	4	1	5	-	2	-
Seismic Ground Improvements (ACRES)	4	4	6	2	2	1
Vertical Wall (LF)	-	-	-	910	-	2,085
Wharf (LF; ACRES)	1,640 5	-	4,550 5	-	-	-
EWN (ACRES)	-	4	-	-	1	43

*Note: vertical shoreline is not included in this table as it's not associated with one of the independent measures listed, rather is a stand-alone measure. In total, vertical shoreline could be applied to 12,100 LF.

4.4.1 Assumptions for Analysis

The scope of this analysis is based on the following assumptions and conditions:

The No Action Alternative (i.e., FWOP) has significant impacts to the majority of resources including health and safety, transportation, and environmental justice communities. An assessment of the No Action Alternative consequences by resource type is presented in Table 4-8.

This assessment is primarily focused on the structural measures of each Alternative. Structural measures include combinations of levees/levees, tide gates, floodwalls, elevated promenades, wharfs, bulkheads, road raising, and deployable gates.

Potential impacts and benefits are based on the preliminary conceptual design of the SFWCFS study measures, which focuses on impacts within the structural measure's footprint of construction, clearing and general disturbance within that footprint, and long-term structural footprint. The measures and measure locations are subject to change during PED as engineering is further developed and as public, Agency, and local stakeholder comments on the DIFR-EIS are incorporated. This assessment will be updated and the potential impacts and benefits will be re-evaluated for the Final IFR-EIS. Where additional information (i.e., modelling or site-specific studies or surveys) is needed, consideration for how that information may be collected and assessed is provided.

Nonstructural and NNBFs are part of Alternative plans C, D, E, F, and G, while Alternative B is a fully nonstructural plan. Currently, conceptual NNBF measures are developed for each of the Action Alternatives but require further analysis. The following sections will mention NNBFs generally; however, those types of measures will be further developed and assessed for potential impacts and benefits in the Final IFR-EIS.

Tidal gate closures are anticipated to primarily occur during a coastal storm (1% AEP) as water elevations rise or during maintenance procedures to ensure the gates are functioning properly in preparation for a coastal storm event. While additional analysis is necessary to assess closure frequency and duration of the gate operations and maintenance criteria, this assessment has assumed a duration and frequency of 1 full tidal cycle (24 hours; 2 high tides and 2 low tides) per year as a baseline to which to compare environmental consequences of tide gate closures. The same assumptions were made for deployable flood gates.

Projects within the SFWCFS study area that are being developed under separate authorizations or entities in the reasonably foreseeable future are considered in the cumulative impacts assessment, while projects currently being constructed are considered in FWOP.

This assumption-based assessment will be further refined in the Final IFR-EIS.

4.5 Summary of Impacts

Table 4-7 presents a high-level assessment of the SFWCFS study Alternative plans, starting with an initial screening to identify if there is a potential for adverse impacts (i.e., Yes or No) by measure type, followed by an assessment of the magnitude of those identified potential adverse impacts, rated on a scale of 1 (No impacts) to 5 (Significant impacts), by Alternative. Measures that also have a potential beneficial effect are marked with a “+” in these Sections to identify those added benefits without muting the potential adverse impact identification and associated rating scores.

As indicated in Table 4-7, there are potential adverse impacts to resources from measures, both structural and NNBF, as well as potential benefits, depending on structure type, location, and existing conditions. Structural measures are anticipated to have greater direct impacts to resources than other measure types (i.e., nonstructural, NNBF) of which may require compensatory mitigation, agency coordination, and regulatory review. For each resource, the impact producing factors have been identified and a summary of impacts is provided in the sections below. In some instances, measures are discussed by location as “shore-based” or “in-water” to distinguish between potential impacts.

Table 4-7. Potential for impacts by resource and measure type

Resource	Bay fill	Levee	Bridge raise	Road raising	Vertical wall	Bulkhead wall/Seawall	Cantilever wall	Pile supported	Sheetpile wall	T-wall	Elevated promenades	Wharf	Deployable flood gate	Tide gate	Shoreline extension	Ecological Armoring*	Embankment shoreline*	Naturalized shoreline*	Vertical shoreline*	Marsh*	Coarse beach*	Ecotone levee*
Regional Air Quality and Clean Air Act	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y+	Y+	Y	Y+	Y	Y+
GHG	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y+	Y+	Y	Y+	Y	Y+
Regional climate, climate change, RSLC	Y	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+
Geology	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y+	N	Y+	N	Y+
Sediments	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y+	Y+	Y+	Y+	Y+	Y	Y+
Seismicity	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Soils and Mineral Resources	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y+	Y+	Y+	Y+	Y+	Y	Y+
Floodplains	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+

Resource	Bay fill	Levee	Bridge raise	Road raising	Vertical wall	Bulkhead wall/Seawall	Cantilever wall	Pile supported	Sheetpile wall	T-wall	Elevated promenades	Wharf	Deployable flood gate	Tide gate	Shoreline extension	Ecological Armoring*	Embankment shoreline*	Naturalized shoreline*	Vertical shoreline*	Marsh*	Coarse beach*	Ecotone levee*
Coastal hydrology, currents, and circulation	Y	Y	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y	N	N	Y	Y	N	N
Tides, tidal exchange, and waves	Y	Y	Y	N	N	Y	Y	N	N	N	N	Y	Y	Y	Y	Y+	Y+	Y+	Y+	Y+	Y+	N
Water Quality	Y	Y	Y	N	N	Y	Y	N	Y	N	Y	Y	Y	Y	Y	Y	Y+	Y+	Y+	Y+	N	N
Groundwater	N	Y	N	N	N	Y	Y	Y	Y	N	Y	N	N	N	Y	N	Y+	Y+	N	N	N	Y+
Intertidal habitat	Y	N	N	N	N	Y	Y	N	Y	N	N	Y	N	Y	Y	Y+	Y+	Y+	Y+	Y+	Y+	N
Subtidal habitat	Y	N	Y	N	N	Y	Y	N	Y	N	N	Y	N	Y	Y	Y+	Y+	Y+	Y+	Y+	Y+	N
Pelagic habitat	Y	N	N	N	N	N	N	N	N	N	N	Y	N	Y	Y	N	N	N	N	N	N	N
Wetlands	Y	N	N	N	N	N	N	N	N	N	N	N	N	Y	Y	Y+	N	N	N	Y+	Y+	N
Fish	Y	N	Y	N	N	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y+	Y+	Y+	Y+	Y+	Y+	N

Resource	Bay fill	Levee	Bridge raise	Road raising	Vertical wall	Bulkhead wall/Seawall	Cantilever wall	Pile supported	Sheetpile wall	T-wall	Elevated promenades	Wharf	Deployable flood gate	Tide gate	Shoreline extension	Ecological Armoring*	Embankment shoreline*	Naturalized shoreline*	Vertical shoreline*	Marsh*	Coarse beach*	Ecotone levee*
Commercial and Recreational Fisheries	Y	N	Y	N	N	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y+	Y+	Y+	Y+	Y+	Y+	N
Macroinvertebrates	Y	N	Y	N	N	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y+	N	N	Y+	Y+	Y+	N
Terrestrial vegetation	N	Y	Y	Y	Y	N	N	Y	N	Y	Y	N	Y	Y	Y	N	Y+	Y+	N	Y	N	Y+
T&E Species - Terrestrial	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y+	Y+	Y	Y+	Y+	Y+
T&E Species - Aquatic	Y	Y	Y	N	N	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y+	N	N	Y+	Y+	Y+	N
State listed species	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y+	Y+	Y+	Y+	Y+	Y+
Designated Critical Habitat	Y	N	Y	N	N	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y+	N	N	Y+	Y+	Y+	N

Resource	Bay fill	Levee	Bridge raise	Road raising	Vertical wall	Bulkhead wall/Seawall	Cantilever wall	Pile supported	Sheetpile wall	T-wall	Elevated promenades	Wharf	Deployable flood gate	Tide gate	Shoreline extension	Ecological Armoring*	Embankment shoreline*	Naturalized shoreline*	Vertical shoreline*	Marsh*	Coarse beach*	Ecotone levee*
Migratory Bird Treaty Act Species	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y+	Y+	Y+	Y+	Y+	Y+
Marine Mammal Protection Act Species	Y	N	Y	N	N	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y+	N	N	Y+	Y+	Y+	N
EFH and EFH-designated species	Y	N	Y	N	N	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y+	N	N	Y+	Y+	Y+	N
HAPC	Y	N	Y	N	N	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y+	N	N	Y+	Y+	Y+	N
SAV – Eelgrass	Y	N	N	N	N	Y	N	N	Y	N	N	Y	Y	Y	Y	Y+	N	N	Y+	Y+	Y+	N
Coastal Zone Management Act Areas	Y	N	Y	N	N	Y	Y	N	Y	N	N	Y	Y	Y	Y	Y	N	N	Y	Y	Y	N

Resource	Bay fill	Levee	Bridge raise	Road raising	Vertical wall	Bulkhead wall/Seawall	Cantilever wall	Pile supported	Sheetpile wall	T-wall	Elevated promenades	Wharf	Deployable flood gate	Tide gate	Shoreline extension	Ecological Armoring*	Embankment shoreline*	Naturalized shoreline*	Vertical shoreline*	Marsh*	Coarse beach*	Ecotone levee*
Coastal Barrier Resources System Areas	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Noise and vibration	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Cultural Resources	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Native American lands	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Environmental Justice	Y	Y	Y+	Y+	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y+	Y	Y+	Y	Y+	Y+	Y+
Socioeconomics and community	Y	Y	Y+	Y+	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y+	Y	Y+	Y	Y+	Y+	Y+
Transportation	Y	Y	Y+	Y+	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Utilities	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Resource	Bay fill	Levee	Bridge raise	Road raising	Vertical wall	Bulkhead wall/Seawall	Cantilever wall	Pile supported	Sheetpile wall	T-wall	Elevated promenades	Wharf	Deployable flood gate	Tide gate	Shoreline extension	Ecological Armoring*	Embankment shoreline*	Naturalized shoreline*	Vertical shoreline*	Marsh*	Coarse beach*	Ecotone levee*
Recreation and Access	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y+	Y+	Y+	Y+	Y+
Aesthetics	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y+	Y+	Y+	Y+	Y+	Y+
HTRW	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+
Land Use	Y	Y	Y+	Y+	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y+	Y	Y+	Y+
Public Health and Safety	N	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+	Y+

Notes:

Y – measure type has potential to adversely impact resource
N – measure type is not anticipated to adversely impact resource
+ - measure type anticipated to also have beneficial effects to resource
* - indicates EWN/NNBF measure

4.6 No Action Alternative

This No Action Alternative section serves as a baseline comparison to the following alternative plans impact assessment, including the tentatively selected plan. While the No Action Alternative would have no additional impacts from construction or operations and maintenance of coastal flood risk measures under the SFWCFS study, it would leave the SFWCFS study area vulnerable to continued damages, loss of life, and destruction of study area resources caused by severe coastal hazards compounded by RSLC. A summary of potential impacts under the No Action Alternative to each resource is provided in Table 4-8.

Table 4-8. Summary of potential impacts of the No Action Alternative

Resource	Summary of No Action Potential Impacts
Regional Air Quality & Clean Air Act	The potential for emergency maintenance activities is expected to increase because of coastal flooding. Equipment and vehicles used for emergency maintenance activities would generate emissions and, thus, could expose receptors to increased pollutant concentrations. Future road closures would also be likely to increase emissions due to increased vehicle delays and congestion. Individuals displaced from their homes because of flooding may also experience increased health risks, particularly if they are relocated to areas with higher ambient air pollution or if they become unhoused.
GHG	The potential for emergency maintenance activities is expected to increase because of coastal flooding. Equipment and vehicles used for emergency maintenance activities would generate GHG emissions. Disruption of the electrical grid could also generate GHGs, particularly if replacement power sources, such as diesel generators, are fossil fueled.
Regional climate, climate change, RSLC	The trends described in the existing conditions chapter would continue. Climate change could lead to increased ocean and terrestrial temperatures, ocean acidification, RSLC, duration and intensity of extreme events, weather patterns, and has the potential to cause changes in the nature and character of the bay waterfront. Climate change is expected to result in more intense and frequent extreme precipitation, droughts, and heat waves within the next century (NCA 2014, 2018; Ault et al. 2014; Ault et al. 2016; Cook et al. 2016; Jones and Gutzler 2016). This is likely to cause flooding, erosion, and increases in the rate and amount of nutrients and sediments entering the bay.

Resource	Summary of No Action Potential Impacts
Geology	No significant impacts are expected on the underlying geology or geologic processes, only minimal changes to the topographic features, geologic formations, and soils in the study area would be expected.
Sediments	No significant impacts are expected on the underlying sediment type. Sediment quality will continue to be impacted due to coastal flooding which potentially introduces contaminants into surface waters and nearby waterbodies. There is also the potential for contaminants to become trapped in sediments over time.
Seismicity	The current risk from a seismic event would continue into the future which could affect life safety, infrastructure disaster response and recovery, maritime commerce, commerce, utilities, transportation, historic resources, environment (contamination), land use, recreational areas, and the economy (MHRA 2020). However, current zone, building codes, and policies would minimize some of the risk for buildings/constructions subject to those policies.
Soils & Mineral Resources	Soils and mineral resources are expected to continue as described in the existing conditions chapter. Future exploration and production of oil, gas, and minerals within the study area is highly dependent on market conditions, value of existing resources, presence of production fields, and future development. It is unlikely that urbanized areas would see any increase in oil and gas production.
Floodplains	The study area would continue to be at risk of flooding and could become more at risk due to RSLC and climate change. Without local or non-Federal interventions, it is expected that nuisance flooding in low-lying areas will continue, where the potential impacts from tidal and/or rainfall flooding will likely increase and worsen over time with climate change and RSLC. Coastal hazards such as wave overtopping, and storm surge is expected to increase over time with climate change and RSLC which would lead to more catastrophic flooding.
Coastal hydrology, currents, & circulation	RSLC would likely increase flooding and wave hazards, resulting in increased soil erosion, modifications to the shoreline, and release of contaminants. RSLC rates may also exceed normal sediment accretion rates in saline marshes resulting in increased inundation and subsidence. Hydrology patterns may be impacted as continued water temperatures rise and trends in the Pacific Ocean circulation patterns change.

Resource	Summary of No Action Potential Impacts
Tides, tidal exchange, & waves	No significant impact to tides is expected. Tidal exchange and range, and wave hazards may be impacted based on RSLC whereby threats from wave hazards increase.
Wild and Scenic Rivers	No impact as Wild and Scenic Rivers are not designated within the SFWCFS study area.
Stormwater	Climate change, including more frequent and intense storms and flooding events, can increase stormwater runoff. An increase in stormwater runoff can exacerbate existing, or introduce new, contaminants into water sources and soils. Increased precipitation could overwhelm the study area's municipal stormwater management system, which can lead to backups that cause localized flooding or greater runoff of contaminants (e.g., trash, nutrients, bacteria) in waterways and soils (EPA 2023).
Water Quality	Current water quality trends could improve with changes in land use or improve through implementation of new water quality improvement programs such as TMDLs administered by Federal, state, and local agencies. However, with the existing status of water quality in the study area, it is more likely that conditions would worsen with increased flooding associated with climate change and RSLC. Increased flooding would lead to more runoff, potentially carrying contaminants, thereby lowering water quality. Climate change and RSLC introduce uncertainty of continued trends where changes in temperature, precipitation, chemical composition (e.g., ocean acidification), and increases in salinity could also impact water quality.
Groundwater	Groundwater may be significantly impacted by RSLC by causing groundwater elevations to rise.
Intertidal habitat	Intertidal habitats are expected to continue as described in the existing conditions chapter. With climate change and RSLC, there could be an increase in intertidal habitats as fringe marshes and low-lying vegetated areas are converted.

Resource	Summary of No Action Potential Impacts
Subtidal habitat	Subtidal habitats are expected to continue as described in the existing conditions chapter. With climate change and RSLC, there could be an increase in subtidal habitats as fringe marshes and low-lying vegetated areas are converted. RSLC could also potentially impact subtidal habitat suitability by increasing water depths resulting in reduced productivity and exposure to tidal exchange.
Pelagic habitat	Changes in water quality (e.g., temperature, salinity, DO), flow patterns, and habitat due to extreme events could degrade pelagic habitat quality. Climate change could cause a shift in plankton and benthic communities which are food sources for pelagic fish and mammal species.
Wetlands	Continued wetland losses and degradation through erosion and degrading water quality. Complete loss of Heron's Head Park wetlands and valuable habitat for T&E species.
Fish	Changes in water quality (e.g., salinity, dissolved oxygen) and flow patterns could disrupt fish use and cause a shift in prey availability. Fish could be impacted by increasing water temperature and ocean acidification which are anticipated to continue under climate change.
Commercial & Recreational Fisheries	Potential impacts to commercial and recreational fisheries include changes in species abundance and diversity due to direct and indirect impacts from flooding, RSLC, and climate change. Risk of coastal flooding and hazard increases may impact facilities that support commercial and recreational fishing thereby limiting ability to fish.
Macroinvertebrates	Changes in water quality (e.g., salinity, dissolved oxygen) could disrupt invertebrates and cause a shift in abundance or species diversity. Invertebrates could be impacted by increasing water temperature and ocean acidification which are anticipated to continue under climate change.
Terrestrial vegetation	Existing land use trends are expected to continue as described in the existing conditions chapter. The SFWCFS study area is highly urbanized with limited availability of terrestrial vegetation. Some undeveloped terrestrial habitats may be converted to urban lands with planned development. RSLC may convert some lower lying upland areas to wetlands or subtidal and/or intertidal habitats.

Resource	Summary of No Action Potential Impacts
T&E Species – Terrestrial	Continued habitat loss, particularly wetlands, intertidal and subtidal habitats, would reduce the space available for T&E terrestrial species. This may impact important foraging habitats for Ridgway's rail, refuge for salt marsh harvest mice, and available space for California seablite. RSLC may directly impact wetlands and intertidal habitats where erosion is persistent, which impacts foraging and nesting habitat for Ridgway's rail. Increased flooding from climate change, and erosion and subsidence from RSLC, may also lead to conversion of wetland habitats to intertidal habitats and loss of low-lying upland habitats that are necessary transition areas for species such as salt marsh harvest mice.
T&E Species - Aquatic	Climate change and RSLC may impact available foraging habitats for green sturgeon. Warming water temperatures can influence egg development and hatching rate, which may have more detrimental effects to the overall recovery of the species (NMFS 2022). Changes in flow patterns or currents may change the behavior of green sturgeon in marine environments which could make them more susceptible to human activities such as dredging and bottom disturbances (NMFS 2022). Climate change and warming water temperatures could shift prey availability for salmon and steelhead trout, as well as endangered marine mammals. Ocean acidification could have negative impacts of protected shellfish.
State listed species	Continued habitat loss would reduce the space available for state listed terrestrial species, while water quality degradation is likely to contribute to loss or shift in distribution of aquatic species. The study area is highly urbanized so any continued loss in habitat may prove to have significant impacts on the distribution and abundance of state listed species. Climate change and RSLC would increase flooding in the study area which disturbs available terrestrial habitat, wetlands, and can lead to water quality degradation (e.g., lowered DO, contaminants). Additionally, increases in water temperature or salinity may also impact state listed aquatic species ability to thrive or reside in the bay.
Designated Critical Habitat	Designated CH for green sturgeon and Chinook salmon in the SFWCFS study area would continue to be impacted by climate change, RSLC, and maritime use.
Migratory Bird Treaty Act Species	The Bay is critical stop over habitat for migratory bird species. Climate change and RSLC may exacerbate conditions for some of these species by contributing to loss of critical habitat.

Resource	Summary of No Action Potential Impacts
Bald & Golden Eagles	Populations of bald and golden eagles are found in the less urbanized areas of San Francisco Bay and coastal range. While individual eagles may migrate through the area, the project area does not support nesting habitat for eagles as it generally lacks large mature trees. The loss of mature trees from repeated flooding would make the study area even less inhabitable to bald and golden eagles if found nesting.
Marine Mammal Protection Act Species	Climate change and RSLC may exacerbate conditions for marine mammal species migrations and habitat use from rising seawater temperatures and ocean acidification. It is uncertain, but plausible, that long-term habitat changes would have indirect effects on prey availability.
EFH & EFH-designated species	EFH impacts would be focused on loss of shallow nearshore areas including SAV. The SFWCFS study area supports a diverse fish community including EFH. Shellfish resources are being impacted by ocean acidification and water quality degradation which would continue with climate change and frequent flooding. Impacts to water quality during storm events would occur in addition to the changes in temperature, precipitation, flooding patterns, and chemical composition over time.
HAPC	HAPC impacts would be focused on degradation of the quality of habitat through ocean acidification driven by climate change. More frequent flooding would increase contaminants delivery to HAPC which would reduce water quality.
SAV – Eelgrass	Due to the urbanized nature of the shoreline and water quality degradation, the amount of SAV has been greatly diminished in the study area over time. Climate change and RSLC introduce greater uncertainty of continued trends where changes in temperature, precipitation, flooding patterns, and chemical composition could impose additional impacts on water quality, algal blooms and SAV/macroalgae distribution and abundance. RSLC could also potentially impact habitat suitability for seagrasses by increasing water depths resulting in reduced light penetration, photosynthesis, and productivity (Strange 2008; USACE 2014).
Coastal Zone Management Act Areas	CZMA areas within the SFWCFS study area are extensive and would continue to be impacted by coastal flooding and the increasing threats of climate change and RSLC.

Resource	Summary of No Action Potential Impacts
Coastal Barrier Resources System Areas	No impact as Coastal Barrier Resource System Areas are not designated within the SFWCFS study area.
Noise	Emergency flood defense and response, and cleanup actions would require the use of a considerable amount of heavy equipment, which would generate noise. Buildings and infrastructure damaged by flooding would need to be demolished and the services provided would need to be relocated to other areas of the city, requiring new construction. The use of heavy equipment for flood defense on an emergency basis would very likely be substantial and could be any hour of the day or night. As such, there is a high potential for sleep interference due to emergency flood-defense and response activities. Equipment noise from redevelopment could occur at any scale or location within the city and, as such, impacts of construction noise would be expected.
Vibration	Heavy equipment types used for flood defense and demolition would create a perceptible level of vibration in the immediate vicinity of the equipment. It is unlikely that high-impact equipment, such as pile drivers, would be used for these types of activities, although jackhammers and hoe rams may be used for demolition. The relocation of services and properties would use heavy equipment that may potentially produce vibration near sensitive receptors and historic buildings that are more susceptible to building damage. The frequency and duration of these activities would be commensurate with flooding events, which could occur on an emergency basis within residential areas with a high risk or flooding. In situations where deep support systems are needed for building foundations, vibratory or impact pile driving may be used.
Cultural Resources	Taking no action to prevent water intrusion into the San Francisco waterfront would degrade the access and use of historic properties as well as contribute to physical impacts and potential loss of resources in the Area of Potential Effect. Impacts would consist of erosion from wave energy and inundation. Resources in low-lying areas are at highest risk for adverse effects from the No Action Alternative. Resources along the waterfront in the Marina and Northeast planning districts would be at risk of flooding, particularly Fisherman's Wharf and The Embarcadero. Identified resources in the Mission, South of Market, and South Bayshore planning district are at the highest risk for adverse effects as they are currently the lowest-lying areas and already experience flooding.

Resource	Summary of No Action Potential Impacts
Native American lands	Because no traditional cultural properties have been identified at this time, there would be no or negligible impact.
Environmental Justice	Overall, while the No Action would generate adverse effects, the distribution of these effects (displacement and flooding) would be dispersed throughout the study area. Therefore, the adverse environmental effects under the No Action would not be disproportionally felt by a minority or low-income population.
Socioeconomics & community	Flooding events would physically divide the waterfront neighborhoods, inhibiting community function and interaction throughout every reach, cause the displacement of various structures including residences, commercial and industrial businesses, and community and public facilities in every reach. These events would have a substantial adverse effect on economics, with the coastal neighborhoods experiencing loss in employment, school district funding, and county and city property and sales tax revenues.
Transportation	Several important transportation corridors would be impacted by rising sea levels and flooding that carry or provide access to vehicles, transit users (rail, bus and ferry), bicyclists and pedestrians. Flooding and associated freeway on- and off-ramp, road, sidewalk, and bike path closures and repairs would become increasingly common and gradual retreat of these facilities is expected to occur over time as RSLC continues. There would also be several transportation facilities for maintenance and operations such as the MUNI Municipal East facility that would be subject to flooding and infrastructure affected that would lead to a high degradation of transit by the end of century (SFMTA, 2022).
Utilities	The reliability of potable water is necessary for many industries in the study area. Climate change could lead to a short-term or long-term water shortage which could significantly impact potable water-dependent industries. RSLC would continue to stress the water main system, requiring increased investment into utilities such as sewage and potable water. Corrosion from rising groundwater could shorten life expectancy of buried pipes and require more frequent report or replacement. If buried pipelines are compromised, saltwater infiltration from increased groundwater levels may occur and affect the quality of drinking water. Increased precipitation would challenge the study area's combined stormwater and wastewater drainage system, potentially leading to more combined sewer overflows. An increase in sewer overflows can reduce water quality (EPA 2023).

Resource	Summary of No Action Potential Impacts
Recreation & Access	The study area would continue to be at risk of flooding and could become more at risk due to RSLC and climate change, which may impede the public's access to recreation areas. Access to the waterfront is critical for the public in the study area but flooding under RSLC may render it inaccessible. Additionally, loss of important natural recreation areas would be expected with climate change due to erosion and subsidence. Access to local piers and wharves may be temporarily inaccessible with nuisance flooding or lost with repeated storms and RSLC.
Aesthetics	The aesthetics are expected to continue as described in the existing conditions chapter over time. No significant impacts are expected to the aesthetics in the study area, though climate change and/or RSLC could cause damage to structures that contribute to the aesthetics of the waterfront from repeated nuisance flooding or more significantly from storms.
HTRW	Capped and un-capped HTRW areas would be exposed to flooding and erosion from RSLC, which could result in releasing contaminants that impact water, soil, and sediment quality, as well as human health.
Land Use	Land use changes would occur either directly or indirectly as the sea levels rise. As the water levels begin to encroach into the developed waterfront, some buildings and uses are expected to be abandoned in these flooded parcels. From this retreat away from the San Francisco Bay, other parcels may alter their land use due to decreased access or connectivity from regular flooding, and transition to a land use that is better able to accommodate flooding or reduced connections. Although floodproofing some buildings can delay retreat, substantial changes to buildings, building demolition, and movement of residences, businesses, and industrial/institutional uses would be expected particularly in the Mission Creek and Islais Creek low-lying areas. Land uses included in current general plans, specific area plans, and zoning may not be achievable in the increasingly inundated locations, and planning for where these uses may instead be accommodated would be needed.

Resource	Summary of No Action Potential Impacts
Public Health & Safety	The study area would continue to be at risk of flooding and could become more at risk due to RSLC and climate change, which may impede the publics access to critical safety infrastructures (i.e., hospitals) or the ability of public safety entities (i.e., ambulance, police) to aid the public. Currently planned life safety measures in the event of a major earthquake may not be accessible due to increased flooding. Nuisance flooding would make access to health and safety infrastructure troublesome, while severe flooding from storms may render them inaccessible. Increased flooding is likely to release contaminants from HTRW sites that pose a risk to human health.

The No Action Alternative was identified as the USACE low SLR curve NED Plan. The No Action is not discussed further in subsequent sections as summaries are provided in Table 4-8.

4.7 Air Quality

See Appendix D-1-1 for a discussion of the impacts of the alternatives on Regional Air Quality.

4.8 Climate, Climate Change, and Relative Sea Level Change

Climate impacts were assessed quantitatively and qualitatively for the action alternatives by reviewing state and federal reports, available data, and published literature.

Significance Criteria

Effects on climate were considered significant if implementation of an alternative plan would result in any of the following:

- **CC-01:** Directly or indirectly exceed applicable Federal or state GHG standards.
- **CC-02:** Conflict with an applicable plan, policy, or regulation adopted to reduce GHG emissions and climate change impacts.

NEPA considers that climatic environmental effects can include both the potential effects of a proposed action on climate/climate change and the implications of climate change on the performance of the proposed action. Thus, climate is analyzed from these two perspectives when evaluating environmental consequences of a project.

NEPA does not specify significance thresholds that may be used to evaluate the effects of a proposed action on global climate, rather, the appropriate approach to evaluate a project's impact on global climate is still under development. However, the Forest

Service developed guidance for climate considerations under NEPA, which focuses on 1) the effect of the project on climate change through greenhouse gas (GHG) emissions, and 2) the effect of climate change on the project (USFS, 2009). GHG emissions may include short-term impacts and alteration to the carbon cycle caused by fuels or extraction of fossil fuels and minerals. Climate change could affect the environment in such a way that it would impact the purpose and need of the project. For example, climate change could alter habitat suitability for target species or ecosystems in restoration efforts or increase flooding in a region that may render a project less successful. Finally, the implications of climate change for the environment with the proposed action should be considered with respect to other resources and/or actions that could lead to cumulative effects in the project area. For example, the potential for the project to lead to habitat fragmentation exacerbated by climate change that could lead to listing of a species under ESA (Brandt and Schultz, 2016).

On January 9, 2023, the CEQ released interim NEPA guidance for consideration of the effects of GHG emission and climate change under any Federal action. The 2023 guidance does not establish a quantity of GHG emissions as “significant” with respect to affecting the quality of the human environment, rather assists agencies to disclose and consider the effects of GHG emissions and climate change. The interim guidance recommends agencies quantify a proposed action’s reasonably foreseeable GHG emissions and place them in an appropriate context to estimate impacts to climate change.

EPA reinstated California’s authority under the CAA to implement its own GHG emission standards and zero emission vehicle (ZEV) sales mandate in March 2022 (87 FR 14332). California passed legislation requiring the state to reduce its overall GHG emissions to 1990 levels by 2020 and 40% below 1990 levels by 2030 (Senate Bill 32; Assembly Bill 32). Additionally, the California Air Resources Board (CARB) was appointed to develop policies to achieve this goal. The 2030 target was further refined with Assembly Bill 1279 and E.O. B-55-18 which seeks carbon neutrality for the state by 2045. In 2020, CARB set the GHG emission limit for the state at 431 million metric tonnes of carbon dioxide equivalent ($MMTCO_2e$; CARB 2023).

In many natural habitats, GHG emissions can be combatted or reduced through the process of carbon sequestration – the practice of removing carbon from the atmosphere and storing it (USGS, n.d.). Biological carbon sequestration occurs in aquatic and vegetated habitats that have microbial communities which can break down carbon, plants to store carbon in their tissues, and carbon that can be dissolved in marine and aquatic water (USGS, n.d.). Blue carbon refers to atmospheric carbon that is captured by ocean and wetland habitats (USGS, n.d.). Saline marshes contribute 50% of carbon burial in marine sediments, making these habitats a critical component of CO_2 sinks and reservoirs globally for GHG emissions (Duarte et al. 2013). Coastal wetlands efficiently preserve carbon through dense foliage and root networks that protect carbon deposited in the soil from erosion. Restoring salt marshes is a Blue Carbon initiative, proposed in

2009 (Nelleman et al. 2009), to help reduce GHG emissions through natural ecosystem enhancements (Duarte et al. 2013).

By identifying the level of GHG emissions and carbon sequestration, in relative terms, it can be determined or suggested whether an action would have net adverse or beneficial impacts to climate change.

ER 1100-2-8162, *Incorporating Sea Level Change in Civil Works Programs*, discusses the need to consider future sea level change impacts to coastal and estuarine zones in Civil Works projects due to the likelihood of continued or accelerated climate driven mean SLR through the 21st century and beyond. Global average sea level is rising and is expected to rise at greater rates in the future (Parris et al. 2012), though this is not expected to be uniform along U.S. coasts. Higher sea levels lead to greater coastal erosion, change sediment transport and tidal flows, exacerbate flooding frequency, increase landward migration of barrier shorelines, fragment islands, and expand saltwater intrusion to aquifers and estuaries (IPPC 2007; Titus et al. 2009; Irish et al. 2010; Burkett and Davidson 2012; Rotzoll and Fletcher 2013). In San Francisco, sea level rose 9 inches between 1854 and 2016 (Gonzalez et al. 2018).

The closest NOAA tide gauge to the study area is the San Francisco Presidio (ID: 9414290). USACE has three SLR scenarios (low, intermediate, and high) that are predicated on data from the National Research Council and Intergovernmental Panel on Climate Change (IPCC). USACE policy does not ascribe likelihood for any of the future SLR curves, because it is problematic to reliably assign a specific likelihood for future relative sea level change (RSLC) and ascertain its effect on a given coastal project. Instead, USACE guidance applies a scenario-based approach for evaluating RSLC risk on project performance which is based on all three USACE RSLC curves. Additional details about the USACE RSLC can be found in Appendix J (Climate). Figure 4-1 presents the USACE SLR curves for the study period.

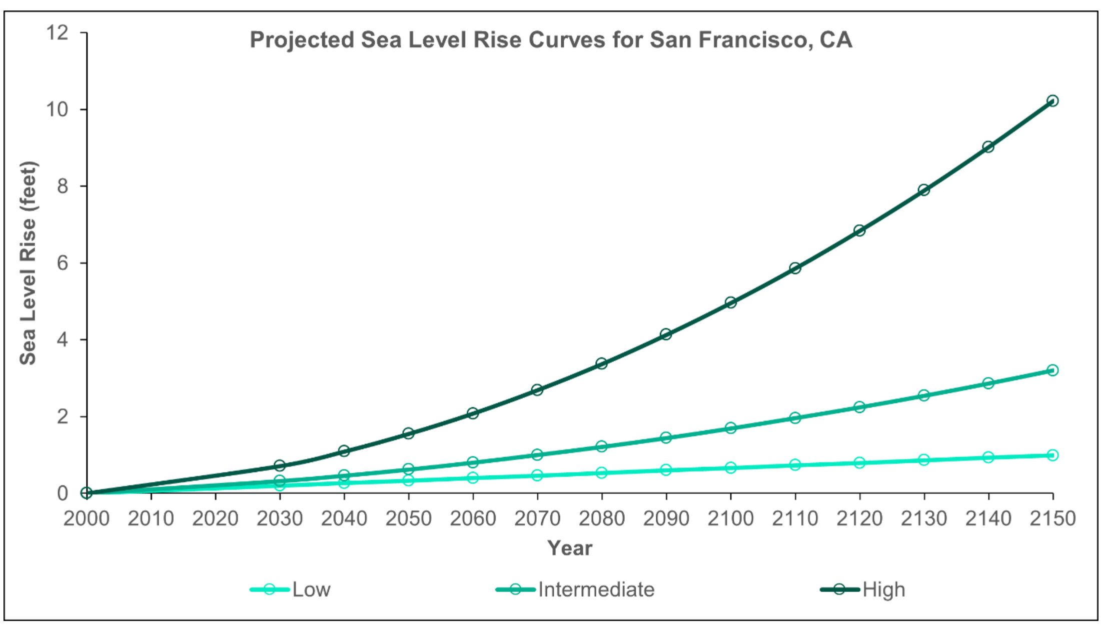


Figure 4-1. USACE relative SLR curves compared to mean sea level change

Throughout the construction and life of the project, RSLC/climate change is anticipated to continue causing increases in mean water elevation, precipitation, extreme events, and storm severity and frequency. Construction of measures are expected to mitigate damage from anticipated RSLC and climate change at varying rates of SLR. USACE projects SLR to range in an increase from 0.93 feet for the low scenario, 2.86 feet for the intermediate, and 9.02 feet for the high scenario by 2140 in the study area. Coastal hazards and storms would cause flooding at increased heights and over larger areas than in the past as RSLCs. It is also projected that frequency and intensity of coastal storms and precipitation would increase over time (Chung et al. 2021).

4.8.1 Construction Impact Summary

The SFWCFS study is unique in that it has designed Action Alternatives predominantly to address the impacts of RSLC. Thus, the Action Alternatives are evaluated considering all three SLR scenarios for FWP conditions. As stated throughout the DIFR-EIS, measures in each alternative are designed to an elevation relative to the SLR scenarios. As such, the alternatives performance against different rates of SLR impacted the overall score for this resource, as it was assumed if climate driven flooding impacts breached the measure, this would lead to adverse impacts for the study area. However, for this analysis, it was assumed the measures would perform adequately under the SLR scenario they were designed for.

Temporary localized emission increases would be produced from diesel-powered construction equipment working at the various project locations such as, operating on- and off-road mobile sources, heavy machinery, non-mobile mechanized equipment, and support vehicles; released CO_2 embedded in steel and concrete during fabrication; and energy consumption (e.g., use of generators). The localized emission increases from the diesel-powered equipment would last only during the project's construction period in each location and then end when the project phase is complete, thus any potential impacts would be temporary in nature and geographically dispersed over the project duration. At draft report, the study's General Conformity-related annual emissions do not exceed the de minimis threshold levels for the relevant pollutants; thus, a General Conformity Determination is not required for compliance with the CAA (Appendix D-2-1).

The generation of GHG emissions associated with the project's construction activities would be temporary in nature, spanning only the construction period. The primary GHG emitted from diesel-fueled equipment is carbon dioxide (CO_2). Although nitrous oxides (N_2O) and methane (CH_4) have significantly higher global warming potentials (298 times and 25 times greater than CO_2 for N_2O and CH_4, respectively), they are emitted at significantly lower rates, resulting in minimal fractional increases in carbon dioxide equivalents (CO_2e) when compared with CO_2 alone. Other GHGs (e.g., hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride) are typically associated with specific industrial sources and processes, thus would not be emitted during construction. Upon construction completion, all GHG emissions would cease, and the area would return to baseline conditions. There are no apparent negative impacts to carbon sequestration (e.g., loss of wetlands) that would result from implementation of the Action Alternatives; rather a net gain in carbon sequestration benefits is anticipated with the addition of marsh habitat through EWN features. On a global scale, however, this sequestration contribution would be negligible.

4.8.2 Operations and Maintenance Summary

The SFWCFS includes protection of critical infrastructure, business, life safety, residents, transportation corridors, and natural environments through a variety of Coastal Flood Risk Management (CFRM) measures and EWN features. Grey features (e.g., levees, walls) all contribute to production of emissions during O&M activities, while EWN features contribute to carbon sequestering. All features contribute to structural resiliency during storms and flooding events. The protection of the infrastructure and natural features provided by the project would minimize future storm damage further inland and associated reconstruction emissions. As a result, generation of emissions, including CO_2, during future emergency response clean-up and restoration of the coastline would be limited or avoided.

4.8.3 Tentatively selected plan

The TNBP is anticipated to have no to moderate to high impacts on climate change during construction of CFRM measures and operations and maintenance activities. Table 4-9 predominantly reflects the impact to GHG emissions as the TNBP is designed to sustain RSLC under the intermediate and high scenarios. Details of the GHG emission estimates can be found in Appendix D-1-1.

Table 4-9. Summary of Climate, Climate Change, and RSLC Impacts associated with the TNBP

TNBP Climate, Climate Change, and RSLC Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*

Construction/Footprint (1st Action)	1	3	4	3	4	3	3	3	4	3+	3+	3+	3+	1
Construction/Footprint (2nd Action)	4	3	4	1	4	1	3	1	4	3+	3+	3+	3+	3+
O&M Assumptions	1	2	2	2	1	2	2	2	2	2	2	2	2	2
Mitigated Rating	*3*	*2*	*3*	*2*	*3*	*2*	*2*	*2*	*3*	*2*	*2*	*2*	*2*	*2*

4.8.4 Alternative B

Alternative B is anticipated to have low to moderate to high impacts on climate change. Alternative B is nonstructural and includes floodproofing, modifying, or relocating buildings and infrastructure to reduce flood risks. As sea levels rise, areas with higher flood risks could be managed for responsible retreat, while areas with lower risks could be floodproofed or modified. Nature-based features would be added to retreat areas to reduce flood risks, while policy changes would be implemented to allow for increased housing density and business relocations in inland areas. Essential utilities and major transportation and transit corridors would be relocated or modified to continue providing service. Details of the GHG emission estimates can be found in Appendix D-1-1.

4.8.5 Alternative F

Alternative F is anticipated to have no to moderate to high impacts on climate change during construction of CFRM measures and operations and maintenance activities. Table 4-10 predominantly reflects the impact to GHG emissions as Alternative F is designed to sustain RSLC under the intermediate and high scenarios. Details of the GHG emission estimates can be found in Appendix D-1-1.

Table 4-10. Summary of Climate, Climate Change, and RSLC Impacts associated with Alternative F

Alternative F Climate, Climate Change, and RSLC Impact Rating by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	4	3	4	4	4	3	3	4	3+	3+	3+
O&M Assumptions	1	2	2	1	2	2	2	2	2	2	2

Mitigated Rating	3	2	3	3	3	2	2	3	2	2	2

4.8.6 Alternative G

Alternative G is a retreat strategy that shifts the line of defense the furthest inland of any alternative. This alternative allows for the greatest flooding under the high SLR scenario; however, it is not intended to flood beyond the line of defense. Table 4-11Table 4-11 summarizes the impact scores of climate change and RSLC associated with Alternative G. Impact producing factors are air emissions as indicated in the Air Quality section, and GHG emissions, thus alternative impact scores are the same as those in Sub-appendix D-1-1. Details of the GHG emission estimates can be found in Appendix D-1-1.

Table 4-11. Summary of Climate, Climate Change, and RSLC Impacts associated with Alternative G

Alternative G Climate, Climate Change, and RSLC Impact Rating by Measure	**Levee**	**Bridge raise**	**Bulkhead wall/Seawall**	**Roadway Impact**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint	3	3	4	4	3	3	4	3+	3+	3+	3+	3+
O&M Assumptions	2	2	2	1	2	2	2	2	2	2	2	2
Mitigated Rating	2	2	3	3	2	2	3	2	2	2	2	2

4.8.7 Independent Measures for Consideration

The independent measures are anticipated to have no to moderate to high impacts on climate change during construction and operations and maintenance activities. Table 4-12 predominantly reflects the impact to GHG emissions as the independent measures are designed to sustain RSLC under the intermediate and high scenarios. Details of the GHG emission estimates can be found in Appendix D-1-1.

Table 4-12. Summary of Climate, Climate Change, and RSLC Impacts associated with the Independent Measures

Independent Measures [Insert Resource] Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	3	3	4	3	3	3	3
O&M Assumptions	2	2	2	2	2	2	2
Mitigated Rating	2	2	3	2	2	2	2

4.8.8 Mitigation

While construction activities associated with the No Action cannot be defined and climate change impacts are fairly speculative at the current level of detail, mitigation measures are available to reduce construction emissions as necessary.

For Alternatives B, F, G, the TNBP, and independent measures, the avoidance and minimization measures that follow would be necessary to reduce impacts.

After detailed construction assessments are conducted, and impacts are identified, if necessary, measures to reduce GHG emissions would be included. Reductions in emissions can be accomplished by the measures listed below, as feasible. The list of strategies are informed by measures recommended by the BAAQMD (2023) to reduce construction-generated GHG emissions; as such, these measures should be updated as project-specific analyses are conducted.

Require all on-road heavy-duty trucks to be zero-emission vehicles or meet the most stringent emissions standard at the time of construction, such as a model-year (MY) standard, as a condition of contract.

Minimize idling time, either by shutting equipment off when not in use or reducing the time of idling to no more than 2 minutes (a 5-minute limit is required by the State airborne toxics control measure [Title 13, Sections 2449(d)(3) and 2485 of the California Code of Regulations]). Provide clear signage that posts this requirement for workers at the entrances to the sites and develop an enforceable mechanism to monitor idling time and ensure compliance with this measure.

Prohibit off-road diesel-powered equipment from being in the “on” position for more than 10 hours per day.

Use CARB-approved renewable diesel fuel in off-road construction equipment and on-road trucks.

Use EPA SmartWay-certified trucks for deliveries and equipment transport.

Require all construction equipment to be maintained and properly tuned in accordance with manufacturer's specifications. Equipment should be checked by a certified mechanic and determined to be running in proper condition prior to operation.

Where grid power is available, prohibit portable diesel engines and provide electrical hook-ups for electric construction tools, such as saws, drills, and compressors; use electric tools whenever feasible.

Encourage and provide carpools, shuttle vans, transit passes, and/or secure bicycle parking to construction workers and offer meal options on-site or shuttles to nearby meal destinations for construction employees.

Reduce electricity use in construction offices by using LED bulbs, powering off computers every day, and replacing heating and cooling units with more efficient ones.

Minimize energy used during site preparation by deconstructing existing structures to the greatest extent feasible instead of demolishing structures and discarding all materials.

Recycle or salvage non-hazardous construction and demolition debris, with a goal of recycling at least 15 percent more by weight than the diversion requirement in Title 24.

Use locally sourced or recycled materials for construction materials (goal of at least 20 percent, based on costs for building materials and volume for roadway, parking lot, sidewalks, and curb materials). Wood products used should be certified through a sustainable forestry program.

Use low-carbon concrete, minimize the amount of concrete used, and produce concrete on-site if it is more efficient and lower emitting than transporting ready-mix.

Develop a plan to efficiently use water for adequate dust control because substantial amounts of energy can be consumed during the pumping of water.

Purchase carbon offsets.

Future construction located within 1,000 feet of sensitive receptors would be required to perform a health risk assessment (HRA). If the HRA demonstrates health risks would be significant, additional feasible on- and off-site mitigation shall be analyzed to help reduce risks to the greatest extent practicable. Potential measures may include the following:

Create buffers between residences and construction (e.g., vegetative barriers or other temporary buffers).

Use construction equipment with the highest commercially available tier of emissions controls (in 2023, this is Tier 4).

Use equipment during times when receptors are not present (e.g., when school is not in session or during non-school hours), as feasible.

Establish staging areas for the construction equipment that are as distant as possible from off-site receptors, including existing residences.

Where feasible, use haul trucks with on-road engines instead of off-road engines, even for on-site hauling.

Provide financial assistance for high-efficiency air filtration systems to those affected for use in residences.

Implement dust-suppression site controls to limit the exposure to potential contaminated soils, as necessary. Refer to the Hazardous, Toxic, and Radioactive Waste (HTRW)/soil quality section, as needed.

4.9 Geology

Direct and indirect effects on geologic resources were considered significant if implementation of an alternative plan would result in any of the following:

- **GEO-01:** Substantially alter the existing drainage pattern of the site or area that would result in substantial erosion or siltation on- or off- site;
- **GEO-02:** Increase in channel and/or bank erosion;
- **GEO-03:** Substantial loss of sediment supply;
- **GEO-04:** Substantially modify the geology which would induce seismic activity.

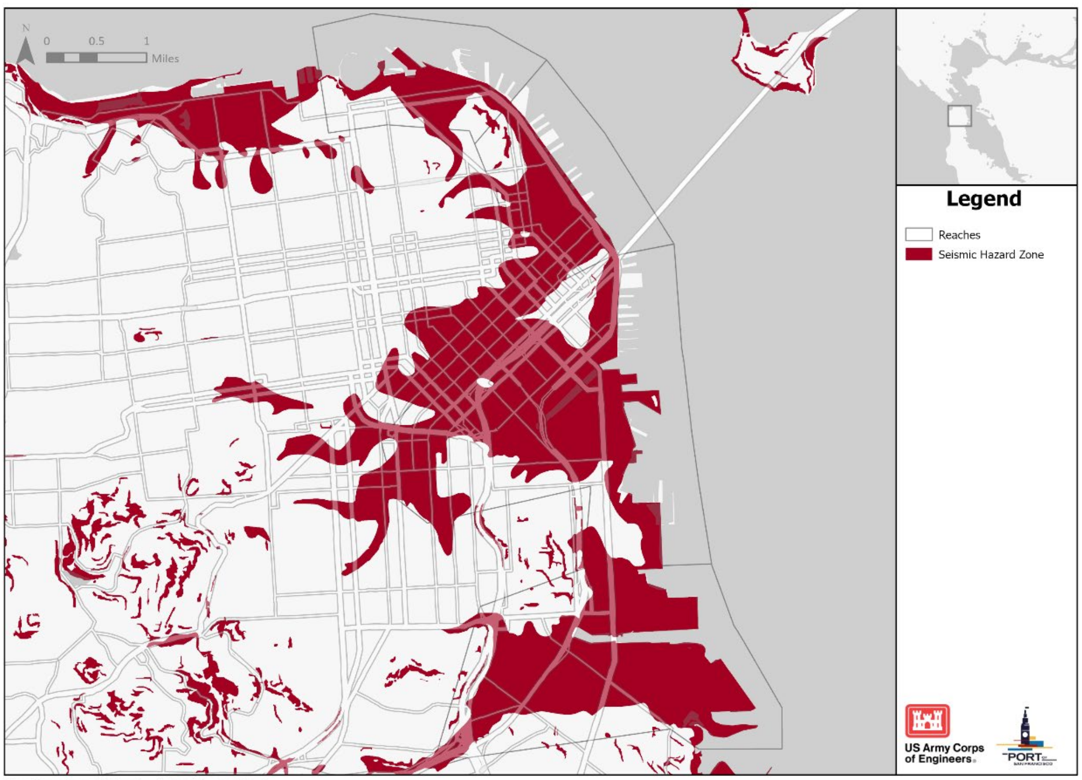
Impacts to geology were qualitatively described.

4.9.1 Construction Impact Summary

Excavation actions could expose shallow subsurface geologic layers, which may require drilling through, if necessary, to reach the design depths. Impacts would be localized and none of the proposed measures would affect regional geology. To raise surface elevation, commercially sourced fill material would be placed on excavated construction sites which introduces new surface geologic and soil layers. However, the addition of these soils is not expected to induce any seismic related failures or risks.

All Action Alternatives would design project features in accordance with USACE seismic regulations, policy, and design methodologies to provide measures that meet required seismic performance criteria including strength, ductility, displacements, mitigation, and overall performance standards. No seismic hazard would be induced by the construction of any project feature.

The CFRM features are proposed to be constructed along a seismically active area (Figure 4-2) that could experience strong to violent ground shaking from a major earthquake. The San Francisco Bay area has a 72 percent chance of experiencing an earthquake of 6.7 magnitude or higher over the next 30 years, with the Hayward and Calaveras being the most likely faults to cause such an event (SFP 2022). Strong seismic shaking could adversely impact a proposed alternative by damaging foundations, misaligning sheet piles, dislodging stone/concrete structures, or causing fill settlement. Additionally, measures could be damaged by soil displacement caused by lateral spreading in areas of liquefiable soils. Measures more vulnerable to damage from seismic activity are being reinforced with ground improvements to reduce the risks of damage from seismic ground shaking and lateral ground movement. Construction of CFRM features in the study area would have ***no impact*** on the risk of fault rupture, landslides, substantial soil erosion or loss of topsoil, expansive soils, or directly or indirectly destroy unique paleontological or geological resources.



San Francisco Waterfront Resiliency Study
Integrated Feasibility Report/Environmental Impact Statement

Figure 4-2. Seismic hazard zone in the study area. Source: City of San Francisco (https://data.sfgov.org)

4.9.2 Operations and Maintenance Impact Summary

O&M activities are anticipated to have ***no impacts*** to geologic resources. Maintenance actions would occur on the surface, thus, would not impact geologic structure or integrity, nor is it expected to induce seismic activity.

4.9.3 Tentatively selected plan

The TNBP is anticipated to have no to low impacts on geologic resources during construction of CFRM measures and operations and maintenance activities (Table 4-13).

Table 4-13. Summary of Geology Impacts associated with the TNBP

TNBP Geology Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint (1st Action)	1	2+	2+	2	2+	2	2+	1	2+	2+	2+	2+	2+	2+
Construction/Footprint (2nd Action)	2	2+	2+	1	2+	1	2+	1	2+	2+	2+	2+	2+	2+
O&M Assumptions	1	1	1	1	1	1	1	1	1	2+	2+	2+	2+	2+
Mitigated Rating	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*1*	*2*	*1*	*1*	*1*	*1*	*1*

Construction of CFRM features that overlap with Alternative F and G are anticipated to have similar impacts as those described in the sections below. Unique to the TNBP is the addition of sheetpile walls and deployable flood gates. Sheetpile walls are anticipated to have similar impacts as those described for vinyl sheetpile walls in levee features in Alternative F. Deployable flood gates would require excavation, fill, and grading to prepare the construction site for installation which would have local minor impacts to geology. Operations and maintenance of the gates are anticipated to have no impacts to geology as they occur on the surface and should not disturb underlying soils. Overall, impacts are anticipated to be similar during construction in 2040 and 2090 and would be ***less than significant*** for both periods.

4.9.4 Alternative B

Alternative B is not anticipated to have any additional impacts beyond minor surface work for infrastructure that is being demolished or moved elsewhere, which may include some excavation and use of heavy machinery. Soil movement would be limited to upper layers to remove structure debris and regrade the construction site. Thus, Alternative B is expected to have ***no impacts*** to geologic resources.

4.9.5 Alternative F

Alternative F impacts to geology range from no to low adverse impacts, as well as have some beneficial impacts (Table 4-14). Impacts to geology are predominantly attributed to seismic ground improvements needed before construction of the CFRM features.

Table 4-14. Summary of Geology Impacts associated with Alternative F

Alternative F Geology Impact Rating by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	2	2+	2+	2+	2+	2+	1	2+	2+	2+	2+
O&M Assumptions	1	1	1	1	1	1	1	1	2+	2+	2+
Mitigated Rating	*2*	*2*	*2*	*2*	*2*	*2*	*1*	*2*	*1*	*1*	*1*

Ground improvements are needed to stabilize existing soils to address seismic concerns associated with the new loads born to the underlying geology. Ground improvements could be completed with a variety of techniques, as described in the construction techniques section above (section 4.3), which would be determined during PED. These techniques reinforce soils, stabilize slopes, support embankments, and mitigate for liquefaction after hardening (Denies and Huybrechts 2015); however, adverse impacts to local geology and soils are also expected. Table 4-4 and Table 4-5 provides the acreage anticipated to be impacted by ground improvements for Alternative F in 2040 and 2090, respectively. Alternative F is anticipated to have lesser impacts to local geology than Alternative G and the TNBP in 2040 and 2090 given the smaller footprints.

Addition of cementitious or binding materials would change the geologic signature and structure and would destroy any soil development or composition that was present. As existing soils are blended with a cementitious material, or binder, the soil composition would no longer resemble the pre-existing structure. Mechanical equipment (e.g., auger, cutter machine) physically dislodges soil to mix with a binding material, which would displace existing soils and distribute them along varying depth gradients. Additionally, the binding material introduced into the soil would render it unsuitable for soil invertebrates and may lead to lower soil biodiversity.

Soil represents one of the largest reservoirs of biological diversity and is responsible for critical ecosystem functions such as nutrient cycling, organic matter decomposition, soil formation, and plant performance (Bardgett and Van Der Putten 2014). Soil invertebrates enhance water filtration and retention, and removal of pathogens, nutrients, and contaminants in urban areas. Removal and/or replacement of soil and compaction affects soil biodiversity, with subsequent impacts to ecological function (Sun et al. 2023). The ground improvements are expected to have localized, minor, short-term impacts to soil composition, as well as soil biodiversity. Although the ground improvements are anticipated to be long-term solutions, the impacts to soil biodiversity are expected to be short-term and ***less than significant***, as soil invertebrates would adapt to the change in environment and likely return to pre-existing conditions over time. The soil impacted in the study area would be artificial fill overlying bay mud deposits (Baldwin et al. 2018), thus, ***no impacts*** to native soils and geology are anticipated as they are too deep for the construction actions to penetrate.

The linear extent of ground improvements ranges from 50 ft to 100 ft wide depending on proximity to the waterfront. Additional details for ground improvements designs and dimensions can be found in the Appendix B. These improvements are intended to reinforce liquefiable soil hazards to reduce the risk of damage from seismic ground shaking and lateral ground motion. The reinforced soils ensure that CFRM features, and the foundations, could withstand a strong to violent ground shaking seismic event without the underlying soils experiencing loss of bearing strength, lateral spreading, or seismically induced settlement from liquefaction. As such, the construction of these features is anticipated to have a beneficial impact to geologic resources in the long-term. Final design geotechnical investigations would be conducted during PED to evaluate ground shaking and liquefaction potential to verify that foundation designs and ground improvements would be adequate to protect the CFRM features.

Levees with a height greater than 4 ft would require the installation of a vinyl sheet pile wall driven into the ground for stabilization. Vibratory hammers or impact hammers would be used to install the sheet piles which generate ground vibrations during operation. The scale and impact of ground vibrations is measurable; however, these are typically used to determine safe operating distances from existing structures rather than impacts to geology (e.g., Weng et al. 2020). The vibrations can dislodge soils and geologic layers locally as sheet piles are driven into the ground, as well as change the interaction of neighboring soils once sheet piles are present. Overall, the use of impact/vibratory hammers are anticipated to have direct, minor, localized, short-term, adverse impacts to geologic structure and soil composition at the surface in the study area. These impacts would be ***less than significant***.

Sheet pile walls are expected to reduce erosion on embankments with soils exposed to wave energy once installed. In this instance, soil erosion is improved, which would have direct, minor, localized, short-term, beneficial impacts to geology along the shoreline.

Best Management Practices (BMPs) used to manage soil erosion and sediment loss can be followed to further minimize impacts to geologic resources. Refer to the Mitigation section for additional information.

4.9.6 Alternative G

Table 4-15 summarizes the impact scores from construction to geologic resources, which is driven by those described in Alternative F. Impacts to geologic resources range from no to low for Alternative G.

Table 4-15. Summary of Geology Impacts associated with Alternative G

Alternative G Geology Impact Rating by Measure	**Levee**	**Bridge raise**	**Bulkhead wall/Seawall**	**Roadway Impact**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint	2+	2+	2+	2+	2+	1	2+	2+	2+	2+	2+	2+
O&M Assumptions	1	1	1	1	1	1	1	1	2	2	2	2
Mitigated Rating	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*

Alternative G measures would have similar impacts as those described in Alternative F, with a greater impact from seismic ground improvements. Seismic ground improvements span nearly twice the total geographic extent as Alternative F (Table 4-4 and Table 4-5), ranging from 50 ft to 100 ft wide dependent on proximity to the waterfront. However, these impacts are anticipated to be ***less than significant*** with the use of BMP’s (see Mitigation). Beneficial impacts are expected because the reinforced soils aim to avoid measure failure in a seismic event.

4.9.7 Independent Measures for Consideration

Adverse impacts from construction and operation of independent measures are expected to be equivalent to those described in the construction impact summary, as well as those in the TNBP, Alternative F, and G (Table 4-16). As such, the impact rating was equivalent to that of the previously described alternative features where applicable. Unique to the independent measures is the EWN vertical shoreline. Installation of the vertical shoreline is anticipated to have ***no impact*** on geologic resources because panels would be installed on the seawall once construction of that feature was completed and there would be no contact with geology.

Table 4-16. Summary of Geology Impacts associated with the Independent Measures

Independent Measures Geology Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	2+	2+	2+	1	2+	2+	1
O&M Assumptions	1	1	1	1	1	1	1
Mitigated Rating	*2*	*2*	*2*	*1*	*2*	*2*	*1*

Minor adverse impacts to sediments/geologic resources are expected during construction of 2B for the coarse beach, similar to those described in the construction impact summary. These would be localized, temporary, and ***less than significant***. BMPs would be used to reduce overall impacts during construction. In the long-term, coarse beaches are expected to have a beneficial impact for sediment by reducing the loss of sediment transfer through erosion protection.

4.9.8 Mitigation

No compensatory mitigation is expected to be required for impacts to geologic resources. However, avoidance and minimization measures would be used to reduce impacts to soils, sediments, and geology to the greatest extent practicable.

BMPs would be used to manage sediment and erosion during the construction of any of the alternatives. Construction period preparedness and weather condition BMPs control erosion and sediment through management and monitoring that includes:

- Ensuring the contractor has the appropriate equipment and materials available at the start of construction to complete the project within the planned time frame.
- All disturbed areas are treated with erosion control measures.

- Coordination between vegetative planting and grading is in place prior to construction.
- Daily weather monitoring for possible precipitation events and a plan in case of significant rainfall.
- Preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP) to control erosion, storm water runoff, sedimentation, and other construction-related pollutants during all phases of construction, until the construction is complete and all disturbed areas are permanently stabilized throughout the project area.

The short-term increase in sediment would be reduced by implementing the following erosion control measures during construction:

All soils would be stabilized within 14 days of completed work.

Construction equipment would be limited to the actual area being disturbed and vehicles may not travel in areas outside of designated staging areas or access routes.

Short-term staging of soil material (less than 1 week) would be surrounded by a silt fence, fiber rolls, or other perimeter.

Long-term staging of soil material (longer than 1 week) would be placed away from surface waters, vegetated, and surrounded by a levee perimeter to control runoff and erosion.

Excavation would be limited to the extent practicable. All excavated material that is not relocated to another portion of the project area would be completely removed to a disposal site located outside the study area.

Existing vegetation would be left in place to the maximum extent possible.

Bare ground would be monitored for dryness and watered, if necessary, to reduce wind and water erosion.

The contractor would be required to conduct water quality tests specifically for increases in turbidity and sedimentation caused by in-water construction activities. Water samples for determining background levels would be collected in San Francisco Bay in the vicinity of the construction site. Testing to establish background levels would be performed at least once per day when construction activity is in progress. The contractor would monitor turbidity and settleable solids at least daily and turbidity at least hourly when a turbidity plume is visible. If turbidity limits are exceeded, the contractor would slow the rate of earthwork or use other means to comply with the requirements, including stopping construction activities until the plume has cleared.

Sediment barriers would be installed on graded or other disturbed slopes, as needed, to prevent sediment from leaving the project sites and entering nearby surface waters.

The contractor would have a designated vehicle and equipment maintenance staging area that is self-contained to protect groundwater, surface water, and soils from contamination.

Construction traffic would be restricted to predetermined routes.

Traffic during wet weather or within the wet zone would be minimized.

Pivoting excavators would be used within the wet zone to prevent rutting and excess erosion.

A spill prevention and containment countermeasure plan that addresses all potential mechanisms of contamination would be developed. Suitable containment materials would be on site in the event of a spill. All discarded material and any accidental spills would be removed and disposed of at approved sites.

Equipment and vehicles operated within the floodway would be checked and maintained daily to leaks of fuels, lubricants, and other fluids to surface waters. Hardened armoring would be used in areas susceptible to high erosion rates as identified by hydrologic and sedimentation modeling.

4.10 Soils and Mineral Resources

Impacts to soils and mineral resources were assessed qualitatively and quantitatively. A summary of impacts is described in the section below.

Significance Criteria

The following significance criteria were used to determine significances:

MIN-01: Surface access to mineral estate would be severely limited violating the mineral estate's right to freely use the surface estate to the extent reasonably necessary for the exploration, development and production of the oil and gas under the property.

4.10.1 Construction Impact Summary

Soils would be disturbed, and the topsoil and several inches to feet of subsoil would be removed to construct new access roads, flood risk features, and any staging areas. During removal, there is a chance that shallow soil horizons could be mixed, resulting in the blending of soil characteristics and types. This blending would modify physical characteristics of the soil structure, texture, and rock content, potentially leading to a loss of soil productivity and reduced reclamation potential. Native soils could be impacted during excavation and replaced with fill material or buried during foundation installation of project measures. This would be a long-term permanent impact to soils within the project construction footprint.

Compaction from repetitive use or use by heavy equipment would reduce aeration, permeability, and water-holding capacity of soils. An increase in surface runoff can be expected, potentially leading to erosion during construction. After heavy precipitation events, additional soil impacts may occur, such as soil saturation and water erosion. When saturated areas are used, tire ruts develop, increasing the compaction rate and affecting the ability for vegetation to reestablish unless mitigated. Wind erosion would be expected to be a minor contributor to soil erosion except for dust from vehicle traffic traveling on dry access roads during construction.

The magnitude, extent, and duration of construction-related impacts depend on the erodibility of the soil; proximity of the construction activity to receiving waters; and the construction methodologies, duration, and season.

To avoid and minimize these potential impacts, a National Pollutant Discharge Elimination System (NPDES) Construction General Permit from the Waterboard would be required. To obtain this permit, a contractor would be required to prepare and implement a SWPPP that would incorporate erosion and sedimentation control measures to minimize the potential for contamination of water resources. A SWPPP typically specifies BMPs they would implement to minimize disturbances to soils, such as minimizing ground disturbance to the smallest extent necessary, utilization of existing access roads and previously disturbed areas (e.g., parking lots) for staging, implementation of silt fences to minimize soil movement, and restoration actions for disturbed areas. Similar BMPs to those described in the Geology Mitigation section would also apply to soils to reduce project related impacts.

Based on existing conditions, contaminated soils are present within the project area. As additional details and site-specific testing can be done, soil and sediments may be characterized prior to construction per existing Federal and State regulations.

All alternatives are anticipated to have ***no impact*** on mineral resources, thus, it is not discussed further. The Burton Act reserved mineral rights to the State of California, thus, accessing minerals would be done so in a manner as to not interfere with any lease, franchise, permit, or license. Additional information can be found in Appendix F.

4.10.2 Operations and Maintenance Summary

Operations and maintenance of the proposed measures are expected to have no to low impacts to soils and mineral resources overall. The majority of adverse impacts would occur during construction when soils are at the highest risk of being disturbed. Some features may require additional fill material (e.g., marsh restoration) with RSLC; however, this would likely be placed on existing fill material rather than mixing or replacing native soils.

4.10.3 Tentatively selected plan

Impacts to soils and minerals would be the same as those described in the construction and O&M summary sections, and Alternatives B, F, and G. Impacts ranged from no to low to soils and mineral resources for the TNBP (Table 4-17).

Table 4-17. Summary of Soil and Mineral Resources Impacts associated with the TNBP

TNBP Soils and Mineral Resources Impact Rating by Measure	**Bay Fill**	**Levee**	**Bulkhead wall/Seawall**	**Deployable Flood Gate**	**Roadway Impact**	**Sheetpile Wall**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint (1st Action)	1	2	2	2	2	2	2	1	2	2+	2+	2+	2+	1
Construction/Footprint (2nd Action)	2	2	2	1	2	1	2	1	2	2+	2+	2+	2+	2+
O&M Assumptions	1	1	1	1	1	1	1	1	1	2+	2+	2+	2+	2+
Mitigated Rating	2	2	2	2	2	2	2	1	2	1	1	1	1	1

Adverse impacts to the resources associated with construction activities in the TNBP would be comparable to those of Alternative G, but more than those for Alternative F in 2040 (Table 4-4). The TNBP has a greater spatial extent of measures that would have adverse impacts to soils (e.g., seismic ground improvements, roadway impacts, levees). In 2090, the TNBP would have greater impacts to soils than Alternative F and G. The TNBP CFRM features have a greater impact than measures from Alternative F, particularly in reaches 3 and 4 where new feature construction would need to occur. CFRM features are comparable in size between the TNBP and Alternative G in 2090; however, Alternative G adds a considerable amount of EWN that would have long-term beneficial impacts to soils and minerals that the TNBP does not offer (Table 4-5).

4.10.4 Alternative B

Alternative B is not anticipated to have any additional impacts beyond minor surface work for infrastructure that is being demolished or moved elsewhere, which may include some excavation and use of heavy machinery. Soil movement would be limited to upper layers to remove structure debris and regrade the construction site. Thus, Alternative B is expected to have ***less than significant*** impacts to soils and mineral resources.

4.10.5 Alternative F

Impacts to soils are anticipated to be similar to those described in the Geology section, ranging from no to low impacts (Table 4-18).

Table 4-18. Summary of Soil and Minerals Impacts associated with Alternative F

Alternative F Soils and Minerals Impact Rating by Measure	Bay fill	Levee	Bulkhead wall/Seawall	Roadway Impact	Tide Gate	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Marsh Enhancement*
Construction Footprint	2	2	2	2	2	2	1	2	2+	2+	2+
O&M Assumptions	1	1	1	1	1	1	1	1	2+	2+	2+
Mitigated Rating	*2*	*2*	*2*	*2*	*2*	*2*	*1*	*2*	*1*	*1*	*1*

The greatest impacts are expected during construction activities, predominantly from earthwork as described in the construction impact summary above. The adverse impact to soils differs from geology because earthwork would disturb soils during construction of any of the measures, as well as during some O&M activities. O&M for levees could result in the need for additional fill material which would require earthwork similar, but likely less impactful, to that used during initial construction. Maintenance of ecological armoring would require placement of additional stone along banks that has the potential to compact soils while using heavy machinery, and or, erosion if the soil becomes too saturated. No impacts are expected to occur with construction of vertical walls and curb extensions as these activities should not disturb soils. Curb extensions would be constructed around piers in 2040 which would not have contact with soils. In 2090, vertical walls are intended to be added to the top of existing CFRM features and should not require disturbance of underlying soils.

It was assumed fill material would be purchased from commercial sources, but there is potential to beneficially use dredged material if it is determined to be suitable for construction. Adverse impacts to soils and minerals are expected to be temporary and localized to the construction area while earthwork activities are underway. Although permanent changes to soil composition would occur, the construction area would be returned to pre-existing conditions with native vegetation, such that permanent adverse impacts are not realized. Thus, construction effects to soils are anticipated to be ***less than significant***.

EWN features, such as ecological armoring and marshes, are anticipated to have long-term beneficial impacts to soils as these habitats are known to reduce the loss of sediment transfer through erosion protection. Ecotone levees could improve soil quality by adding new areas of native vegetation that offer ecologically favorable conditions by improving nutrient transfer, oxygenating soils, moisture retention, offer refuge and forage space, as well as potentially increasing soil biodiversity. Additionally, native vegetation planted in ecotone levees should alleviate soil erosion and loss. This would have long-term beneficial impacts to soils.

4.10.6 Alternative G

Impacts to soils are expected to be the same as those described in the Geology section for Alternative G (Table 4-19).

Table 4-19. Summary of Soil and Mineral Resource Impacts associated with Alternative G

Alternative G Soil and Minerals Impact Rating by Measure	**Levee**	**Bridge raise**	**Bulkhead wall/Seawall**	**Roadway Impact**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint	2	2	2	2	2	1	2	2+	2+	2+	2+	2+
O&M Assumptions	1	1	1	1	1	1	1	1	2	2	2	2
Mitigated Rating	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*

Adverse impacts to soils for Alternative G range from no to low impact (Table 4-19). Earthwork (i.e., excavation, regrading, fill activities) associated with the construction of CFRM features would likely disturb, modify, and mix native soils as described in the construction impact summary above. Fill material was assumed to be commercially sourced, but has the potential to be beneficial use of dredged material. Overall, adverse impacts to soils are expected to be ***less than significant*** in Alternative G.

Adverse impacts to soils are anticipated to be synonymous with those to geologic resources and sediments; however, beneficial impacts to soils vary from those described for geology. EWN features are anticipated to have long-term beneficial impacts to soils similar to those described in Alternative F. Embankment and naturalized shorelines could improve soil quality thereby potentially increasing soil biodiversity. Additionally, planted vegetation should alleviate soil erosion and loss. Alternative G proposes the largest extent of EWN features, particularly in 2090 (Table 4-5), thus, offers the greatest beneficial effects to soil resources of all alternatives.

4.10.7 Independent Measures for Consideration

Adverse impacts from construction and operation of independent measures are expected to be equivalent to those described in the construction impact summary, as well as those in the TNBP, Alternative F, and G for respective measures (Table 4-20). As such, the impact rating was equivalent to that of the previously described alternative features where applicable. The impact of an independent measure alone would be much lower; however, as a contributor to the overall alternative, if added, it would have equivalent impacts to those measures described previously. Unique to the independent measures is the EWN vertical shoreline. Installation of the vertical shoreline is anticipated to have ***no impact*** on soil and mineral resources because panels would be installed from the water and would have no contact with soils.

Table 4-20. Summary of Soil and Mineral Impacts associated with the Independent Measures

Independent Measures Soil and Mineral Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	2+	2+	2+	1	2+	2+	1
O&M Assumptions	1	1	1	1	1	1	1
Mitigated Rating	*2*	*2*	*2*	*1*	*2*	*2*	*1*

No adverse impacts are anticipated from construction of the coarse beach for independent measure 2B; however, the seawall construction is likely to have low adverse impacts during installation. Planted levees in 3C are anticipated to have beneficial impacts to soils as the vegetation would help to reduce soil loss and erosion. Similarly, 4A is anticipated to have long-term beneficial impacts to soils by reducing loss through erosion protection.

4.10.8 Mitigation

The BMPs described in the Geology Mitigation section is also applicable to reduce impacts to soils in the study area.

4.11 Hydrology and Hydraulics

This section describes the adverse impacts expected to coastal hydrology, currents, circulation, tides, tidal exchange, and waves under the Action Alternatives.

Significance Criteria

Effects on hydrology (i.e., changes in inflow, changes in water surface profiles, and flow distribution, assessment of local and system-wide resultant impacts, upstream and downstream impacts, etc.) and geomorphic conditions may be considered significant if implementation of an alternative would:

- **HYD-01:** Substantial increase in the rate or amount of surface runoff in a manner that would result in flooding on or off site
- **HYD-02:** Significantly change flood stage elevations
- **HYD-03:** Substantially change the frequency and duration of inundation of lands
- **HYD-04:** Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam.

While this section addresses the significance of project-induced changes in flood risk, the significance of other types of water hydrology-related effects, both direct and indirect, is assessed in the sections of related resource areas (e.g., geological resources, water quality, fisheries, recreation, etc.). The CFRM features for any of the action alternatives are designed to reduce coastal flood risk in the study. Sustained flooding with a coastal storm event varies with the approach of each alternative, such that one the defends at the shoreline (Alternative F) should not experience flooding beyond the line of defense when construction is completed for the anticipated risk. Whereas an approach that recedes from the shoreline (Alternative G) should experience flooding inland flooding bayward of the line of defense as these areas are converted to open space and would likely transition to coastal habitats with increased flooding. The performance of alternatives is detailed in Appendix B, while the following sections focused on the impacts of construction to hydrology and hydraulics.

4.11.1 Construction Impact Summary

Temporary impacts to currents may result during construction of shore-based measures as this is located at the MHHW line, such as levees, and some EWN features such as marshes and ecological armoring. Localized, temporary impacts from the in-water measures such as bulkhead walls/seawalls, wharfs, and bay fill are also anticipated to adversely impact currents due to increased velocities at the toe of the structural measures, which may change wave energy in the bay. Wave energies could increase at the hardened structures which may increase tidal current velocities and lead to temporary indirect impacts from sedimentation or scour. The waterfront is highly urbanized at present; however, some new hardened structures may be introduced to protect against flood risks. Temporary impacts during construction include physical seabed disturbance that increase current velocities such as foundation installation, excavation, and fill activities.

CFRM measures installed in the bay below the high tide line would likely alter the bay shoreline permanently. Such an alteration could affect the movement of water in the bay due to altered circulation patterns, which could substantially change the bay floor adjacent to the new shoreline as a result of sediment scour. Sediment transport induced by waves and currents interacting with the new structures could alter the hydraulic forces exerted on the bay floor and shoreline, thereby inducing changes in scour and deposition.

Standard engineering hydrodynamic and wave modelling of tidal currents and wind waves would need to be conducted to analyze the proposed projects impacts associated with altered coastal hydraulics, which could occur from the proposed CFRM features. This type of model analysis could evaluate whether the project would include changes to currents and waves that could change the bay’s bed elevations, and if so, the amount of change in depth and extent that it could be expected.

4.11.2 Operations and Maintenance Impact Summary

Operational impacts involve long-term effects related to the proposed CFRM features, including EWN measures, to maintain the adequacy of performance against RSLC. Operations and maintenance activities could include inspections, repairs, and fill activities. Hardened structures would require regular inspection for natural wear and/or damage following coastal storm or seismic events. EWN features such as marshes, coarse beaches, and ecological armoring would require supplementation as sea levels rise over time. In the long-term this would offer benefits to coastal hydrology by dissipating wave energy, but would result in temporary, localized impacts to currents and hydrology during O&M activities. Maintenance for wharves would have temporary impacts to coastal hydrology through use of in-water construction equipment, similar to that described in construction impacts. However, these are expected to be far less impactful than those from construction because of the shorter duration.

4.11.3 Tentatively selected plan

Impacts to hydrology and hydraulics from the TNBP range from no to moderate to high (Table 4-21).

Table 4-21. Summary of Hydrology and Hydraulics Impacts associated with the TNBP

TNBP Hydrology and Hydraulics Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint (1st Action)	1	1	1	1	1	1	1	1	3	2+	1	2+	2+	1
Construction/Footprint (2nd Action)	4	1	4	1	1	1	1	1	3	2+	1	2+	2+	2+
O&M Assumptions	1	1	1	1	1	1	1	1	2	2+	1	1	1	2+
Mitigated Rating	*4*	*1*	*4*	*1*	*1*	*3*	*1*	*1*	*3*	*2*	*1*	*1*	*1*	*1*

Impacts from construction of the new seawall range from no to moderate to high depending on the year and location of construction. In 2040, the seawall is anticipated to be built landward of the existing seawall and thus would require no in-water work, nor cause any change to the existing hydrology, like in Alternative G. In 2090, the new seawall would be constructed bay ward of the existing seawall and require bay fill in the void between the two structures. These impacts are anticipated to be like those described in Alternative F. Overall, the TNBP would have lower adverse impacts in 2040 than Alternatives F and G (Table 4-4), but greater adverse impacts in 2090 than Alternatives F and G (Table 4-5), given the spatial extent of the new seawall.

Installation of a sheetpile wall is expected to have ***no impacts*** to coastal hydrology. A new sheetpile wall is proposed along the waterfront at Pier 96 in 2040 and would be constructed of steel/reinforced concrete that has a vertical interlocking system to create a continuous wall. Sheetpiles would be driven into the bay sediments using a vibratory hammer or impact hammer. Construction would occur in sections, installing one sheet pile after another to ensure each are interlocked and driven to the correct depth. In-water work is not anticipated for installation of the sheetpile wall. The new sheetpile wall would be built parallel to the existing approximately five feet bay ward. This is not expected to change the local or regional hydrology as the original hardened structure is being replaced with a similar feature across the same spatial extent.

4.11.4 Alternative B

Alternative B includes demolition of piers and buildings, dry and wet floodproofing of structures, and building relocation. Demolition, relocation, and floodproofing measures should have ***no impact*** on hydrology and hydraulics as all construction related activities would be shore-based and does not change the structure of the waterfront. However, demolition of piers could have a potentially significant impact to hydrology and hydraulics. Artificial structures, such as piers, affect local wave and current patterns by reducing current speeds and attenuating waves which deposits sediments in some areas, while scouring others. By removing these structures, current speeds and wave energies are no longer slowed, increasing the potential for erosion and sediment suspension (Cosentino-Manning et al. 2010). Detailed hydrodynamic modelling would be needed to determine how removing the piers would change the wave energy and sediment deposition in the bay. Overall, there is fairly minimal pier removal in Alternative B – Hyde Street Pier in 2040 and Pier 47 in 2115 – thus, impacts to hydrology and hydraulics are expected to be ***less than significant***.

No impact from O&M are expected for Alternative B. Details about the changes in flooding can be found in Appendix A and Appendix B.

4.11.5 Alternative F

Impacts to hydrology and hydraulics from Alternative F are scored in Table 4-22.

Table 4-22. Summary of Hydrology and Hydraulics Impacts associated with Alternative F

Alternative F Hydrology and Hydraulics Impact Rating by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	4	1	4	1	3	1	1	3	2+	1	2+
O&M Assumptions	1	1	2	1	2	1	1	2	2+	1	2+
Mitigated Rating	*4*	*1*	*4*	*1*	*2*	*1*	*1*	*3*	*1*	*1*	*1*

Impacts are expected to range from no impact to moderate to high for hydrology and hydraulics (Table 4-22). CFRM measures that are not expected to impact coastal hydrology are those shore-based features that should not require in-water work during construction and would not be adding hardened structures to the bay shoreline upon construction completion. Those include levees, t-walls, and vertical walls. Additionally, roadway impacts such as excavation, grading, and re-pavement are not anticipated to have any impact to hydrology. EWN ecotone levees are intended to be in upland habitats and constructed from shore, thus, would also have no impact to wave climate or currents.

EWN features ecological armoring would impact currents and hydrology temporarily during construction as in-water barges and/or cranes would be used to place the riprap or other stone along the shoreline. In the long-term, ecological armoring is anticipated to be beneficial for wave dissipation during tidal exchange and surge during coastal events. It is unclear how addition of ecological armoring could impact bay-wide current movement or wave refraction, though this is expected to be minor. Additionally, EWN marsh enhancement may have temporary, adverse impacts during construction if in-water work is performed. While the marsh is establishing, some sediment loss may occur contributing to increased sedimentation in the bay. In the long-term, marsh creation and/or enhancement is anticipated to have beneficial impacts by dissipating wave action in the bay. Construction and maintenance of these EWN features are expected to have ***less than significant*** impacts on bay hydraulics.

The construction of tide gates at the mouths of Islais and Mission Creeks is anticipated to have moderate impacts. Tide gates would require construction of deep foundations with cast-in-place techniques and installation of gates, such as sector and/or lift gates. Cofferdams would be used to dewater the construction site to facilitate the building process, and the heavy equipment used to construct the features would be staged on floating plants or barges outside of the cofferdam. This would temporarily disrupt tidal flows and could increase current velocities in and around the construction site. Construction would occur in sections as to minimize the overall impacts to waves and currents. Construction is expected to have adverse impacts to local hydraulics, this is believed to be ***less than significant***, though detailed hydrodynamic modelling would provide a better understanding of impacts to current velocities and wave climate in the bay.

Annual operations and maintenance of the tide gates are anticipated to be low overall. When the tide gates are in the open position, potential long-term direct impacts from decreasing current velocities could occur. The number of gates would be designed to mimic existing tidal flow as closely as possible. When the gates are in the closed position, temporary impacts to tidal currents are anticipated due to decreasing current velocities; however, permanent changes to the hydrodynamics and water flow of the bay are not expected. Hydrodynamic modelling simulating tidal gate operation would be needed to determine the extent of these impacts, though they are anticipated to be ***less than significant***.

Construction of a new seawall is anticipated to have moderate to high impacts to coastal hydrology. The new seawall would be constructed bay ward of the existing seawall and bay fill would be placed in the void between the two structures. In-water activities to construct the new seawall may include but are not limited to stationary barges for staging equipment and/or machinery, and pile driving. Use of in-water equipment would temporarily alter currents and wave energies as described above in the construction impact summary. Although a hardened structure already exists where the new seawall is planned for construction, extending into the bay may have long-term permanent changes to the overall current flow and pattern in and around the new shoreline. This impact could be ***significant and unavoidable***, though hydrodynamic modelling would be needed to determine if the new seawall installation would have direct, long-term impacts to bay wide current velocities and wave action.

Alternative F is proposed to replace wharf in limited locations along the waterfront in 2040 and 2090 (Table 4-4 and Table 4-5, respectively), which is anticipated to have moderate impacts to waves and currents. Pile driving of new steel or corrosion resistant piles would have temporary, localized impacts to coastal hydrology as previously described. In the long-term, the new wharf could change current and wave patterns near the shoreline resulting in sediment scouring and/or erosion, as well as altering current velocities. Hydrodynamic modelling would be needed to determine the extent of this impact on coastal hydrology, though it is anticipated to be ***less than significant*** overall.

4.11.6 Alternative G

Impacts to hydrology and hydraulics from Alternative G are scored in Table 4-23.

Table 4-23. Summary of Hydrology and Hydraulics Impacts associated with Alternative G

Alternative G Hydrology and Hydraulics Impact Rating by Measure	**Levee**	**Bridge raise**	**Bulkhead wall/Seawall**	**Roadway Impact**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint	1	1	1	1	1	1	3	2+	1	2+	2+	2+
O&M Assumptions	1	1	1	1	1	1	2	2+	1	1	1	2+
Mitigated Rating	*1*	*1*	*1*	*1*	*1*	*1*	*3*	*1*	*1*	*1*	*1*	*1*

Construction impacts range from none to moderate, with wharf being the only structure anticipated to have greater impacts during construction and potentially lead to long-term changes in currents and wave patterns. All measures expected to have ***no impact*** are constructed using shore-based techniques and do not change the hardened surfaces along the shoreline, thus would not alter coastal hydrology. EWN features that are constructed landward of the tidal zone to provide transition zone habitat from terrestrial to tidal wetland ecosystems, such as ecotone levees would also have ***no impact*** to waves and currents.

The other EWN features proposed in Alternative G include ecological armoring, embankment and naturalized shorelines, and marsh enhancement. Construction of these features is intended to be shore-based, thus would not impact hydraulics directly. The proposed alignment would construct planted levees inland along the Mission Creek area and would demolish all buildings that exist bay ward of the line of defense. The new open space would be returned to nature. The new shoreline alignment would alter coastal hydraulics and could substantially alter the bay floor adjacent to the new shoreline due to changes in scour, sedimentation, and sediment supply. Sediment transport induced by waves and currents interacting with the new shoreline features could alter hydraulic forces exerted on the bay floor and shoreline, thereby inducing changes in scour and sediment deposition. SLR would increase the water depth along the entire shoreline which has the potential to exacerbate the effects of altered coastal hydraulics, though this is expected to be reduced with the design of EWN features. Significant impacts could occur if altered erosion, scour, or depositional patterns increase suspended sediment or sediment transport leading to degraded water quality. Impacts could also be significant if the proposed project substantially changed erosion, scour, or sediment deposition to the degree that foundations or other shoreline features at or adjacent to the project area are compromised, undermined, or degraded to an extent that causes additional hydrologic or water quality impacts. To determine the significance of impacts from the altered bay shoreline, hydrodynamic and wave modelling would need to occur. In the long-term, these EWN features would change the structure and function of the shoreline, particularly in 2090, offering wave dissipation benefits. Additionally, they offer naturalized shorelines as opposed to hardened shorelines while providing protection against coastal hazards. The true is same for the O&M of these features as they would likely require augmentation to adapt to rising sea levels. Overall, the impacts from EWN features are expected to be beneficial and ***less than significant*** to coastal hydrology.

Wharves would have similar impacts as those described in Alternative F, but construct more than double the acreage, and thus is anticipated to have greater impacts. Short-term impacts are likely to be the same as Alternative F, but there is uncertainty about the potential long-term impacts that could occur by permanently alternating waves and currents. As with Alternative F, hydrodynamic modelling would be needed to determine the extent of change to hydraulics and whether that would cause significant adverse impacts. However, given wharf structures already exist in the area and would be replaced, it is assumed construction and long-term impacts would be ***less than significant*** to hydrology and hydraulics.

Overall, Alternative G is anticipated to have the least adverse and most beneficial impacts to hydrology and hydraulics.

4.11.7 Independent Measures for Consideration

Impacts to hydrology and hydraulics from independent measures range from no to moderate to high impacts (Table 4-24).

Table 4-24. Summary of Hydrology and Hydraulics Impacts associated with Independent Measures

Independent Measures Hydrology and Hydraulics Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	4	4+	3	1	1	1+	3
O&M Assumptions	2	2	2	1	1	1	1
Mitigated Rating	*3*	*3*	*3*	*1*	*1*	*1*	*3*

Independent measures 3B, 3C, and 4A are anticipated to have no impacts to coastal hydrology as they would not be adding hardened structures to the shoreline nor using in-water work activities that would temporarily or permanently change waves and currents. Measure 4A is expected to have long-term beneficial impacts to hydraulics as the EWN feature would offer wave dissipation.

Measures 3A and the EWN vertical shoreline are anticipated to have moderate impacts. Adverse impacts would occur during construction of wharf in 3A, which may also have long-term impacts by changing current velocities and wave patterns in the bay. Hydrodynamic modelling would be needed to assess these impacts and long-term changes. Overall, as previously described, these impacts are anticipated to be ***less than significant*.**

Increased surface roughness of EWN vertical shorelines could mitigate extreme wave overtopping hazards by dissipating wave energy; however, this is largely driven by length and density of surface protrusions (Salauddin et al. 2021). Hydrodynamic modelling could be used to assess the level to which wave energy is dissipated, as well as how that impacts currents and wave refraction throughout the bay. It is unclear if a textured seawall would cause erosion at other areas of the bay through wave refraction or scouring at the base of the seawall. In the short-term, installation of vertical shorelines is anticipated to have moderate impacts to waves and currents as cofferdams would be installed in sections to install pre-cast panels onto the new or existing seawall surface. Similar to that described in Alternative F, cofferdams would temporarily alter hydrologic patterns and could intensify current velocity near and around the construction site.

Measures 2A and 2B include bay fill and construction of seawall that would have moderate to high impacts during construction, as well as likely permanent changes to bay hydrology, as described previously. Both measures are expected to have ***significant and unavoidable*** impacts to bay hydrology. Construction of the coarse beach in 2B would require some in-water work activities, including work barges to stage equipment or transport material for placement, as well as heavy equipment that would be needed to move and grade material. These impacts are expected to be localized and temporary but would alter coastal hydrology in the construction area. Construction impacts are expected to be ***significant and unavoidable***. Upon construction completion, coarse beaches are anticipated to have beneficial impacts on coastal hydrology by attenuating wave energies during tidal exchange and coastal surge. The coarse beach would require augmentation to be adapted to SLR, which would use similar techniques as those during construction, but would likely take less time. Maintenance activities are anticipated to have low impacts and be ***less than significant***.

4.11.8 Mitigation

To reduce overall impacts of in-water construction activities, BMPs described in Geology and Water Quality would be used.

4.12 Water Quality

This section describes the adverse and beneficial impacts expected to water quality in the study area, including surface water and stormwater runoff.

Significance Criteria

The alternative could pose a significant impact to water quality if implementation of an alternative would result in any of the following conditions:

- **WQL-01:** Violate any water quality standards or otherwise substantially degrade water quality to the detriment of beneficial uses;
- **WQL-02:** Provide substantial additional sources of polluted runoff; or
- **WQL-03:** Require or result in construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects.

4.12.1 Construction Impact Summary

Construction related impacts to water quality are separated by shore-based and in-water activities.

4.12.1.1 Shored-based Activities

Direct and indirect construction-related impacts on surface water hydrology and water quality could occur during shore-based construction activities. Shore-based construction activities include levees, bridge raising, vertical walls, t-walls, deployable flood gates, roadway improvements/impacts, and some EWN features. Shore-based construction could result in water quality related impacts such as during grading and excavation; demolition of existing structures; construction of access roads; placement of rock revetments along levees; and construction of stormwater conveyance and discharge infrastructure. Localized and temporary impacts to water quality include reduction of water clarity; change in color; and release of organic material with varying quantities of ammonia, nitrogen, and phosphorous, which could stimulate growth of algae and other aquatic plants. The factors responsible include, but are not limited to, increased turbidity, increased suspended sediments, and organic enrichment, chemical leaching, reduced dissolved oxygen, and elevated carbon dioxide levels.

Moderate temporary impacts to turbidity could result during construction of shore-based measures during land disturbing activities such as foundation installation, excavation, and fill activities. Dust and sediments could become airborne with wind and transported to surface waters, which become dispersed in the water column resulting in increased turbidity and reduced water clarity. Likewise, temporary minor impacts to DO may result from shore-based construction that cause increased turbidity and sediment suspension. No impacts to salinity are anticipated during the construction of shore-based measures.

During construction, stormwater runoff and associated discharges have the potential to exceed water quality criteria or waste discharge requirements, including National Pollutant Discharge Elimination System (NPDES) permit effluent limitations. A NPDES permit would be required because more than 1 acre of surface disturbance would occur. Any discharges of shallow groundwater produced during excavation dewatering could also exceed these criteria. Stormwater runoff from disturbed soils associated with construction activities is a common source of pollutant to receiving waters. Earthwork can render soils and sediments more susceptible to erosion from stormwater runoff, causing it to migrate to storm drains and downgradient water bodies such as the bay. It is likely project construction would involve using materials such as paint, solvents, oil and grease, petroleum products, concrete, and corrosion resistance coating, which if not handled properly, could be mobilized, and transported offsite by stormwater runoff thereby degrading water quality of receiving bay waters.

Any such impacts would be minimized and controlled by using BMPs, such as those described in the Geology Mitigation section and mitigation section below, as well as a site-specific SWPPP. Following shore-based construction, degraded water quality conditions would be expected to return to baseline conditions.

4.12.1.2 In-water Activities

Any work along the San Francisco Bay shoreline below the high tide line is considered in-water construction. In-water construction activities would include the use of equipment such as support barges, small support vessels, and vibratory or impact hammers for installation of sheet pile walls and support piles. In-water construction have the potential to exceed water quality criteria or waste discharge requirements, including water quality standards and NPDES permit effluent limitations.

Support vessels could be used as work platforms during construction, for staging equipment and construction supplies, and refueling. As such, support vessels would require anchoring to the bay floor, which disturbs the seabed and increases turbidity.

To varying extents, historic creosote wood piles that currently support existing wharf structures would be removed from the bay and discarded. Historic pilings are typically constructed of wood that has been treated with creosote and encased in concrete, which is no longer permitted for structures in the bay because of its toxicity to marine organisms. Creosote-treated pilings would be replaced with non-toxic materials such as steel, concrete, or corrosion resistant composite materials, which would result in a long-term improvement in water quality. However, temporary adverse impacts would occur during pile removal through resuspension of sediments and potential debris released during removal efforts. Wood piles would be removed in a manner that minimizes and avoids impacts to water quality of the receiving water.

Temporary impacts to salinity would be expected during in-water construction measures, which may occur if there is a physical barrier in the water that prevents full tidal exchange (e.g., cofferdam).

In-water construction activities would result in disturbance of localized bay sediments, which could contain legacy chemical contamination. Disturbance of these sediments could temporarily increase turbidity and resuspend these contaminants in bay waters. In-water construction activities would involve the use of diesel-fueled construction equipment, and potentially require the use of petroleum-based oils and lubricants, as well as application of anti-corrosion coatings to steel sheetpiles, by which accidental spills could introduce these into the bay. Several CFRM measures require placement of fresh cement, which if released or accidentally spilled into the bay would degrade water quality resulting in potentially significant impacts.

To protect overall water quality during construction, BMPs such as those described in the Geology Mitigation section and the mitigation section below, as well as a site-specific SWPPP would be used.

4.12.2 Operations and Maintenance Impact Summary

Operations and maintenance activities would include inspections, damage repair, and reapplication of corrosion resistant coatings to steel sheetpile walls. Deployable flood gates would be inspected annually for visible damage or misuse and repaired as needed. Corrosion resistant coating would be applied to sheetpiles by hand to localized areas where needed using brushes or paint sprayers. Maintenance activities would be required to adhere to the same BMPs and SWPPP as construction activities; however, accidental spills could occur. If hazardous material is released into the bay, they would degrade water quality and potentially have a significant impact. Using the BMPs described in the Mitigation section would reduce the overall impacts to ***less than significant*** if a spill were to occur with mitigation.

4.12.3 Tentatively selected plan

Impacts to water quality from the Total Net Benefits Plan are scored in Table 4-25.

Table 4-25. Summary of Water Quality Impacts associated with the TNBP

TNBP Water Quality Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint (1st Action)	1	2	4	2	4	3	2	2	4+	2	2	2+	2+	1
Construction/Footprint (2nd Action)	4	2	4	1	4	1	2	1	4+	2	2	2+	2+	2+
O&M Assumptions	1	2	3	2	1	1	2	2	3	2	2	2+	2+	2+
Mitigated Rating	*4*	*2*	*3*	*2*	*3*	*3*	*2*	*2*	*3*	*1*	*2*	*1*	*1*	*1*

The adverse impacts to water quality are expected to range from no to moderate to high. Low impacts are anticipated for construction shore-based measures such as levees, flood gates, t-walls, and EWN features. These impacts would be equivalent to those discussed in the shore-based construction impact summary and overall are expected to be ***less than significant***.

As with Alternative F and G, wharf, seawall, and roadway construction are anticipated to have moderate to high impacts to water quality in the TNBP. These impacts would be realized in 2040 and 2090 for the TNBP as additional seawall, roadway, and wharf construction were undertaken. In 2040, the TNBP would be expected to have less impact from seawall construction as compared to Alternative F and G (Table 4-4), but far greater impacts in 2090 (Table 4-5). Similarly, the impacts from roadway construction would be less for the TNBP in 2040 than Alternative F and G (Table 4-4). However, by 2090, impacts would be greater in the TNBP than Alternative F and comparable to that of Alternative G (Table 4-5). Overall, the TNBP would have the greatest adverse and beneficial impacts from wharf replacement in 2040 (Table 4-4) and 2090 (Table 4-5) as compared to the other alternatives. Impacts from wharf construction would be ***significant and unavoidable*** to water quality.

Sheetpile walls are anticipated to have moderate adverse impacts to water quality during construction, and low impacts during maintenance activities (see Operations and Maintenance Impact Summary). Sheetpile walls would be installed as described in the Hydrology and Hydraulics section. Construction would include shore-based and in-water activities like those described in the construction impact summary, which could result in the impacts discussed therein. If installed, steel sheetpile walls would be susceptible to corrosion if in contact with saltwater like in reach 4. Corrosion resistant coating would be applied after installation and during routine maintenance as needed. However, corrosion is one of the most common problems amongst iron and steel, thus, it is plausible for steel sheetpiles to undergo corrosion. If gone untreated, corrosion can cause the wall to deteriorate (Royani et al. 2019). Corrosion could impair water quality by introducing metal particulates (e.g., lead, iron, zinc) and discoloring the water (CEWA 2023). Release of metal particulates could become a significant water quality issue if not properly remediated. A site-specific pollution prevention plan would be developed prior to construction to reduce the likelihood of spills and contamination occurring, as well as instilling BMPs (as described in Geology and Water Quality mitigation sections).

Water isolated within sheetpile walls have the potential to contain elevated concentrations of suspended sediment resulting from ground disturbance within the isolated construction area and presents the potential for fine-grained Young Bay Mud sediments to become mobilized and remain suspended in water for extended periods of time (days to weeks). The direct discharge of such waters into San Francisco Bay or the storm drain system could result in localized increases in suspended sediment and turbidity that persists. Mitigation measures could be used to reduce the potential impact on water quality to less than significant by requiring implementation of monitoring and standard BMPs to remove sediment from the discharge. With implementation of mitigation measures, adverse impacts to water quality from construction and maintenance of sheetpile walls would be ***less than significant with mitigation***.

4.12.4 Alternative B

Alternative B relies on demolition, relocation, and floodproofing infrastructure at risk of flooding implemented in four-time steps commensurate with the trajectory of SLR inundation levels that would trigger the need for protective measures. Demolition and removal would require the use of heavy machinery including backhoes, cranes, wrecking balls, large trucks, etc. Relocating buildings would require storage of infrastructure while a new site was prepared, which may include grading, excavating, and constructing new foundations. Alternative B is anticipated to only include shore-based activities; thus, the impacts would be similar to those described in the construction impact summary. With the use of Water Quality BMP's, impacts from Alternative B are anticipated to be ***less than significant***.

4.12.5 Alternative F

The impacts to water quality from Alternative F range from no to moderate to high, with in-water activities expected to have more adverse impacts (Table 4-26). The greatest adverse impacts are expected to be associated with construction of new seawall, tide gates, wharves, filling the bay, and roadway improvements. Shore-based measures are expected to have low impacts and would be the same as those described in the construction impact summary above.

Table 4-26. Summary of Water Quality Impacts associated with Alternative F

Alternative F Water Quality Impact Rating by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	4	2	4	4	4	2	2	4+	2	2	2+
O&M Assumptions	1	2	2	1	2	1	1	2	2	2	2+
Mitigated Rating	*4*	*2*	*3*	*3*	*2*	*2*	*2*	*3*	*1*	*2*	*1*

As previously described, historic creosote wood pilings would be removed prior to construction of the new wharf, which would have temporary adverse impacts during removal but long-term beneficial impacts to water quality. Wood pilings would be replaced with steel, concrete, or corrosion resistant composite materials which requires pile driving. As described above, installation of piles can increase local turbidity, suspend sediments, and potentially release contaminants from sediments. Additionally, existing concrete deck and surfacing (concrete or asphalt) would need to be demolished, hauled offsite, and disposed of. This is likely to be accomplished using shore-based and in-water construction activities. In-water construction activities are likely to consist of support vessels and work barges, both of which have the potential to increase turbidity and sediment suspension while anchored or in operation. Demolition activities have the potential to release debris into the bay. Impacts of debris removal would be minimized with a debris prevention and removal plan. A new reinforced concrete deck would be constructed on the wharf pilings of pre-cast elements or using cast-in-place construction over the water. During either construction methods, there is potential for debris and release of contaminating materials (e.g., fuel, concrete) as described in the in-water and shore-based construction impact summaries above. A release of construction materials into the bay could pose a significant impact to water quality if not effectively and efficiently treated. The BMP's specified in the Geology and Water Quality mitigation sections would be followed to reduce the likelihood of contamination, as well as a site-specific SWPPP. However, given the extent of wharf that would be replaced in 2040 (Table 4-4) and 2090 (Table 4-5), the impacts from constructing these structures is anticipated to be ***significant and unavoidable***.

A new seawall is proposed to be constructed bay ward of the existing seawall to raise the elevation of the waterfront, as described in the Hydrology and Hydraulics section with pile driving and in-water work equipment. Piles would be driven in the wet with a pile driver likely operating from a floating work barge and would include other in-water construction activities as described above. Any structure driven into the bay sediment could cause a release of buried contaminants that would be released into the Bay, which could violate water quality standards and degrade water quality. A plan for removing any contaminants prior to discharge would be required before construction began. Additionally, Young Bay Mud sediments could become mobilized and suspended in the water column during pile driving, increasing turbidity in the construction area. The extent of this turbidity would be maintained using BMP's, such as turbidity curtains, to reduce the spread of suspended sediments. However, the isolated work area would likely remain turbid for extended periods of time (days) while the pile driving is undertaken.

Following piles, wooden casts would be built using the cast-in-place techniques described previously to fill with cement for construction of the new seawall. Water that is within the casts would need to be dewatered and effluent discharged appropriately. The dewatered effluent could contain pollutants (e.g., sediment, residual petroleum hydrocarbons, heavy metals) that would need to be removed before discharge to avoid potential water quality impacts. Dewatering could result in a significant impact if contaminated effluent were not managed properly and released untreated into surface waters. Such a release would violate water quality standards and degrade the quality of receiving waters. Prior to discharge, effluent would need to be sampled and analyzed for pollutants by a qualifying lab to determine if all water quality constituent parameters are below acceptable discharge limits. If determined suitable, effluent could be discharged directly into the Bay, or stormwater, industrial, or sanitary systems.

During effluent discharge, construction of the casts, and pile driving, receiving waters would result in increased turbidity and resuspended sediments, temporarily degrading water quality in the Bay. The extent of increased turbidity would primarily depend on the potential for dispersion and dilution by tidal effects or water circulating currents, composition of the sediments, and duration of operations. Dewatering could temporarily lower dissolved oxygen, reduce light, and increase temperatures of receiving waters. A SWPPP would be in place during construction to help with spill prevention, as well as provide guidance on cleanup if an accidental spill were to occur. Given the linear extent of new seawall that would be constructed, the impacts to water quality are anticipated to be ***significant and unavoidable***.

Placement of fill in the bay would be required to be uncontaminated and suitable for use for in-bay fill. For this analysis, it was assumed the fill would be sourced commercially; however, dredged material could be used during construction if determined suitable. In Alternative F, the intent is to construct the new seawall bay ward of the existing and then fill the void between the two structures. To do this, the area between the structures would need to be dewatered prior to placing in-bay fill. Water would be extracted at the construction site using pumps on floating barges or on land and the effluent would be discharged appropriately following testing (e.g., Bay, treatment plant). Impacts of discharging effluent are expected to be similar to those described for seawall construction, but on a larger scale. Once the area is de-watered, the void would be filled. BMP's as described in the mitigation section would be used to reduce impacts to water quality; however, in Alternative F, in-bay fill would result in a loss of 25 acres of open water and discharge of dewatered effluent, thus, impacts are ***significant and unavoidable***.

Updates to roadways would be required in Alternative F with the elevation increase, construction of CFRM features, and seismic ground improvements. The majority of roadway impacts in 2040 are expected in Reaches 1 and 2 along the Embarcadero, while impacts in Reaches 3 and 4 would be realized in 2090. To construct CFRM features and seismic ground improvements, any existing paved roadways, walkways, sidewalks, track lines, and paths within the construction area would need to be demolished to place earthen fill material to raise ground elevation. Once fill is placed, the new surface would be regraded and repaved with asphalt, concrete hardscape, and landscaped surfaces. Any track work removed would need to be replaced and updated. Concerns for impacts to water quality during roadway construction are the same as those described for shore-based activities above.

Stormwater, sewer, and inland drainage systems are currently located throughout the study area, including below tracks and roadways. Additionally, combined sewer outfalls are located along the waterfront throughout all four reaches. Construction of the new roadways and seawall would require construction of new stormwater drainage facilities, as well as an expansion of existing facilities to maintain changes in water flows and reconfiguration of the waterfront. An analysis conducted by the SFPUC estimated that three new pumps should be added between reaches 1 and 2 in 2040 to account for increased flood risk and to reduce impedance of flow of interior drainage, as well as new flap gates added on existing combined sewer outflows. In reaches 3 and 4, new flap gates would be added onto existing combined sewer outflows also, as well as two box culverts with backflow prevention added in reach 4. Maps and additional details for new drainage infrastructure can be found in the Appendix B. During roadway construction, existing drainage systems would temporarily be disturbed and rerouted, which may result in additional water accumulation after heavy rains and inland drainage to enter the construction site requiring dewatering and redistribution of water. Similar to dewatering impacts described above, this has the ability to introduce contamination from the construction site or upland areas to receiving waters. Additionally, this would increase turbidity and suspended sediments in receiving water, as well as could lower dissolved oxygen levels, increase nutrient input, and lower salinity directly in the discharge areas. A SWPPP and BMP’s would be used to help reduce these impacts; however, it was assumed the change to inland drainage facilities would have a ***significant and unavoidable*** impact to water quality during construction.

Tide gates would be constructed as described in the Hydrology and Hydraulics section requiring installation of new underwater foundations and gate systems, which would be completed in dry conditions by building cofferdams. Similar to impacts described for construction of the new seawall, tide gates are expected to have moderate to high adverse impacts to water quality during installation. Operations and maintenance of the tide gates are expected to have low impacts overall. Tide gates are anticipated to undergo annual maintenance testing to ensure sufficient operation. This is expected to occur at low tide and may temporarily cause turbidity, resuspension of sediments, and changes in salinity. Long-term, tide gates could influence water quality conditions by reducing tidal exchange and water connectivity that may have cascading effects including but not limited to lower dissolved oxygen, high nutrient concentrations, and intensified algal blooms (Chen and Orton 2023; Zhao et al. 2020; Choudri et al. 2015; Paalvast and van der Velde 2014). A recent study suggested gate closures coupled with low stream flows temporarily lead to salt intrusion and stratification in the Hudson River, by which recovery to normal conditions was highly dependent on duration, flow velocity, and estuary length (Chen and Orton 2023). Moreover, increased frequency of closures (monthly) did not afford recovery to normal estuary conditions under low stream flow scenarios which could lead to measurable permanent changes to physical conditions in the estuary (Chen and Orton 2023). As with this study, hydrodynamic modelling would be undertaken in PED to determine the anticipated impacts to water quality for tide gate operations to limit permanent impacts to estuary conditions. Given the uncertainties in tide gate construction, design, and operation, this measure is anticipated to have ***significant and unavoidable*** impacts to water quality.

All shore-based CFRM features and EWN measures are anticipated to have low impacts during construction, as described in the shore-based construction impact summary above, and thus are anticipated to be ***less than significant***. The use of BMP's described in the mitigation section would help reduce impacts to water quality during construction and maintenance.

4.12.6 Alternative G

Impact scores for water quality are summarized for Alternative G (Table 4-27).

Table 4-27. Summary of Water Quality Impacts associated with Alternative G

Alternative G Water Quality Impact Rating by Measure	Levee	Bridge raise	Bulkhead wall/Seawall	Roadway Impact	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint	2	2	3	4	2	2	4+	2	2	2+	2+	2+
O&M Assumptions	2	2	2	1	1	1	2	2	2	2+	2+	2+
Mitigated Rating	*2*	*2*	*3*	*3*	*2*	*2*	*3*	*1*	*2*	*1*	*1*	*1*

Impacts to water quality would range from low to moderate to high, with shore-based activities contributing the lowest impacts and wharf, seawall, and road construction causing the highest. The potential adverse impacts for shore-based construction of CFRM measures was described above in the construction impact summary, and thus, is applicable to Alternative G. Additionally, wharf impacts as described in Alternative F are applicable to this alternative as well. These impacts, both beneficial and adverse, are expected to be greater as compared to Alternative F as more wharf is proposed for construction (Table 4-4). As with Alternative F, the impacts to water quality are anticipated to be ***significant and unavoidable.***

Updates to roadways and interior drainage systems would also be required in Alternative G. An analysis conducted by the SFPUC estimated that three new pumps should be added between reaches 1 and 2 in 2040 and another seven pumps between reaches 3 and 4. New flap gates would be added to existing combined sewer outfalls in all four reaches. Two circular culverts with backflow prevention would be added in reach 3, while two box culverts with backflow prevent would be added in reach 4. Maps and additional details for new drainage infrastructure can be found in Appendix B. As described in Alternative F, impacts to water quality from the construction disturbance to interior drainage systems with new roadways would be ***significant and unavoidable***.

Seawall construction is expected to have moderate impacts to water quality during construction. The new seawall in Alternative G is proposed to be constructed landward of the existing seawall, thus is not anticipated to require any in-bay fill. However, similar techniques as Alternative F are expected to be used from shore, including driving piles and using cast-in-place techniques. Dewatering is expected to occur for installation of the new seawall as groundwater tables are disturbed. Additionally, interior drainage would need to be modified during construction as previously described. Dewatering involves extracting excess water from the construction area and then discharging effluent onto land, nearby storm drains, sanitary sewer systems, temporary storage tanks, or released back into receiving waters such as the Bay depending on the suitability of effluent. BMPs described in the Mitigation section would be followed to limit impacts to water quality to the greatest extent practicable, thus construction of the new seawall in Alternative G is anticipated to be ***less than significant with mitigation***.

EWN measures such as marsh enhancement, naturalized and embankment shorelines, and ecotone levees would have low impacts during construction and O&M activities similar to those described in the shore-based construction methods. O&M would include augmentation of EWN features to adapt to raising sea levels. In the long-term, EWN measures would offer beneficial impacts to water quality by minimizing or eliminating runoff, particularly with contaminated waters, stabilizing the shoreline, and reducing erosion. Aquatic vegetation in the marsh helps to purify water quality by reducing excessive nutrients and aerating surrounding water with oxygen (Audubon n.d.). Overall, the beneficial impacts of EWN features far outweighs the adverse impacts of construction and maintenance, and would be ***less than significant***.

Alternative G would have the least negative effects to water quality and the greatest beneficial effects.

4.12.7 Independent Measures for Consideration

The impacts to water quality for the construction of independent measures were anticipated to range from low to moderate to high (Table 4-28).

Table 4-28. Summary of Water Quality Impacts associated with the Independent Measures

Independent Measures Water Quality Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	4+	4	4+	2	2	2+	4+
O&M Assumptions	2	2	2	1	2	2	2
Mitigated Rating	*3*	*2*	*3*	*2*	*2*	*1*	*3*

Independent measures 2A and 2B require in-bay fill, in which impacts are expected to be similar to those described in Alternative F on a smaller scale (Table 4-6). Additionally, these independent measures include the additional of new seawall similar to that described in Alternative F. Independent Measure 2A includes rebuilt wharf that would have adverse impacts during construction but would offer long-term beneficial impacts to water quality with the removal of creosote pilings. A coarse beach would be constructed over the bay fill in Independent Measure 2B which would likely employ shore-based and in-water construction techniques as described in the construction impact summary above. As such, impacts would be similar to those described in the construction impact summary. In the long-term, coarse beaches have minor benefits to water quality by reducing turbidity through enhancing sedimentation at the feature. Adverse impacts from construction are anticipated to be temporary and localized to the construction area; however, addition of in-bay fill is a permanent impact to water quality by removing open water. Thus, construction of Independent Measures 2A and 2B are anticipated to be ***significant and unavoidable***.

Similarly, Independent Measure 3A would construct new seawall and replace wharf that would have the same impacts as those described in Alternative G (seawall) and Alternative F (wharf). Thus, it is anticipated to have ***significant and unavoidable*** impacts to water quality for the reasons discussed therein.

Independent Measures 3B, 3C, and 4A would all utilize shore-based construction techniques as described above in the construction impact summary. Additionally, 3C and 4A incorporate EWN features that could help to improve water quality with sediment retention, improved oxygen with vegetation, and nutrient cycling. Construction of these features are assumed to have low impacts and would overall be ***less than significant***.

It was assumed dewatering, as described above in Alternative F and G, would be required to install textured panels onto the existing, or new, seawall. Approximately

12,100 linear ft of shoreline could accommodate a living seawall. It was assumed pre-cast textured panels would be installed with steel bolts using pneumatic tools in 50 ft sections. The impacts are expected to be similar to those as described in Alternative F for the construction of a new seawall, thus, would be expected to be ***significant and unavoidable***. In the long-term, a living seawall could provide beneficial impacts by improving water quality through recruitment of bivalves. Bivalves can alter adverse water quality conditions by filtering algae and removing an overload of nutrients (Featherstone 2011; Kreeger et al. 2018).

4.12.8 Mitigation

In order to avoid and/or minimize potential impacts to waters of the U.S. and state, water quality, and biological resources, the following minimum construction BMPs would be implemented as part of the proposed project. These minimum measures would be subject to modification and additions based upon regulatory and resource agency review.

Unless otherwise specified in the project biological opinion, in-water construction activities shall be restricted to the NOAA approved environmental work window (June 1 to November 30).

No debris, trash, creosote-treated wood, soil, silt, cement, concrete, or washings thereof, or other construction-related materials or wastes, oil, or petroleum products shall be placed in a location where it would be subject to erosion by rain, wind, or waves and allowed to enter jurisdictional waters, including as a result of fueling activities and storage of hazardous materials.

No fresh concrete or concrete washings shall enter into jurisdictional waters. Fresh concrete would be isolated until it no longer poses a threat to water quality using appropriate measures, including exclusion of poured concrete from jurisdictional waters, such as open San Francisco Bay waters. Contractor(s) shall use only designated concrete transit vehicle cleanout stations for cleanout.

Protective measures shall be utilized to prevent accidental discharges to waters during fueling, cleaning, and maintenance.

Floating booms shall be used to contain debris discharged into waters and any debris shall be removed as soon as possible, no later than the end of each workday.

Machinery or construction materials not essential for project improvements shall not be allowed at any time in the intertidal zone. The construction contractor shall be responsible for checking daily tide and current reports.

Well-maintained equipment shall be used.

A spill prevention contingency plan for hazardous waste spills into San Francisco Bay shall be prepared for review and approval. The plan shall include, at a minimum, floating booms, and absorbent materials to recover hazardous wastes.

Contractors shall prepare an anchoring plan that applies to all ships, barges, and other open water vessels and describes procedures for deploying, using, and recovering anchorages.

BMPs for construction water-handling procedures and requirements for dewatering discharges in the study area include:

Dischargers shall not violate any discharge prohibitions contained in applicable Basin Plans or statewide water quality control panels.

The discharge does not cause or contribute to a violation of any water quality standard.

The discharge is not prohibited by the applicable Basin Plan.

The discharger has included and implemented specific BMPs required by their permit to prevent or reduce the contact of the non-stormwater discharge with construction materials or equipment.

The discharge does not contain toxic constituents in toxic amounts or (other) significant quantities of pollutants.

The discharge is monitored and meets the applicable numeric action levels.

4.13 Groundwater

As relative sea levels rise within San Francisco Bay, the groundwater table would be expected to rise, intersecting with buried infrastructure first and eventually emerging to the surface impacting drainage, infrastructure, and operations. In the absence of groundwater-specific flood risk reduction measures, rising groundwater would impact the feasibility of the flood protection alternatives in protecting landward areas from flooding and drainage challenges.

There is not sufficient engineering and design detail to evaluate how the CFRM measures may alter or influence the inland groundwater table, thus, detailed groundwater analyses would occur during PED. Thus, this section qualitatively describes the adverse and beneficial impacts expected to groundwater in the study area during construction and maintenance of the alternative measures.

Additional details on an assessment of groundwater in the study area can be found in Appendix B.

Significance Criteria

The alternative could pose a significant impact to groundwater if implementation of an alternative would result in any of the following conditions:

GW-01: Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin;

GW-02: Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan;

GW-03: Adversely alter the rate or direction of flow groundwater.

4.13.1 Construction Impact Summary

The groundwater closest to the surface and most relevant to implementation of the proposed project is shallow groundwater (i.e., water table, shallow aquifer). Potential impacts to shallow groundwater could result from activities associated with construction and operation of the alternatives. Construction-related impacts could occur during excavation, grading or trenching that could expose soils and shallow groundwater; placement of fill materials into waterways; shore-based dewatering operations; concrete pouring and washout activities; seismic ground improvements; or the storing and use of chemicals, fuels, and lubricants. Constructing CFRM measures along the shoreline would change the three-dimensional characteristics of flow and may require infrastructure or design features to manage inland water, of which, would be refined and determined in PED.

Construction of barriers, grouting, and compaction aimed to lower liquefaction potential (seismic improvements) would reduce permeability and potentially porosity, which could lead to higher shallow groundwater tables. The level of change would be highly dependent on the specific conditions at the construction site and the mechanisms proposed for improving soils to withstand seismic loading. Conversely, if the groundwater table is already high and requires dewatering, the reduced porosity and permeability could reduce the connectivity of coastal groundwater to San Francisco Bay and allow for more efficient dewatering and less capture of the Bay water. Quantitative modeling would be required to determine the specific impacts of ground improvements on groundwater responses, which would occur during PED. At this stage, there is insufficient evaluation to determine level of significance; however, groundwater flows are expected to be adversely impacted by seismic improvements. Because data and/or modelling is lacking to determine the extent, it was assumed the adverse impacts would be ***significant and unavoidable***.

Small volumes of petroleum products (e.g., fuel, engine oil, hydraulic line oil) would be temporarily used and handled to operate the construction equipment. These materials could be released in accidental spills. A NPDES permit would be required, and as part of that permit, a SWPPP that describes BMPs to be implemented to control accelerated erosion, sedimentation, and other pollutants during and after project construction. The specific BMPs that would be incorporated into the SWPPP would be determined during the final stages of the project design. However, the SWPPP would likely include many, if not all, of the BMPs listed in the Geology and Water Quality Mitigation sections to substantially reduce the potential for groundwater impairments as a result of ground and vegetation disturbance to ***less than significant***.

Construction activities would not deplete groundwater resources from the deeper groundwater basins in the study area because, other than temporary and limited dewatering during construction, the proposed project would not require continuous extraction of groundwater for water supply. Most areas proposed for CFRM measures are currently developed and largely covered by impervious surfaces, which have historically been used for industrial, residential, and commercial facilities, or bay waters that do not contribute significant substantial recharge to local aquifers used for water supply. Therefore, construction impacts would have ***no impact*** on deep groundwater resources, thus, this resource is not discussed further.

The proposed project would be designed in a manner as to not conflict or obstruct implementation of a sustainable groundwater management plan. Groundwater impacts would not be worsened by the construction of CFRM features and thus, impacts are expected to be ***less than significant***.

4.13.2 Operations and Maintenance Impact Summary

Operations and maintenance activities would include inspections, damage repair, excavation, and fill activities. Hardened structures would require regular inspection for natural wear and/or damage following coastal storm or seismic events. Repairs could range from minor (e.g., cracked concrete walls) to major (e.g., replacement of walls) dependent on the severity of damage. Major repairs would be expected to rarely occur – with the most likely opportunity being after a major seismic event. EWN features would require supplementation with fill material and excavation/grading as sea levels rise over time. Impacts during operations and maintenance are expected to be similar to, or less than, those described for construction. Maintenance activities would be required to adhere to the same BMPs and SWPPP as construction activities. Thus, adverse impacts from operations and maintenance activities are expected to be reduced to ***less than significant*** for shallow groundwater resources when following the BMPs and mitigation measures. As with construction impacts, O&M is anticipated to have ***no impact*** on deep groundwater resources.

4.13.3 Tentatively selected plan (TNBP)

The TNBP is anticipated to have no to moderate impacts on groundwater resources during construction of CFRM measures and operations and maintenance activities (Table 4-29).

Table 4-29. Summary of Groundwater Impacts associated with the TNBP

TNBP Groundwater Impact Rating by Measure	**Bay Fill**	**Levee**	**Bulkhead wall/Seawall**	**Deployable Flood Gate**	**Roadway Impact**	**Sheetpile Wall**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint (1st Action)	1	2	3	2	2	3	2	1	2	2	2+	2+	2+	2+
Construction/Footprint (2nd Action)	3	2	3	1	2	1	2	1	2	2	2+	2+	2+	2+
O&M Assumptions	1	2	2	1	1	2	1	1	1	1	1	1	1	1
Mitigated Rating	*3*	*2*	*3*	*2*	*2*	*3*	*2*	*1*	*2*	*1*	*1*	*1*	*1*	*1*

Construction of CFRM features that overlap with Alternative F and G are anticipated to have similar impacts as those described in the sections below. Unique to the TNBP is the addition of sheetpile walls and deployable flood gates. Sheetpile walls are anticipated to have similar impacts as those described for seawalls as groundwater flow would be interrupted during construction activities. These impacts are likely to be ***less than significant with mitigation*** and would require quantitative modelling to design the features in such a way as to not cause permanent adverse impacts to groundwater storage and drainage.

4.13.4 Alternative B

Alternative B moves assets away from flood risk over time or uses a variety of dry and wet floodproofing methods to protect infrastructure at risk of SLR. These strategies are expected to have ***no impact*** on groundwater, as there would be no surficial disturbing activities that would come in contact with the resource.

Nonstructural measures such as relocation and demolition could have temporary adverse impacts to shallow groundwater that are expected to have low impacts. Demolition activities would use heavy machinery, such as excavators, that may penetrate shallow groundwater during excavation and removal activities. Additionally, if groundwater becomes exposed during demolition, site areas would need to be dewatered to move groundwater outside of the construction area. This would temporarily disturb natural routes of groundwater flows and may cause minor surface flooding. Demolition activities are expected to have ***less than significant*** adverse impacts to groundwater as these would be temporary and only last during construction.

Relocation would involve demolition of existing substructure/foundation during the removal process and site preparation for the new location. Site preparation could involve excavation and dirt work that utilizes heavy machinery, bulldozers, graders, and excavators. As with demolition, this disturbance of surface soils could penetrate and expose shallow groundwater that resides within the upper three to six feet of the surface elevation. Under existing conditions, the majority of shallow groundwater is present more than nine feet below the surface; however, as relative sea level rises, it would be expected that groundwater levels would also rise, raising the likelihood of encountering the resource during excavation and site preparation. If groundwater is exposed, the construction area would need to be dewatered to drain the groundwater elsewhere, temporarily disturbing groundwater flows and causing minor surface flooding. If structure relocation results in the conversion of pervious surfaces to impervious surfaces, there is a potential for long-term adverse impacts to groundwater flows. However, it is anticipated that quantitative modelling would be conducted prior to relocating structures as to avoid permanent impacts and loss of groundwater resources. Relocation activities would also include construction of new foundations and those associated with placing structures at new locations, and paving surfaces. These activities are expected to have similar impacts as those already described. Overall, nonstructural measures are expected to have ***less than significant*** impacts to groundwater resources and be temporary, only lasting through construction activities.

4.13.5 Alternative F

Alternative F is expected to have the following impacts to groundwater resources associated with construction activities on CFRM measures and operations and maintenance (Table 4-30). Impacts to groundwater would range from no impacts to moderate dependent on the measure. Several O&M activities are assumed to have no impact to groundwater as they should not require subsurface activities that would disturb the resources. Alternative F is expected to have similar low impacts to groundwater as described in Alternative B for nonstructural measures. ***No impacts*** are anticipated to occur during construction of vertical walls. In 2040, walls would be constructed around existing piers, while in 2090 walls would be constructed along the new seawall. No groundwater resources are expected to occur on the edge of piers where walls would be constructed. In 2090, walls are intended to add vertical height to features constructed in 2040, and thus, should not require disruption of surficial material that would result in contact with groundwater.

Low adverse impacts to groundwater are expected during construction of wharf, ecological armoring, and marsh enhancement. Construction of these measures would predominantly include in-water construction activities, as well as some shore-based activities. Fairly minimal wharf is proposed to be replaced for Alternative F (Table 4-4 and Table 4-5). The wharf being replaced is largely located over San Francisco Bay and would utilize in-water construction activities such as work barges, pile drivers, support vessels, etc. As the Bay does not contribute significantly to recharge of groundwater, the in-water construction is not expected to have adverse impacts to this resource. However, some shore-based construction activities associated with replacing the wharf, such as any grading, excavation, site preparation, and fill is likely to have low adverse impacts to groundwater during construction similar to those previously described. Construction of the wharves is not likely to permanently modify or adversely impact groundwater as it would not drastically change the porosity, permeability, or perviousness of the existing area. The areas proposed for wharf replacement are already impervious surfaces that would remain impervious and simply raise in elevation.

Placement of ecological armoring would have low impact to groundwater resources during construction as some excavation and grading may need to occur prior to placing stones. However, upon construction completion, the stone should be placed in a manner that does not impede groundwater flow and allows for drainage to continue into the Bay. Similarly, marsh enhancement would require grading and excavation activities to prepare the area for placement of fill material and native plants. However, this is intended to enhance or create pervious surfaces that are beneficial to groundwater drainage and absorption. Construction would have low impacts for reasons described above, but long-term would be beneficial to groundwater. Overall, these three measures are expected to have temporary impacts during construction that would be ***less than significant***.

Table 4-30. Summary of Groundwater Impacts associated with Alternative F

Alternative F Groundwater Impact Rating by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	3	2	3	2	3	2	1	2	2	2+	2+
O&M Assumptions	1	2	2	1	2	1	1	1	1	1	1
Mitigated Rating	*3*	*2*	*3*	*2*	*2*	*2*	*1*	*2*	*1*	*1*	*1*

Construction of the seawall and tide gates, and addition of bay fill, are anticipated to have moderate impacts on groundwater. The seawall is intended to be raised to accommodate future SLR and the inland ground elevation would be raised and graded to effectively meet the new seawall elevation. The inland ground elevation is expected to be raised high enough to avoid groundwater seepage under RSLC conditions; however, additional quantitative modelling would be needed to refine final designs to ensure this during PED. Construction of the new seawall and addition of bay fill is likely to adversely impact groundwater flows while activities are underway but would be returned to a condition that allows for proper drainage to San Francisco Bay upon completion. During installation, the seawall would disconnect the existing groundwater drainage to the bay, particularly when bay fill is added. This would turn a once open bay bottom and open water habitat into an impervious surface. Because the Bay is not a significant contributor to groundwater recharge, the impact to supplies is not anticipated to be adverse. Drainage would be redirected or require dewatering during construction as the permeability would be permanently changed. These activities are likely to require mitigation to lessen the adverse impacts to groundwater, set to be determined by BCDC and the Waterboard. Upon construction completion, groundwater discharge routes and storage would need to be addressed as to not impede water flows, thus, eliminating the likelihood of permanent adverse impacts to the resource. Adverse impacts from the construction of the seawall and addition of bay fill are expected to be ***less than significant with mitigation***.

Alternative F includes water control structures (i.e., tide gates in 2040 converted to pump stations in 2090) at the mouth of both Islais and Mission Creeks. In the near-term, the intent is for the tide gates to be designed (i.e., number of gates) in a manner to maintain similar inflow and outflow volumes and to remain open to allow flushing of the creeks with tidal fluctuations under normal conditions. Tide gates would be closed during low tide in the event excessive tidal conditions and storm surge combine to warrant closing them. This would allow maximum storage in the creek from inland storm runoff or rising groundwater, that would be released once conditions allow, to drain into San Francisco Bay. The operation and maintenance of tide gates is anticipated to have low impacts to groundwater resources, as storage and drainage would not be impeded during normal conditions.

Construction of the tide gates would temporarily impede and redirect groundwater resources for sections that are constructed on land; however, no long-term permanent impacts are anticipated as construction is set to occur on areas of impervious surface. Any excavation, demolition, and grading work that would need to be completed would have similar impacts on the resource as described above. In later years, when SLR increases to the point tidal exchanges become too difficult to regulate the creek water levels to avoid flooding, the tide gate structure would be converted to a pump station utilizing the majority of the existing structure. If this were to occur, groundwater levels would likely be rising with RSLC and any drainage to the creek area (now likely a managed lagoon) behind the water control structure would be manually pumped into the bay by the pump station. From theory (i.e., Darcy's Law), maintaining a lower water level in the creek/lagoon with a water control structure would direct groundwater flow to the creek/lagoon. During high Bay levels, groundwater discharge to the creek could be substantially increased, leading to sufficient discharge to raise creek water levels. However, this effect requires more analysis on groundwater response timescales and groundwater discharge effects on the water budget of the creek, which would be completed during PED. It is likely mitigation would be needed to reduce adverse impacts to groundwater, set to be determined by BCDC and the Waterboard. Overall installation of tide gates are anticipated to have moderate impacts to groundwater and would be ***less than significant with mitigation***.

4.13.6 Alternative G

Alternative G is expected to range from no impacts to moderate impacts to groundwater resources associated with construction activities on CFRM measures and operations and maintenance activities (Table 4-31).

Table 4-31. Summary of Groundwater Impacts associated with Alternative G

Alternative G Groundwater Impact Rating by Measure	**Levee**	**Bridge raise**	**Bulkhead wall/Seawall**	**Roadway Impact**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint	2	2	3	2	2	1	2	2	2+	2+	2+	2+
O&M Assumptions	2	1	2	1	1	1	1	1	1	1	1	1
Mitigated Rating	*2*	*2*	*3*	*2*	*2*	*1*	*2*	*1*	*1*	*1*	*1*	*1*

Construction related impacts are anticipated to be similar to those described in Alternative F for overlapping CFRM features, but overall would have lower impacts to groundwater than Alternative F or the TNBP because of the conversion of industrial areas to EWN features as the LOD is retreated inwards with increasing flood risks. The amount of pervious and impervious surfaces over a groundwater-shed has a large influence on both groundwater emergence and intrusion. Pervious surfaces help to reduce runoff and saltwater intrusion, but may enhance recharge and raise water tables, leading to more groundwater emergence. However, converting impervious surfaces to pervious surfaces is anticipated to have beneficial impacts to groundwater supplies overall.

Marsh vegetation could transpire sufficient groundwater to reduce the effect of SLR minorly and locally. The vegetative barrier would likely have a cyclic effect on groundwater levels with transpiration occurring during daytime, such that the net flux would need to overcome local groundwater flow conditions. EWN features would be designed to slope towards the Bay to allow for adequate drainage of shallow groundwater under normal and extreme storm conditions. Because of the EWN features, Alternative G impacts to groundwater are anticipated to be ***less than significant*** and overall beneficial.

4.13.7 Independent Measures for Consideration

Adverse impacts from construction and operation of independent measures are expected to be equivalent to those described in the construction impact summary, as well as those in the TNBP, Alternative F, and G (Table 4-32). As such, the impact rating was equivalent to that of the previously described alternative features where applicable. Unique to the independent measures is the EWN vertical shoreline. Installation of the vertical shoreline is anticipated to have ***no impact*** on groundwater resources because panels would be installed on the seawall once construction of that feature was completed. It was assumed any groundwater outflow and storage improvements that were needed as a result of seawall construction would be completed prior to the living seawall panels being installed.

Table 4-32. Summary of Groundwater Impacts associated with the Independent Measures

Independent Measures Groundwater Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	3	3	3	1	2	2	1
O&M Assumptions	2	1	2	1	2	2	1
Mitigated Rating	*3*	*3*	*3*	*1*	*2*	*1*	*1*

Measure 2B has a moderate construction impact associated with the bay fill; however, is assumed to be mitigated with the addition of an EWN coarse beach. Similarly, measure 4A includes constructing levees that are anticipated to have low impacts, but also converts impervious surface to an EWN feature.

4.13.8 Mitigation

Mitigation and BMPs would be the same as those described in the Water Quality section.

4.14 Aquatic Resources

This section describes impacts, adverse and beneficial, to aquatic habitats and wildlife including intertidal and subtidal habitats, wetlands, pelagic habitat, fish, and macroinvertebrates. Impacts to aquatic resources in the study area are anticipated during construction and operations and maintenance activities depending on the measure and existing conditions. The following are impact producing factors to aquatic wildlife and habitat: physical seabed/land disturbance, sediment suspension, discharge/release and withdrawals, habitat conversion/loss, land use, economic change, and noise.

4.14.1 Construction Impact Summary

Short-term direct impacts from construction-related activities are anticipated to adversely affect aquatic habitat and wildlife, whether they occur as a resident, migrant, or incidental, within or near the project area. Impacts include habitat removal and/or fragmentation and habitat avoidance due to increased noise, dust generation, vibrations, debris, accidental discharge, and overall lower quality habitat. Impacts to water resources are the same as those described in Water Quality.

There are two wetlands and associated water resources in the study area – Pier 94 wetlands and Heron’s Head Park. They are considered significant in the study area, particularly Heron’s Head, due to the rare nature in the otherwise urban environment. Temporary impacts to wetlands are anticipated to occur during the construction of shore-based measures near the wetlands, such as levees, t-walls, and vertical walls, as well as during construction of NNBF such as marsh enhancements and ecological armoring.

Preparation of the construction sites would require clearing and grading of vegetation that could result in temporary wetland, subtidal and intertidal habitat, and water quality impacts. Any temporary impacts to vegetation are anticipated to be replaced on-site. Placement of dredged or commercial material in wetlands and aquatic areas would have temporary impacts during construction, as well as to adjacent transition areas that are likely to be impacted by clearing, soil disturbances, and suspended sediments. Temporary impacts would be managed through implementation of a site-specific SWPPP and construction BMPs. The specific BMPs to be incorporated into the SWPPP would be determined during PED; however, BMPs expected to be used to reduce impacts to aquatic resources include but are not limited to those described in the Geology and Water Quality mitigation sections.

Temporary in-water impacts include increased turbidity during construction activities and resuspension of sediments into the water column during pile driving, placement of concrete blocks, dewatering, and excavation and fill activities. Temporary and localized impacts to aquatic habitats from vessel anchoring and dewatering activities may occur but are expected to return to pre-existing conditions following active construction. Spills or leaks of fuels, lubricants, and coolant from construction equipment could significantly impact water resources as described in the Water Quality section. Additionally, sheetpiles would be treated with corrosion-resistant coating prior to installation, which may require application by hand as necessary to touch-up areas potentially damaged during the installation process. These activities could pose a temporary risk of exposing resident aquatic organisms to toxic contaminants and non-edible forage. A site-specific spill prevention control and countermeasure plan (SPCC) would be developed and implemented to prevent spills and minimize the potential impacts for any inadvertent spills. With implementation of the SPCC and BMPs, impacts from spills or leaks are anticipated to be minor. Water quality is anticipated to return to baseline conditions after construction activities are completed.

Impacts to fish during construction are the same as those described for similar EFH-designated species (demersal and pelagic) in the Special Status Species section and are primarily associated with in-water measures such as wharfs, bulkhead/seawalls, sheetpile walls, and NNBFs (e.g., marsh enhancement/creation, ecological armoring). Temporary direct impacts include altered habitats associated with noise, vibration, sediment suspension, physical disturbance, and impaired water quality (e.g., lower dissolved oxygen). Permanent adverse impacts include habitat loss through measures such as bulkhead wall construction and wharf extensions. Impacts associated with Noise and Vibration are described in Sub Appendix D-1-2. Fish are expected to actively avoid most in-water work areas, opting for another appropriate habitat nearby. This avoidance behavior would occur only in those areas where construction is underway. Fish species are expected to return to the area when construction is completed.

Losses of slow moving and less mobile species (e.g., aquatic invertebrates, benthic species) are anticipated within the construction footprint due to burial of individuals and/or increased turbidity. Suspension/filter feeding organisms could be impacted due to clogging of gills and feeding mechanisms, which would cause death or reduce growth and reproduction. Visual predators would have a reduced success rate at catching prey due to lower visibility levels. Following construction activities, water quality is expected to return to pre-construction conditions.

In general, most fish, wildlife, and benthic species would become habituated to the work and adapt to the habitat changes; however, species with low tolerance are anticipated to be displaced for the duration of activities. The severity of the impacts is dependent on the final design of features, type of equipment used, and duration of construction activities. Once construction is complete, it is anticipated that construction-related impacts to aquatic organisms would cease. These adverse impacts would be minimized and controlled by implementing the best available practical techniques and BMPs during construction.

Long-term beneficial impacts to aquatic resources are expected with NNBFs such as enhanced or created wetlands, ecological armoring, and vertical shorelines/living seawalls, as they would result in improved habitat conditions and an expansion of available habitat for aquatic species, including special status fish. Wetlands improve water quality, flood control, and ecological benefits to aquatic resources. The NNBFs would allow for improved diversity and provide refuge for aquatic plant and animal species to promote higher abundances than would likely be supported in their absence. Wetlands, ecological armoring, and vertical shorelines would provide surface area to colonize, which establishes a more sufficient food supply to support primary (i.e., herbivores) and secondary (i.e., carnivores) consumers. Intertidal marsh and marsh edge would provide increased foraging opportunities for shorebirds and wading birds using the shoreline habitats. Nesting habitat would be improved as the enhanced/created marsh would provide more desirable nesting habitat in an area that would otherwise be inhabitable for nesting under FWOP conditions. The increase in vegetative structure would also provide shelter for prey species to evade predators.

4.14.2 Operations and Maintenance Summary

During operations and maintenance, potential impacts to aquatic resources may occur, but are anticipated to be low overall. Temporary in-water impacts include increased turbidity from resuspension of sediments, noise, vibration, spill of toxic material, and physical disturbance. Inspection and maintenance of sheet pile walls may require re-application of corrosion-resistant coatings, which would be applied by hand to localized areas where needed. Accidental spills of anti-corrosion coatings or diesel fuel could occur during O&M activities. This could be a significant impact that would require mitigation to reduce the impact to a less-than-significant level. A SPCC and BMPs would also be employed to reduce overall impact and likelihood of a spill occurring. Additionally, similar impacts as described in the Water Quality operations and maintenance section would be applicable to aquatic resources.

4.14.3 Tentatively Selected Plan

The impacts to aquatic resources from the TNBP range from no to moderate to high, with in-water activities expected to have more adverse impacts (Table 4-33).

Table 4-33. Summary of Aquatic Resource Impacts associated with the TNBP

TNBP Aquatic Resources Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint (1st Action)	1	2	2	2	2	3	2	2	4	2+	2+	2+	2+	1
Construction/Footprint (2nd Action)	4	2	4	1	2	1	2	1	4	2+	2+	2+	2+	2+
O&M Assumptions	1	2	2	2	1	3	1	1	2	2+	2+	2+	2+	2+
Mitigated Rating	3	3	3	2	2	3	2	2	3	1	1	1	1	1

The impacts for construction of a new bulkhead wall varies between 2040 and 2090 as they would be located in different areas. In 2040, the bulkhead wall would be constructed similar to that described in Alternative G and would be expected to have low impacts to aquatic resources. However, in 2090, the bulkhead wall is constructed more similar to described in Alternative F, requiring in-bay fill (though much smaller quantities), and is anticipated to have moderate to high impacts to aquatic resources. As with the other action alternative, shore-based measures are expected to have low impacts to aquatic resources.

As described in Alternative B, F, and G, replacement of wharf structure would have moderate to high impacts to aquatic resources during removal of existing piles and pile driving of new ones. Additionally, over-water work has the potential to have significant impacts to aquatic resources if any construction-related material is dropped into the water. As with the other alternatives, wharf replacement in the TNBP is expected to have impacts that are ***less than significant with mitigation***.

Sheetpile walls would have similar impacts to those of bulkhead walls constructed bayward of the existing seawall, albeit at a much smaller scale, and may require dewatering activities as described in Alternative F. Installation of sheetpile walls is expected to have impacts that are ***less than significant with mitigation*** by employing BMPs described in this mitigation section, as well as the water quality and geology sections.

EWN features are anticipated to have low impacts during construction and maintenance activities but would overall be beneficial to aquatic resources through the creation of habitat ideal for foraging, resting, and refuging. Adverse impacts from construction and maintenance of EWN measures are expected to be ***less than significant***.

Overall, in 2040, impacts would be comparable between the TNBP and Alternative F or G (Table 4-4). More adverse impacts would be realized for the TNBP during the second construction phase which includes exceedingly more bulkhead wall and wharf replacement than Alternative F or G (Table 4-5).

4.14.4 Alternative B

Construction related impacts are associated with demolishing buildings and installing floodproofing barriers. These are expected to have low impacts to aquatic resources, particularly because most activities would be shore-based. However, some impacts to aquatic resources may still occur, including noise, physical disturbance, and turbidity which would result from operating machinery in the construction area. BMPs such as those described in the Noise and Vibration and Water Quality sections would be used to reduce impacts from these activities to aquatic resources. All impacts are anticipated to be temporary and ***less than significant***, only lasting as long as the construction period.

O&M for Alternative B are expected to have no impacts to aquatic resources. The non-structural alternative is designed to be implemented in four-time steps commensurate with the trajectory of SLR inundation levels that would trigger the need for protective measures. These implementation steps are expected to have “construction” related impacts, particularly in the case for building demolition. Details about assumptions for building demolition and relocation are described in Appendix B: Engineering.

Two piers are proposed for demolition in Alternative B, one in 2040 and another in 2115. Pier demolition would have temporary adverse impacts to aquatic resources, including physical disturbance, impaired water quality, increased turbidity, release of contaminants, and noise. However, permanent impacts, both adverse and beneficial, are also expected which may include but are not limited to altered hydrology and sediment deposition, habitat and shade structure loss, increased turbidity and erosion, and contaminant removal. Impacts to water quality and hydrology can be found in those respective sections. For aquatic resources, particularly fish, the loss of a shade structure could be beneficial by increasing abundance of visual predators. Overwater structures are known to interrupt visual predator behavior and localized movements of migratory fish (Munsch et al. 2017); thus, the removal of these structures could have beneficial effects.

Sessile (e.g., oysters, mussels), non-native (e.g., bryzoans, tunicates, anemones, sponges), and motile (e.g., herring) organisms use the pier pilings as habitat, refuge, nursery, and for foraging. Removal of these structures would have direct negative impacts to existing organisms through injury and death. Many of the pier pilings were injected with creosote to minimize fouling, which contain polycyclic aromatic hydrocarbons (PAHs) that are toxic to some organisms. By removing creosote pilings, long-term beneficial impacts would likely result to marine species through improved water quality.

Strong circulation around pilings may minimize direct effects of creosote on motile organisms; however, those that forage on sessile prey species inhabiting the pilings are likely exposed to creosote through their food (Cosentino-Manning et al. 2010). It is unclear what long-term impacts would occur by eliminating the piers, both in terms of habitat and local wave, current, and sedimentation patterns. It is clear the pier pilings support valued ecosystem services and removal could have detrimental impacts to aquatic resources (Cosentino-Manning et al. 2010). It is expected BMPs during removal would be used to minimize impacts of contamination, while mitigation would help to offset permanent losses to aquatic resources. There remains uncertainty of the local and regional impacts of removing the piers, in which more detailed analyses would be needed during PED. However, given few (two) piers are expected to be demolished in Alternative B, overall, the impacts are expected to be ***less than significant***.

4.14.5 Alternative F

The impacts to aquatic resources from Alternative F range from no to moderate to high, with in-water activities expected to have more adverse impacts (Table 4-34).

Table 4-34. Summary of Aquatic Resource Impacts associated with Alternative F

Alternative F Aquatic Resource Impact Rating by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	4	2	4	2	3	2	2	3	2	1	2+
O&M Assumptions	1	2	2	1	3	1	1	2	2	1	2+
Mitigated Rating	*3*	*2*	*3*	*2*	*3*	*2*	*2*	*3*	*1*	*1*	*1*

Low impacts are predominantly for shore-based measures that could negatively impact water quality as described in the section above, as this would conversely have negative impacts to aquatic resources. A levee is planned for construction adjacent to Heron's Head Park; however, all work is shore-based and should not impede natural functions of the wetland during or after construction. The low impacts are similar to those described in the Water Quality section. In the same location, EWN marsh enhancement and an ecotone levee are planned for construction to compliment the levee feature. Construction of these EWN measures could have direct and indirect and temporary and permanent impacts on jurisdictional wetlands and waters. Temporary adverse impacts would result if excavation and dirt work were to cause sediment suspension or the inadvertent entry of deleterious construction-related materials (e.g., fuel, lubricant) into the bay during construction. The long-term permanent impacts are expected to be beneficial as marsh is enhanced and expanded, while the ecotone levee that would offer additional space for conversion to wetlands with SLR.

Low impacts to intertidal and subtidal habitats are anticipated with the installation of ecological armoring and marsh enhancement features. Placement of rock for ecological armoring would remove open benthic space in these habitats but are anticipated to create microhabitats within crevices and textured surfaces that could still be occupied by organisms that utilize these areas. Additionally, ecological armoring is likely to increase sediment retention that could have a long-term benefit for replenishing intertidal and subtidal habitats. Enhanced marsh habitat would be beneficial for intertidal and subtidal habitats offering improvements to water quality, vegetation for habitat, forage, and refuge, and additional space for aquatic organism colonization. As SLR, marsh habitat would convert to intertidal and subtidal zones, increasing the available space of these habitats in the long-term. Overall, addition of these EWN features would offer long-term beneficial impacts that would outweigh the temporary and low impacts from construction and maintenance.

Jurisdictional waters of San Francisco Bay would be filled with the bulkhead wall/seawall measure, resulting in direct, adverse, permanent impacts to aquatic resources. Additionally, wharf being replaced would install new pilings and overhang structure to support the facilities. Installing piles for the seawall and wharf would require in-water work including but not limited to pile driving, support vessels, work barges, etc. Construction of the wharf would utilize over-water work, but not necessarily in-water work methods. However, this could still inadvertently drop construction-related materials into the bay that could have significant impacts to aquatic resources. Placement of in-bay fill would require water quality certification and/or waste discharge requirements from the regional Waterboard, and also a permit from BCDC, as the fill area is within 100-feet of the shoreline band and within San Francisco Bay. Collectively, the regulatory agencies and the permits and authorizations would require the placement of new fill in jurisdictional waters be avoided or minimized to the maximum extent practicable while still accomplishing the proposed project's purpose. These permits would require water quality protection measures to avoid and/or minimize temporary impacts from in-water and above-water construction activities that would be implemented in conjunction with water quality BMPs. Permanent placement of new fill would result in the loss of 25 acres of jurisdictional waters (Table 4-4) which would likely trigger a requirement for compensatory mitigation aimed at restoring or enhancing ecological functions and services like those displaced. The temporary and permanent impacts anticipated to jurisdictional waters because of in-bay fill are ***significant and unavoidable*.**

Likewise, in-bay fill would result in a permanent loss of open water and benthic habitats in the affected areas. Any sessile and/or benthic organisms present on the seabed during fill would be smothered and likely lost. The 25 acres of bay fill would be rendered inhabitable and inaccessible to aquatic organisms. The lost habitat would also impact food availability locally for fish, including special status species, that rely on pelagic phytoplankton or benthic organisms for food sources. BMPs would be in place to reduce the likelihood of inadvertent spills of fill material outside of the intended area; however, if spill were to enter the water column, it would result in turbidity that could temporarily affect visual predators and/or suffocate filter feeding invertebrates. The study area is highly urbanized; thus, additional loss of aquatic habitat could have significant impacts to marine resources. As with jurisdictional waters, BCDC and the regional water board would have to grant permits for the permanent placement of fill, of which is likely to trigger a requirement for compensatory mitigation. The permanent loss of aquatic habitat, and potential loss or injury of marine species because of in-bay fill renders the impacts ***significant and unavoidable***.

Similar to the impacts described for pier removal in Alternative B, wharf replacement in Alternative F is anticipated to have moderate impacts to aquatic resources. Removal of pilings would have temporary impacts to aquatic resources, including habitat and wildlife, through sediment suspension and/or inadvertently through entry of deleterious construction-related materials into the bay during over- or in-water work. Removal of creosote-laden pilings is likely to have long-term beneficial impacts to aquatic wildlife by removing contaminated structures from the water. However, any sessile organisms present on pilings during removal would be injured or lost. Additionally, an important forage source for fish would temporarily be removed and may take months to years to be replenished once the new wharf is installed. There remains great uncertainty about the local and regional impacts of removing and replacing wharfs, as well as the long-term impacts to aquatic resources, in which more analyses would be needed during PED. Wharf replacement would permanently impact pelagic and benthic habitat, though replacement is expected to cover the same or similar footprint to existing wharf structures. The number, size, and composition of pilings would be determined during PED. BMPs described in this, and the Water Quality section would be used to reduce impacts of wharf replacement on aquatic resources to ***less than significant with mitigation***.

Dewatering would likely be required for construction of bulkhead/seawalls, tide gates, and during in-bay fill. Tide gates would utilize cofferdams to allow dry work conditions during installation of foundations and gate segments. When constructing new seawalls, cements casts would require dewatering prior to being filled, and the open bay area between the new and existing seawall would also need to be dewatered prior to placement of in-bay fill. Bay waters present between the two seawalls and within the cofferdam may contain fish, including special status species, that could become entrapped, injured, or killed, if present at the time when water levels are lowered during dewatering, which would be a significant impact. Benthic invertebrates would be lost during dewatering activities and installation of cofferdams, and it is uncertain at what point they would reinhabit the bay bottom after construction is completed. Benthic faunas recover from other bottom disturbing activities such as dredging and benthic trawling within 1-4 years on average (Wilber and Clarke 2007; Kotta et al. 2009; Wang et al. 2021); therefore, it could be reasonably assumed the temporal recovery of benthic invertebrate populations would be the same or less for dewatering and cofferdams. BMPs described in the Mitigation section would be used to reduce the impact to ***less than significant with mitigation***.

Construction of the tide gates is anticipated to have similar impacts to those described in wharf replacement and dewatering, thus would be ***less than significant with mitigation***. Operation and maintenance of tide gates can temporarily impede fish passage, though this is expected to be short durations (hours to days). Additionally, changes to salinity, temperature, and dissolved oxygen can occur when tidal exchange is reduced with operation of tidal gates (Chen and Orton 2023). There remains large uncertainty around the design and operation of tidal gates, which would need to be determined in PED; however, frequent closures may result in measurable permanent changes to the physical conditions in the estuary (Chen and Orton 2023) that could cause a regime shift in aquatic species. Detailed hydrodynamic modelling would be needed to help develop the design and determine closure frequency to assess potential long-term impacts to aquatic species. The intent would be to design the structures in a manner that would limit changes to tidal exchange to allow for continued use by aquatic species. Later, in 2090, when the tide gates are expected to be converted to pump stations, the interior of creeks would be inaccessible to marine fish and invertebrates unless designed otherwise. This would reduce habitat and food availability and could lead to pulsed releases of water that may change local salinity, dissolved oxygen, and temperature conditions in the bay. The impacts are anticipated to be temporary, occurring during flooding events, but hydrodynamic modelling would be needed to determine the overall sustainability of this feature. In general, the loss of habitat could have a significant impact to aquatic species that have already experienced substantial habitat loss in the San Francisco Bay Estuary.

Overall, Alternative F is expected to have the greatest adverse impacts to aquatic resources due to loss of pelagic and benthic habitat.

4.14.6 Alternative G

Alternative G is anticipated to range from no to moderate impacts on aquatic resources (Table 4-35).

Table 4-35. Summary of Aquatic Resource Impacts associated with Alternative G

Alternative G Aquatic Resource Impact Rating by Measure	**Levee**	**Bridge raise**	**Bulkhead wall/Seawall**	**Roadway Impact**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint	2	2	2	2	2	2	3	2	2+	2+	2+	2+
O&M Assumptions	2	2	1	1	1	1	2	2	2+	2+	2+	2+
Mitigated Rating	*2*	*2*	*2*	*2*	*2*	*2*	*3*	*1*	*1*	*1*	*1*	*1*

All features for Alternative G, apart from wharf replacement, would be shore-based measures that are anticipated to have low impacts to aquatic resources. Impacts would be similar to those described for Shored-based Activities in the Water Quality section, stemming mostly from accidental spills and possibility of turbidity from windblown sediments or dust. Otherwise, shore-based construction should not impact aquatic resources. BMPs as described in the mitigation sections of Water Quality and Geology would be used to reduce impacts to these habitats and resources.

Similar to impacts described for Alternative B and F, Alternative G is anticipated to have moderate impacts with wharf construction, predominantly from pile driving activities. There is the potential for over-water construction to have significant impacts to aquatic resources if debris is inadvertently dropped in the water, but this would be minimized with the use of BMPs to be ***less than significant with mitigation***.

Alternative G maximized the inclusion of EWN features, particularly in 2090, when the line of defense is moved inland. The land bayward of the line of defense would be converted to a range of EWN features including enhanced and created marshes, ecotone levees, and naturalized and embankment shorelines that creates essential habitat for aquatic species, including fish, invertebrates, and birds. By 2090, Alternative G would convert nearly 700+ acres of once urban area to vegetated, naturalized green space. These newly vegetated areas would provide habitat for an array of aquatic species, enhance structural diversity of plants which could lead to increased wildlife diversity, and create large transitional zones from the water to inland green space. Aquatic vegetation in the marsh would provide forage and refuge for amphibians, fish, and invertebrates, waterfowl, and wading birds (Audubon n.d.), including special status species. The beneficial impacts of EWN features far outweighs the potential adverse impacts of construction and maintenance. The construction and maintenance of EWN measures would be ***less than significant***.

Overall, Alternative G would have the least adverse impacts and most beneficial impacts to aquatic resources.

4.14.7 Independent Measures for Consideration

The impacts to aquatic resources for the construction of independent measures were anticipated to range from low to moderate to high (Table 4-36).

Table 4-36. Summary of Aquatic Resource Impacts associated with Independent Measures

Independent Measures Aquatic Resources Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	4	4	4	2	2	2+	4+
O&M Assumptions	2	2	2	1	2	2+	2
Mitigated Rating	*3*	*3*	*3*	*2*	*2*	*1*	*2*

Independent measures 2A and 2B include bay fill, wharf replacement, and addition of bulkhead walls, thus, are anticipated to have moderate to high impacts to aquatic resources. Similarly described in Alternative B and F, impacts from bay fill and bulkhead wall features have ***significant and unavoidable*** impacts to aquatic resources during construction. Wharf replacement would have ***less than significant impacts with mitigation***, with the use of BMPs as described in this mitigation section, as well as water quality and geology BMPs. A coarse beach is proposed to overlay the bay fill in measure 2B, which could have long-term beneficial impacts on foraging for shorebirds and wading birds, as well as provide habitat for invertebrates.

Shore-based measures such as levees and walls associated with measures 3B, 3C, and 4A would have low impacts to aquatic resources during construction. Measure 4A includes 43 acres of EWN that would have long-term beneficial impacts for aquatic resources as previously described.

The construct the living seawall/vertical shoreline, it was assumed the textured panels would be installed on the existing or new seawall in the dry, which would require dewatering activities. It is reasonable to expect the comparable dewatering impacts as described in Alternative F, as nearly the same linear feet of shoreline would be impacted (Table 4-4). Approximately 12,100 linear ft of the shoreline can accommodate a living seawall. These would be constructed in sections to reduce overall impacts and make the dewatering activities more manageable. For this analysis, it was assumed pre-cast textured panels would be installed with steel bolts using pneumatic tools within 50 linear foot sections. As described in Alternative F, the process of dewatering and constructing a cofferdam would have adverse impacts to aquatic species, particularly fish and invertebrates, including special status species. Any invertebrates and/or aquatic vegetation (e.g., algae) present on the seawall would be removed prior to installation of the textured panels. This is most likely to occur on areas where panels are attached to the existing seawall as it has been available for colonization. Long-term beneficial impacts to aquatic resources are expected after construction ceases. Living seawalls create varied microhabitat conditions through surface relief that promotes vegetation growth, provides foraging habitat, and creates shelter from predation benefiting invertebrates, algae, and fish species (O'Shaughnessy et al. 2020, Morris et al. 2017). The structure can also improve water quality through recruitment of bivalves, benefiting aquatic resources.

4.14.8 Mitigation

In order to avoid and/or minimize potential impacts to aquatic resources, the following minimum construction BMPs would be implemented as part of the proposed project. These minimum measures would be subject to modification and additions based upon regulatory and resource agency review.

- Prevent fish entrapment and entrainment during dewatering, such that fish rescue operations shall occur where dewatering and resulting isolation of fish may occur. Fish rescue and salvage operations shall occur prior to and during dewatering. If the enclosed area is wadable (less than 3 ft deep), fish can be herded out of the enclosure by dragging a seine (net) through the enclosure, starting from the enclosed end and continuing to the opening. After completing fish herding, the net or an exclusion screen shall be positioned at the opening to prevent fish from reentering the enclosure. Screens shall be checked periodically and cleaned of debris to permit free flow of water.
- Sheetpiles, block nets, or other temporary exclusion methods (e.g., silt curtains) could be used to exclude fish or isolate the construction area prior to a fish removal process.
- A dewatering plan shall be submitted as part of the SWPPP and Water Pollution Control Program, detailing the location of dewatering activities, equipment, and discharge point. Dewatering pump intakes shall be screened to prevent entrainment of fish in accordance with the NMFS screen criteria.
- A qualified fish biologist or fish rescue team shall be onsite during the dewatering process to minimize the number of fish that become trapped in isolated areas or impinged on pump screen(s) or isolation nets.

Prior to any in-water construction that would require pile driving, a NMFS-approved sound attenuation monitoring plan to protect fish and marine mammals, and the approved plan shall be implemented during construction.

All in-water construction shall be conducted within the environmental work window between June 1 and November 30, designed to avoid potential impacts to fish species.

A soft start technique (release of pile-driving hammer without hydraulic pressure) to impact hammer pile driving shall be implemented, at the start of each workday or after a break in impact hammer driving of 30 minutes or more, to give fish and marine mammals an opportunity to vacate the area.

During in-water installation of piles, when feasible, vibratory hammers should be used in place of impact hammers, as well as cushion blocks should be used.

The USACE and its contractors shall minimize impacts on waters of the U.S. and waters of the state, including wetlands, by implementing the following measures:

The proposed project shall be designed to avoid, to the extent practicable, work within wetlands and/or waters under the jurisdiction of the USACE, the regional waterboard, the CDFW, and BCDC. If applicable, permits or approvals shall be sought from the regulating agencies as required. Where wetlands or other water features must be disturbed, the minimum area of disturbance necessary for construction shall be identified and the area outside avoided.

Prior to construction within 50 ft of any wetlands and drainages, appropriate measures shall be taken to ensure protection of the wetland from construction runoff or direct impact from equipment or materials, such as installation of a silt fence, and signs indicating the require avoidance. No equipment mobilization, grading, clearing, or storage of equipment or machinery, or similar activity, shall occur until a qualified biologist has inspected and approved the fencing installed around these features. The contractor shall ensure the temporary fencing is maintained until construction activities cease.

Where disturbance to jurisdictional wetlands or waters cannot be avoided, any temporarily affected areas shall be restored to pre-construction conditions or better at the end of construction, in accordance with regulating agencies.

4.15 Upland Resources

The evaluation methodology is based on a comparison of existing to future conditions in terms of surface area (acres) and consideration of the value of cover types of terrestrial habitat, wildlife, and fish. Impacts to biological resources can be short-term or long-term. Short-term impacts are primarily associated with construction activities and are described below. Long-term impacts would likely occur with a changing landscape associated with the proposed action.

Significance Criteria

Adverse effects on vegetation and wildlife were considered significant if implementation of an alternative plan would result in any of the following:

BIO-01: Result in a substantial change of native vegetation;

BIO-02: Substantially change the quality of important habitat or access to such habitat for wildlife species;

BIO-03: Result in substantial change of a resource(s), including fish and wildlife and their associated habitats, that are technically, institutionally, or publicly recognized as having substantial nonmonetary value.

4.15.1 Construction Impact Summary

During construction, vegetation removal would be required for construction equipment mobilization, staging areas, and haul routes. Where possible, existing disturbed areas would be used to avoid additional vegetation removal and surface disturbing activities. Where not possible, existing vegetation would be removed and disposed of off-site. The area would be restored to pre-construction conditions once use of the area is complete. Similar vegetation removal practices would also be required in and around areas where excavation, grading, or constructed structures are being implemented. However, the extent of vegetation restoration would be dependent on whether the site has been converted to impervious surface or not.

Adverse effects may occur to vegetation outside of the proposed project area during construction from fugitive dust emissions produced by construction machinery and worker traffic along unpaved roads/routes. Dust emissions could impede photosynthesis by reducing light penetration into plant leaves and increase the risk of growth of plant fungal disease (Jerrett 2021). Impacts from dust generated during construction activities would be short-term and controlled by dust suppression measures (e.g., water spraying) as required by regulations. After construction, local off-site vegetation is expected to recover with no long-term losses.

Use of construction equipment and surface disturbance could contribute to the establishment and spread of non-native plants by transporting species between work areas. Aggressive non-native species could become established if ground disturbance during construction is extensive and lengthy. These potential impacts can be reduced through typical construction BMPs such as minimizing soil disturbances, cleaning equipment of plants prior to moving between project areas, stabilizing disturbed soils as soon as possible, and using certified weed-free seed for revegetation.

While operating construction equipment, there lies the possibility for spillage of fuels and other material that could damage plants and has the potential to cause shifts in population structure, abundance, diversity, and distribution of plants. Certain materials could remain in the environment for an extended period following a spill event.

However, these are expected to be minor as protocols would be in place through the SWPPP, NPDES Construction Permit, and water quality certification to contain and remedy any spill appropriately.

Construction activities are anticipated to adversely impact resident, migrant, or incidental wildlife within or near the project area. Impacts include loss of habitat through removal or alteration of vegetation, habitat fragmentation, and avoidance (e.g., Jackson and Griffin 2000). Vegetation would be removed within the construction zone which would result in temporary or permanent loss, or alteration of available habitat. Mobile wildlife would be capable of relocating to adjacent suitable habitats, whereby such displacement may cause temporary declines in local populations as individuals move to neighboring territories. This dislocation may induce competition between displaced individuals and established populations of the same species, or related species with similar habitat and food requirements, for limited resources. In a highly urbanized environment, like the study area, resources are already scarce and likely stressed, thus may not be capable of supporting a higher population density, which could have cascading impacts leading to further displacement or mortality of wildlife. In general, wildlife would be expected to return and resume use of disturbed areas after construction ceases and habitat recovers or is restored, except where long-term impacts are expected as described in each of the Action Alternative sections. Sessile species, species with small home ranges, or those with specialized habitat requirements, may not be as capable of seeking suitable habitat outside of the construction zone and would likely result in mortality of individuals.

Short-term, localized, adverse effects to wildlife are expected to occur during construction from noise, light pollution, and general physical disturbance of the environment. Wildlife relies on meaningful sounds for communicating, navigating, reproduction, avoiding danger, and foraging. The level of impact from noise on wildlife depends on decibel levels, durations, the physical characteristics of the environment, and the species threshold to disturbance (Sordello et al. 2020). These impacts are referred to as noise pollution, which can harm the health, reproduction, survivorship, habitation, distribution, abundance, and biodiversity of wildlife. Noise pollution can also lead to changes in behavior, including avoidance and disturbance of normal patterns. For example, noise pollution can lead to intrusion-induced behavioral changes among birds such as nest abandonment and decreased nest attentiveness, which have led to species declines (Knight and Gutzwiller 1995). Overall, impacts from noise would be localized to the general vicinity of the construction zone and limited to the duration of the construction activity. In most instances, work would not be concentrated in any one area in exceedance of one year, limiting impacts to breeding and migration seasonally. This reduces the likelihood of long-term population declines resulting from construction activities. Any wildlife displaced by noise would likely return to remaining habitat once construction is complete. The study area is highly urbanized, thus anthropogenic noise is omnipresent, stemming from traffic and other industrial and commercial activities on a regular basis. Noise generated from construction activities would be temporary and localized but would be expected to increase the ambient city noise.

Direct injury and/or mortality of birds, small mammals, reptiles, amphibians, and invertebrates may occur during construction through inadvertent destruction of dens, nests, cryptic organisms, or trampling of slower moving or sessile species by heavy equipment or personal vehicles. Mobile species are expected to be capable of avoiding injury or death while crossing haul roads and by avoiding the construction area.

The severeness and duration of these impacts to wildlife is dependent on the final design of each measure, type of equipment used, length of construction activities, and mitigation, if required. Construction-related impacts are expected to be localized and cease once construction completes, thereby are not anticipated to have population-level effects on any species.

Overall, limited upland vegetation is present in the study area due to the urbanized nature. There exists shrubbery and trees planted amongst urban infrastructure, as well as parks and open space in the vicinity of the study area; however, no native vegetated natural resources exist within the study area. Coastal saltmarsh is present in the study are at Heron’s Head Park.

4.15.2 Operations and Maintenance Impact Summary

O&M impacts would be similar to those described in the construction impact summary but on a much-reduced scale, given the level of activity that would occur. Limited impact to vegetation and upland wildlife would be expected, except in areas where vegetation may occur (e.g., planted levees) that require augmentation or future adaptive actions. Impacts would mostly be limited to short-term, localized effects from noise, light pollution, and general physical disturbance of the environment.

4.15.3 Tentatively selected plan

Impacts from construction the TNBP are expected to range from no to low, with shore-based measures posing the greatest risks to these features (Table 4-37).

Table 4-37. Summary of Upland Resource Impacts associated with the TNBP

TNBP Upland Resource Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint (1st Action)	1	2	2	2	2	2	2	2	1	2	2+	2+	2+	1
Construction/Footprint (2nd Action)	1	2	1	1	2	1	2	1	1	2	2+	2+	2+	2+
O&M Assumptions	1	2	1	1	1	2	2	2	1	2	2+	2+	2+	2+
Mitigated Rating	*1*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*1*	*2*	*1*	*1*	*1*	*1*

As described in the construction impact summary and Alternatives F and G, adverse impacts in the TNBP are anticipated to result from shore-based measures, albeit would be minor given the limited vegetation in the construction areas. Construction and maintenance of shore-based measures would be ***less than significant***. In-water measures such as wharf and bay fill would have ***no impact*** on upland resources as no work would be performed in vegetated areas.

The TNBP includes EWN features that would have long-term beneficial impacts to upland resources by created new vegetated areas available for foraging, refuge, and colonization. In general, there is fewer acreage of EWN measures in the TNBP as compared to Alternative F and G (Table 4-4 and Table 4-5). Construction and maintenance of EWN features would have ***less than significant*** impacts to upland resources.

4.15.4 Alternative B

Adverse impacts to upland resources from Alternative B would be the same as those described in the construction impact summary, particularly when a building would be removed, relocated, and/or demolished. Floodproofing activities would have less impacts as these would be less disruptive and effect a smaller footprint. Given the design of Alternative B, impacts from the non-structural measures would be realized over varying time scales, but occur more frequently than the other action alternatives.

Alternative B was designed to act at varied time steps, dependent on risk of SLR, which resulted in an estimated four-year implementation strategy. It would be expected that impacts to upland resources would be minimal given the urbanized nature of the study area. ***No impact*** to coastal saltmarsh is expected from construction related activities in this alternative. All other impacts would be ***less than significant***.

4.15.5 Alternative F

The adverse impacts for constructing Alternative F range from no to low impacts (Table 4-38).

Table 4-38. Summary of Upland Resource Impacts associated with Alternative F

Alternative F Upland Resource Impact Rating by Measure	Bay fill	Levee	Bulkhead wall/Seawall	Roadway Impact	Tide Gate	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Marsh Enhancement*
Construction Footprint	1	2	1	2	2	2	2	1	2	2+	2+
O&M Assumptions	1	2	1	1	1	2	2	1	2	2+	2+
Mitigated Rating	*1*	*2*	*1*	*2*	*2*	*2*	*2*	*1*	*2*	*1*	*1*

Construction and maintenance related impacts would not differ from those described in the construction impact summary. Limited vegetation is present within the construction footprint, mostly reduced to planted trees, shrubbery, and man-made green space. Heron's Head Park is present near the construction site of an EWN ecotone levee and marsh enhancement. Minor adverse impacts would be expected with excavation, dirt work, and fill operations during construction; however, in the long-term addition of ecotone levees and marsh would have beneficial impacts to upland resources. Building the ecotone levee near Heron's Head Park would offer a transitional zone for aquatic and upland wildlife, as well as provide habitat for special status species such as the saltmarsh harvest mouse.

Shore-based measures are anticipated to have low impacts to upland resources based on those descriptions provided in the construction impact summary. These are anticipated to be low, short-term, and localized to the construction area and would be returned to pre-existing conditions upon construction completion. Thus, shore-based measures would have ***less than significant*** impacts. In-water measures such as wharfs and seawalls are expected to have ***no impact*** to upland resources.

4.15.6 Alternative G

Alternative G is anticipated to have impacts ranging from no to low, like Alternative F, but would also offer a substantial beneficial impact to upland resources with the addition of EWN measures in the 2090 action (Table 4-39).

Table 4-39. Summary of Upland Resource Impacts associated with Alternative G

Alternative G Upland Resource Impact Rating by Measure	**Levee**	**Bridge raise**	**Bulkhead wall/Seawall**	**Roadway Impact**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint	2	2	2	2	2	2	1	2	2+	2+	2+	2+
O&M Assumptions	2	1	1	1	2	2	1	2	2+	2+	2+	2+
Mitigated Rating	*2*	*2*	*2*	*2*	*2*	*2*	*1*	*2*	*1*	*1*	*1*	*1*

As previously described, shore-based measures are anticipated to have impacts like those in the construction impact summary. No rare or unique native vegetation exists within the construction area, thus, is not likely to be impacted by any of the construction or maintenance activities. Indirect impacts through dust generation would be minimal and would not have long-term negative impacts. Alternative G maximized the addition of EWN features as the line of defense was retreated inland with SLR. As such, the alternative adds 700+ acres of new green space that transforms the waterfront from mostly urbanized to potential habitat for vegetation and wildlife.

Coastal saltmarsh is present at Heron's Head Park which is intended to be enhanced and expanded with marsh augmentation, as well as addition of an ecotone levee and naturalized shorelines. This provides new wildlife corridors and habitat connectivity that is not currently present in the study area. Native grasses would be planted in EWN features to maximize the survivability and function of the environment, while invasive species would be controlled and managed to reduce establishment or spread. Overall, this would have substantial positive benefits for upland resources. Adverse impacts from construction and maintenance of these features would be meniscal as compared to the long-term beneficial effects of established such extensive new habitat area.

All shore-based construction activities would be ***less than significant*** in terms of short-term and long-term impacts to upland resources. In-water based measures, such as wharf, would have ***no impact*** to upland resources. Alternative G would have the greatest net beneficial impacts to upland resources of any action alternative.

4.15.7 Independent Measures for Consideration

The following are impact scores for independent measures that could be applied to an alternative (Table 4-40).

Table 4-40. Summary of Upland Resource Impacts associated with Independent Measures

Independent Measures Upland Resource Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	2	2	2	2	2	2+	1
O&M Assumptions	2	2	2	2	2	2+	1
Mitigated Rating	*2*	*2*	*2*	*2*	*2*	*1*	*1*

As with the action alternatives, any shore-based construction is expected to have low impacts to upland resources like those described in the construction impact summary given the urbanized nature of the study area. In the particular areas construction for independent measures would occur, there is very limited vegetation. Terrestrial wildlife, such as birds, rodents, amphibians, and reptiles may transit and utilize the space, though this is anticipated to be fairly minimal. As such, impacts to upland resources would be ***less than significant*** during construction and maintenance activities. In-water work such as installation of a living shoreline would have ***no impact*** to upland resources.

4.15.8 Mitigation

BMPs described in the Geology and Water Quality mitigation sections would be used to reduce overall impacts to upland resources during construction and maintenance activities.

4.16 Special Status Species

This section describes adverse and beneficial impacts to special status species including Federally-listed threatened and endangered species, state-listed threatened and endangered species, designated CH's, migratory birds, marine mammal protection act species, EFH, and HAPCs.

Effects to species and habitats are considered adverse if they result in any one of the following:

- Direct mortality;
- Temporary effects to habitats such that the species suffers increased mortality or lowered reproductive success;
- Permanent loss of habitat determined to be critical and/or essential to the species;
- Substantial reductions in the size of a population of the species.

Significance Criteria

An alternative would be considered to have a significant effect on special-status species or habitats if it would result in:

- **SS-01:** Substantial adverse effects, either directly or through habitat modification, on any species identified as a candidate, sensitive or special status species in local or regional plans, policies, regulations, or by the USFWS, NMFS, or TPWD
- **SS-02:** Take of a Federally- or State-listed threatened or endangered species
- **SS-03:** Adversely affect designated critical habitat

4.16.1 Construction Impact Summary

The impacts described in the Aquatic Resources and Upland Resources sections would be applicable to marine and terrestrial protected species, respectively, under each of the Action Alternatives. A Biological Assessment (BA) was prepared to document the impacts of implementing the TSP on ESA-listed species (Appendix D-5 and Appendix D-6). Details of construction-related impacts and effects determinations for affected species can be found in the BA. A brief impact assessment was conducted for each of the Action Alternatives; however, some species were not expected to be impacted by any of the Action Alternatives as the study area is outside of their known range and/or the area lacks suitable habitat. The USACE determined all of the Action Alternatives would have ***no effect*** on the following list of ESA species:

Mammals: Blue whale, Fin whale, Killer whale, North Pacific right whale, Sei whale, Sperm whale;

Birds: Western snowy plover;

Reptiles: Alameda whipsnake, San Francisco garter snake, Green sea turtle, Leatherback sea turtle, Loggerhead sea turtle, Olive Ridley sea turtle;

Amphibians: California red-legged frog;

Fish: Delta smelt, Tidewater goby, White abalone;

Insects: Monarch butterfly;

Flowering plants: Franciscan manzanita, Marin dwarf-flax, Presidio clarkia, Presidio manzanita, San Francisco lessignia, Showy Indian clover, Sonoma sunshine, and White-rayed pentachaeta.

The mammalian species are mostly migratory and only transit to California waters seasonally, though not within the study area. Most of the whale species identified prefer deeper offshore water in the Pacific Ocean or Gulf of California, with only three species (Gray whale, Humpback whale, Killer whale) known to transit in shallower coastal waters periodically. Gray whales can be found in shallow coastal waters in the North Pacific Ocean but are highly unlikely to be encountered in the San Francisco Estuary.

Impacts to special status species can be direct or indirect. Direct impacts could result in the take of species, physical displacement, change/removal of habitat, change to localized topography, and the temporary and localized impacts from construction activities (e.g., noise, vibration, land disturbance). Indirect impacts would indirectly affect the well-being of a species through activities that cause a loss of forage species, for example, or conversion of potential habitat to grey features.

4.16.1.1 Terrestrial Impacts

Terrestrial mammal species (i.e., salt marsh harvest mouse) would experience temporary impacts from vegetation removal, noise, and vibrations during construction site preparation activities. Salt marsh harvest mouse are generally restricted to brackish and saline marshes but can frequently use terrestrial grassland habitats adjacent to marsh and grass-*Sarcocornia* ecotones (Johnson and Shellhammer 1988; Shellhammer et al. 1988). Construction activities are avoided in wetlands where the mouse would likely be most present; however, all action alternatives would experience construction of an CFRM feature adjacent to Heron's Head Park that would generate noise, air emissions, visible structures, and physical land disturbance that could adversely impact salt marsh harvest mouse populations. No *Sarcocornia* vegetation is expected to be removed or degraded during construction activities, which is the preferred habitat for the mouse species.

Special status birds that could be present in the study area are predominantly marine or waterfowl that use both aquatic and terrestrial habitat for survival, but there are also small terrestrial species (i.e., bank swallow) that could be adversely impacted during construction. Temporary impacts associated with habitat disturbance, lighting, and noise are expected during construction of CFRM and EWN features from activities such as earthwork, use of heavy machinery, pile driving, demolition, placement of fill, installation of stone and concrete, and ground improvements. Construction noise can hinder migratory birds' ability to call and communicate. The study area is highly urbanized with minimal natural habitat available. No nesting habitat for special status species are expected to be directly impacted or removed during construction as none are present. The primary indirect impact to protected bird species is the effect of construction on forage species for birds and insects in the action area. Construction activities may include bottom habitat disturbance, loss of forage organisms, loss of vegetation, and impacts to benthic, tidal invertebrates, and fish from shore-based measures that could adversely impact prey availability.

Turbidity from runoff and dust accumulated in the water column from shore-based construction could temporarily disrupt foraging rates of shore birds, migratory birds, and pelagic species that utilize open water or benthic habitat. It is anticipated that birds would utilize suitable adjacent habitat until construction is complete. Turbidity impacts would be localized and expected to cease when construction is complete. The overall area that would be impacted at any given time is a small percentage of the study area, thus, habitat would be available for birds to forage and roost in adjacent areas. Protected birds are anticipated to move away from the area of construction to suitable available habitat adjacent to the project sites.

Federally listed California seablite could indirectly be impacted due to construction of shore-based measures if present in the study area. This plant grows in a restricted area within the intertidal zone of salt marshes, which are present at Heron’s Head Park. The last observation of California seablite at Heron’s Head Park was in 2003 from an extant population that was reintroduced in 1999 (USFWS 2010). Direct impact from physical disturbance would be avoided because no removal or damage to wetland areas should occur. Indirect impacts from air emissions or fugitive dust from operation of heavy equipment and construction of CFRM features could impede photosynthesis temporarily. Any indirect impact to special status plant is expected to be localized, temporary, and minor.

4.16.1.2 Aquatic Impacts

Protected aquatic species are expected to experience temporary impacts from habitat disturbance with construction of in-water features such as displacement of marine fauna associated with noise, vibration, and physical disturbance. Potential direct impacts during construction include physical contact with construction equipment such as entanglement and vessel strikes, entrainment, exposure to underwater noise, degraded water quality, and exposure to water or effluent discharges.

During construction of in-water features, changes in turbidity levels would be localized and temporary, particularly with the use of BMP’s described in the mitigation section for Water Quality. For fish, turbid water concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). High total suspended solids (TSS) levels can cause a reduction in dissolved oxygen levels, which may result in protected fish becoming stressed. For example, young sturgeons have experienced high levels of mortality at low dissolved oxygen levels while older sturgeon tolerated reduced levels for short durations. However, tolerances may decline if chronic exposure to low dissolved oxygen occurs (Jenkins et al. 1993). Behavioral and physiological effects could occur if sturgeon are exposed to TSS levels of 1,000 mg/L above ambient for greater than 14 days at a time (Johnson 2018). While increases in suspended sediments may cause fish to alter their normal movements, these movements are expected to be minor and temporary. Other suitable habitat would be available in adjacent areas to the construction zone. TSS is not likely to exceed 1,000 mg/L above normal during construction for an extended duration (e.g., 2 weeks) as the turbidity causing activity would not be fully continuous for the duration of construction. For example, pile driving for wharf replacement would occur during daylight hours and cease at night, affording suspended sediments and turbidity time to settle before the next workday. TSS is most likely to affect fish if a plume causes a barrier to normal behaviors; however, the aquatic protected species are mobile and are anticipated to move from the areas of in-water construction to more suitable habitat during those activities. Additionally, BMPs such as seasonal restrictions and protected species observers would be used to mitigate and minimize impacts to ESA and protected species during operations. Details can be found in the Mitigation section.

Sessile and some benthic invertebrates would be lost during removal and replacement of pilings for wharf replacement actions. This would temporarily disrupt prey availability in localized areas for marine protected fish and birds. Other areas would be available for consumption and foraging within and adjacent to the study area, so it is assumed mobile fish and birds would shift elsewhere. Because of the temporary duration of work and that it would be conducted in distinct sections, impacts to protected species forage ability is expected to be ***less than significant***.

Construction of in-water features such as foundations, piles, and walls (e.g., seawall, sheetpile wall) could cause changes to community composition and attraction of structure-oriented invertebrates. The new foundations and structure installations can produce the artificial “reef effect”, attracting species of algae, fish, shellfish, and other invertebrates to the hardened structures (Langhamer 2012). The loss of benthic habitat, in some instances, is expected to be offset by the introduction of new hard-bottoms substrate that would support benthic communities. This may attract prey species important in supporting protect marine mammals, birds, and fish. However, biofouling or colonization by invasive species could also occur, causing a long-term permanent impact.

Construction of in-water structures may indirectly affect pelagic birds that use the San Francisco Estuary for foraging by disturbing benthic habitat, invertebrates, and potentially the fish on which they feed. The area of impact would be relatively small at any given time as the measures would be constructed in sections so that birds could forage in other areas that are not being affected.

No impacts to special status plants are anticipated from in-water construction activities.

4.16.2 Operations and Maintenance Impact Summary

Operations and maintenance activities are expected to have minimal impacts to special status species. O&M would consist of inspections, construction to repair damaged features, and application of corrosion resistant coating for some in-water structures (e.g., sheetpile wall). Adverse impacts from O&M would not differ from those described in the construction impact summary except the effects would be on a much smaller scale and over a shorter period. No loss or take of special status species would be expected with operations and maintenance.

4.16.3 Tentatively selected plan

The TSP is anticipated to have adverse impacts on protected species that range from low to moderate to high (Table 4-41).

Table 4-41. Summary of Special Status Species' Impacts associated with the TNBP

TNBP Special Status Species' Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint (1st Action)	1	2	2	2	2	4	2	2	4	2+	2+	2+	2+	1
Construction/Footprint (2nd Action)	4	2	4	1	2	1	2	1	4	2+	2+	2+	2+	2+
O&M Assumptions	1	2	2	2	1	2	2	2	2	2+	2+	2+	2+	2+
Mitigated Rating	*4*	*2*	*3*	*2*	*2*	*3*	*2*	*2*	*3*	*1*	*1*	*1*	*1*	*1*

Impacts would be similar to those described for Alternative B, F, and G for measures that overlap with those alternatives. Shore-based measures would have ***less than significant*** impacts and, in general, be on a smaller scale for most measures as compared to Alternative F and G. Impacts would be temporary and localized to the construction area, as such, terrestrial protected species and birds would be expected to move to adjacent habitat and avoid the site until construction completes.

Wharf construction is anticipated to have the same impacts as Alternative F and G, but on a much larger scale with nearly 8 and 5 times the acreage being disturbed, respectively. This is still expected to generate impacts that are ***less than significant with mitigation***.

Bay fill would permanently remove protected habitat (e.g., EFH, critical habitat) and suitable habitat for protected species. This would be on a much smaller scale that Alternative F, but would remove habitat nonetheless, thus impacts are expected to be ***significant and unavoidable***. In areas of bay fill, a new seawall would be constructed bayward of the existing, and as with Alternative F, would permanently remove habitat. Similarly, this is expected to have ***significant and unavoidable*** impacts during the second action when the impact would occur. During the first action, the seawall construction would occur landward of the existing, thus no impacts to aquatic species or habitat are anticipated. Temporary adverse impacts, like those described for shore-based measures, would be realized during this action.

A sheetpile wall is proposed to be constructed in Reach 4 adjacent to Heron’s Head Park. Heron’s Head Park is important habitat for protected terrestrial and aquatic species, thus, the impacts from noise, vibration, physical and visual disturbance are anticipated to be moderate during construction. Aquatic species are likely to avoid the area during construction given the noise and physical disturbance (e.g., turbidity, sediment suspension) from pile driving. It is also expected that migratory birds and protected birds would also be displaced from Heron’s Head during construction. Mobile species would be expected to seek adjacent habitat during this period. Overall, construction of this feature is expected to have impacts that are ***less than significant with mitigation***.

4.16.4 Alternative B

Adverse impacts from floodproofing, building demolition, and relocation are anticipated to be like those described in the Construction Impact Summary for Terrestrial Impacts. Construction activities would occur sparsely over time, directed by threats from SLR induced flooding, and be limited to those areas that require action. Habitat would be available in adjacent areas during construction activities that protected species would be able to utilize. Impacts overall are expected to be low and ***less than significant***.

Areas of retreat would expand available habitat in some areas for protected species including birds, terrestrial mammals, and plants as infrastructure and impervious surfaces are converted to green space. Temporary adverse impacts such as noise, vibration, presence of heavy equipment, and land disturbance would occur to conversion of grey space to green, but this is anticipated to be ***less than significant*** as other habitat spaces would be available in adjacent areas. Under Alternative B, Heron’s Head Park is likely to be lost or greatly reduced spatially as sea level rises. This could have a ***significant and unavoidable*** impact on terrestrial protected species (e.g., California clapper rail, Ridgeway’s rail, salt marsh harvest mouse) as it is the only suitable habitat available in the study area. Losing this habitat to SLR would displace local populations and likely result in loss of species that are less likely to be able to move to surrounding areas (i.e., salt marsh harvest mouse).

Pier removal would result in localized, temporary impacts to aquatic protected species, like marine mammals and fish, from noise, turbidity, vibrations, sediment suspension, and physical disturbance. These impacts would be limited in spatial extent through implementation of BMPs described in the Water Quality mitigation section (e.g., use of silt curtains). Pier removal could temporarily disrupt foraging behavior of fish and marine mammals in the vicinity of the construction area, but given the high motility of these species, additional foraging areas would be available during that time. Piers offer artificial intertidal habitat in the San Francisco Bay that support benthic invertebrates, sessile organisms, and larvae. Removal would eliminate this habitat structure and thus, remove foraging, refuge, and nursery habitat for special status fish and animals that rely on prey that congregate around structures. This would result in permanent removal of any organisms directly attached to the piers and displace those around the structure to other areas. Given the limited extent of piers (n = 2) being removed, this adverse impact would be ***less than significant***. In the long-term, water quality is likely to be improved with removal of contaminated pier pilings, and thus, ***beneficial*** impacts would be realized to special status marine mammals and fish that forage or refuge around this area.

4.16.5 Alternative F

The adverse impacts for constructing Alternative F range from low to moderate to high impacts (Table 4-42).

Table 4-42. Summary of Special Status Species' Impacts associated with Alternative F

Alternative F Special Status Species' Impact Rating by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	4	2	4	2	3	2	2	4	2+	2+	2+
O&M Assumptions	1	2	1	1	2	2	2	2	2+	2+	2+
Mitigated Rating	*4*	*2*	*4*	*2*	*2*	*2*	*2*	*3*	*1*	*1*	*1*

Shore-based measures such as levees, walls, t-walls, and roadway construction are expected to have low impacts to special status species. Most impacts are synonymous with those described in the Construction Impact Summary for Terrestrial Impacts. Impacts would be temporary and localized to the construction site. It is anticipated that protected species are mobile and would transit to adjacent habitat during construction. Thus, these actions would have ***less than significant*** impacts to protected species. Additionally, building relocations and demolition are anticipated to have the same impacts as those described in Alternative B.

The construction of EWN features would have temporary, localized, adverse impacts to protected resources such as through generation of noise, turbidity, sediment suspension, vibrations, and physical disturbance. This is anticipated to be ***less than significant*** overall as adjacent habitat would be available during construction, and in the long-term, EWN measures would be increasing available habitat in the area. EWN features such as ecotone levees and marsh enhancement are planned at Heron's Head Park and Pier 94 wetlands. This creation and augmentation of habitat would have long-term ***beneficial*** impacts to protected species of birds, terrestrial mammals, and plants. The ecotone levee at Heron's Head offers a transition from salt marsh to upland that could provide suitable areas for California seablite, as well as refuge for salt marsh harvest mouse that may be present. The expansion of habitat would provide beneficial foraging, roosting, and potentially nesting grounds for protected birds. Ecological armoring, along with marsh enhancement, would offer long-term ***beneficial*** impacts to protected fish by providing habitat and refuge for prey species. Fish would benefit from improved water quality and habitat with enhancement and addition of marsh area.

Protected fish, particularly green sturgeon, are susceptible to entrainment, entrapment, and mortality during dewatering activities and construction of associated enclosure structures, such as cofferdams. Early life stage sturgeon, such as eggs and larvae, are not anticipated in the study area; however, young adults and juveniles are assumed to be present. Dewatering activities are anticipated to be associated with construction of tidal gate foundations, seawall, and bay fill. BMPs as described in the Aquatic Resources mitigation section would be used to minimize entrapment of special status fish in areas set to be dewatered. During removal techniques, fish could become stressed, though this would be minimized to the greatest extent practicable. Removal from dewatered areas is not anticipated to have any long-term or permanent impacts to protected fish species. Dewatering would not directly impact marine mammal or pelagic birds' species; however, indirect effects would be expected by the loss of forage area during construction. Mammals and birds are expected to forage elsewhere in adjacent areas until construction is completed. Impacts from dewatering are anticipated to be ***less than significant with mitigation***, temporary, and localized to the construction area.

Construction of the new seawall and bay fill would permanently remove designated critical habitat for green sturgeon and chinook salmon, HAPC, and EFH from the study area. Approximately 25 acres of bay fill is planned for Alternative F to move the seawall bayward of the existing one. This is anticipated to have permanent impacts to designated CH, HAPC, and EFH, as well as marine mammals, and protected fish and bird species that utilize the pelagic and benthic habitat. Bay fill and seawall would permanently remove forage, refuge, loafing, and nesting habitat used by protected species. Additional habitat is available within the study area that can be utilized during and after construction. Construction of the seawall would also cause physical disturbance, turbidity, sediment suspension, noise, vibration, and potential release of contaminants from sediments that would adversely impact marine protected species. Permanent impacts from habitat loss are expected to be ***significant and unavoidable***.

Wharf construction is anticipated to have moderate to high impacts and be like those described for pier removal in Alternative B, but on a larger scale. Temporary, localized impacts would be recognized in the construction area such as noise, vibration, turbidity, sediment suspension, and physical disturbance. This would occur during removal of pilings, as well as during replacement. Pile driving is anticipated to occur during the day and cease at night, thus, turbidity and sediment suspension would be expected to lessen in the construction area periodically. Overall, the wharf being replaced would exist in the same footprint as before, so no increase to shade structure would be expected. A temporary loss of potential prey sources would occur when pilings are removed but is expected to return once pilings are replaced. Wharf replacement is expected to have adverse impacts that are ***less than significant with mitigation*** to protected aquatic species, EFH, HAPC, and designed CH for chinook salmon and green sturgeon.

Tidal gate construction is expected to have low impacts to migratory birds, waterfowl, and pelagic bird species from construction noise, vibration, and physical disturbance. Indirect impacts may occur during installation through increased turbidity which may lead to reduced foraging capabilities. Birds are expected to utilize adjacent areas in San Francisco Bay during construction. Operation of tidal gates could have temporary adverse impacts to protected birds through noise and vibration and increased turbidity. This would only last during opening and closing of the tidal gates, lasting short durations (hours). The frequency and duration of operation during storm events has not been assessed but would be required to determine overall effects to protected birds. In general, impacts are expected to be low given the temporary and infrequent nature of annual maintenance needs. Beneficial indirect impacts could occur to protected birds through management of flood risk and reducing erosion during large storm events of coastal and terrestrial habitats during barrier closure.

Construction of tidal gates, particularly the foundations, are anticipated to have moderate impacts on protected fish, HAPC, EFH, green sturgeon CH, and marine mammals. Cofferdams would be installed prior to construction of foundations that would require dewatering, which would have the same impacts to fish and marine mammals as previously described. Construction of the gates and support structure would create noise, vibrations, and physical disturbance during installation. The adverse impacts from construction would be temporary and localized; however, foundation installation would permanently remove HAPC, EFH, and green sturgeon designated CH within the direct footprint. This is anticipated to be small in comparison to the study area and San Francisco Bay, thus, impacts would be ***less than significant with mitigation***. Indirect impacts to fish and marine mammals would occur with the potential loss of prey in the construction area, but these species are expected to forage in adjacent areas.

Operation of tidal gates are expected to have low impacts to protected terrestrial species but could have temporary moderate adverse impacts to protected aquatic species. Terrestrial species are likely to be adversely impacted by noise; however, they are not expected to be within the direct vicinity of tidal gates to which this impact could be more severe. The protected species in the study area are highly mobile and would be expected to leave the area of disturbance if or when tidal gates were being closed for maintenance testing. Aquatic species, mammals and fish, could be temporarily impacted by gate closure such as through changes to water quality, increased turbidity and sediment suspension, and minor restriction of passage for the species and/or prey. Tidal gates would be closed primarily during a coastal storm or during annual maintenance procedures. Additional hydrodynamic analyses are necessary to assess closure frequency and duration, by which a more thorough analyses of impacts to special status species could be completed. Mammal and fish species are highly mobile and are anticipated to move away from the maintenance operations for more suitable habitat. It is not likely that marine mammals would become entrapped in the creek areas during operation; however, some fish species (e.g., green sturgeon, smelt) could become temporarily entrapped inside the creek during operation. This is not expected to have substantial consequences as the gate would be temporarily closed and re-opened within a few hours. However, during a storm event, if protected fish were to become entrapped in the creeks, they could experience degraded water quality conditions, be exposed to contaminants from runoff, and may be restricted from prey.

Indirect impacts from gate closure include temporary changes to hydrology and water quality, increased noise, and vibration. Noise and vibration would adversely impact marine mammals and protected fish during gate closure and opening operations but would cease once those actions are completed.

4.16.6 Alternative G

The adverse impacts for constructing Alternative G range from low to moderate to high impacts (Table 4-43).

Table 4-43. Summary of Special Status Species' Impacts associated with Alternative G

Alternative G Special Status Species' Impact Rating by Measure	**Levee**	**Bridge raise**	**Bulkhead wall/Seawall**	**Roadway Impact**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint	2	2	2	2	2	2	4	2+	2+	2+	2+	2+
O&M Assumptions	2	2	2	1	2	2	2	2+	2+	2+	2+	2+
Mitigated Rating	2	2	2	2	2	2	3	1	1	1	1	1

As described in Alternative F and the Construction Impact Summary for Terrestrial Impacts, shore-based measures are anticipated to have low impacts to special status species overall. The majority of shore-based measures are constructed in areas that would not be ideal or suitable habitat for protected birds, mammals, and plants. The species that could be impacted or present in the construction site would be mobile and have the ability to move to adjacent areas during the period of construction. Overall, impacts are expected to be ***less than significant***.

Wharf construction would have moderate to high impacts to aquatic protected species, as well as EFH, HAPC, and designated CH for Chinook salmon and green sturgeon. Adverse impacts from wharf replacement would be the same as those described in Alternative F, but on a larger scale as more wharf is planned for replacement in Alternative G (5 acres vs. 8 acres total, respectively). As with Alternative F, impacts are expected to be ***less than significant with mitigation***.

Alternative G proposes to convert the largest acreage of grey surface to EWN features of any alternative (700+ acres) which would have temporary, localized, minor adverse impacts during construction to protected species, but long-term ***beneficial*** impacts. Construction is anticipated to impact protected species through generation of noise, vibration, physical and visual disturbance, presence of heavy machinery, placement of fill, and earthwork. Overall, these impacts are expected to be ***less than significant*** due to their temporary nature and that the long-term beneficial impacts would far outweigh the limited adverse impacts from construction. Addition and augmentation of marsh at Heron's Head Park would significantly improve suitable and preferred habitat for threatened and endangered federally listed and state-listed species, both terrestrial and aquatic, as well as provide new habitat areas for migratory birds. Heron's Head Park has supported Ridgway's rail breeding populations, with the first chicks discovered in 2011 and the last siting reported in CNDDB also occurring in 2011 (Mosur 2015, CNNDB 2023). Only a single Ridgway's rail remained by 2015 (Mosur 2015). With an increase in suitable habitat, nesting and breeding populations would have the space to potentially become re-established. Pier 94 wetlands also provides habitat for the rail but has not supported any breeding populations to date. Augmentation of these wetlands and addition of ecological armoring would also be beneficial to these species by creating new habitat and protecting it from erosion through wave attenuation.

California seablite is another endangered species known to be present along margins of coastal salt marshes in upper intertidal zones in California. The closest siting's reported in CNNDB occurred at Hunter's Point, approximately 1.5 miles southwest of Heron's Head Park in 2013 (CNNDB 2023). The shrub is endemic to the coastal zone of California, with natural populations limited to Morro Bay and estuarine creek mouths near Cauycos, California (Walgren 2006). However, the species has been re-introduced to other locations in the San Francisco Bay Area (USFWS 2010). California seablite was last observed in Heron's Head Park and Pier 94 wetlands in 2003 and 2008, respectively. The populations at Heron's Head were established in 1999 and maintained at least 20 extant individuals, while Pier 94 populations were extant individuals with seedling recruitment (USFWS 2010). The expansion of ideal habitat in Alternative G would afford California seablite the space to increase population sizes either through passive or active recruitment.

The salt marsh harvest mouth is generally restricted to saline and brackish marsh habitats around San Francisco Bay Estuary. Few major, isolated populations have been documented, though not in the study area (79 FR 10830). Heron's Head Park and Pier 94 wetlands provide suitable marsh habitat for the species, of which, the loss of habitat would reduce populations locally and further lead to overall population isolation. However, with the addition of EWN features such as marsh enhancement, ecotone levees, and naturalized shorelines adjacent to Heron's Head Park, preferred habitat would be created and expanded such that, salt marsh harvest mice could thrive if present.

Alternative G is anticipated to have the most beneficial impacts to protected species and habitat, while having the lowest adverse impacts.

4.16.7 Independent Measures for Consideration

The adverse impacts for constructing independent measures range from low to moderate to high impacts (Table 4-44).

Table 4-44. Summary of Special Status Species' Impacts associated with Independent Measures for Consideration

Independent Measures [Insert Resource] Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	4	4	4	2	2	2	4
O&M Assumptions	2	2	2	2	2	2	2
Mitigated Rating	*4*	*4*	*3*	*2*	*2*	*2*	*3*

Independent measures 2A and 2B include bay fill and new seawall construction that would have permanent impacts to aquatic protect species by removing habitat. The measures would remove 4 and 5 acres, respectively, of pelagic and benthic habitat, which is also EFH, HAPC, and designated CH for green sturgeon and chinook salmon. The adverse impacts would be the same as those described for these actions in Alternative F, but on a smaller scale. Because of the loss of habitat, these measures are expected to have ***significant and unavoidable*** impacts to protected aquatic species and habitat. Measure 2B is expected to have some beneficial impacts to shorebirds with the addition of the EWN coarse beach by increasing foraging habitat and it may increase prey availability locally.

Measure 3A would have moderate to high impacts during replacement of wharf structures like those described in Alternative F and G. Impacts are expected to be on the same scale as Alternative F, given the acreage of wharf being replaced is the same. Overall, wharf replacement is expected to have adverse impacts that are ***less than significant with mitigation***.

Measures 3B, 3C, and 4A are expected to have low impacts to protected species. These are all shore-based measures that would have temporary, localized impacts to terrestrial species through generation of noise, vibration, and physical disturbance. As with the action alternatives, these impacts are expected to be ***less than significant.***

The vertical shoreline would require the use of cofferdams to install textured panels on new or existing seawall. As described in Alternative F, dewatering would be needed which would have adverse impacts to protected fish, particularly juvenile and young adult green sturgeon. Installation of cofferdams would also have temporary adverse impacts to protected fish, habitat, and marine mammals through generation of noise, vibration, physical restrictions to movement, turbidity, and sediment suspension. This is expected to be ***less than significant with mitigation***. In the long-term, the increased intertidal habitat with the vertical shoreline is expected to have ***beneficial*** impacts to protected aquatic species by increased prey availability, particularly for species that feed on small fish, invertebrates, and sessile organisms. Additionally, longfin smelt eggs can adhere to the textured surface providing additional nesting and rearing habitat.

4.17 Noise and Vibration

See Appendix D-1-2 for a discussion of impacts of the alternatives on noise and vibration.

4.18 Cultural Resources

Overall effects determinations consider the context, intensity, directionality (i.e., adverse or beneficial), and duration of the effects and provide the basis for impact-level determination by resource. When considering the magnitude of impacts, the analysis should identify if the impacts are geographically local, regional, or widespread. With regard to temporal extent, this study uses a 100-year period of analysis in which the structural plans recognize adaptability through a phased implementation approach, simplified as 2040 and 2090 actions. For the nonstructural alternative, phased implementation is broken down into four steps to capture the response more accurately on an asset-by-asset level (i.e., 2040, 2065, 2090, and 2115). For each implementation, new aboveground historic properties would have reached the 50-year historic-age threshold and therefore be considered potential historic resources. Therefore, the IFR-EIS considers the time frame, beginning with construction and installation and ending when conceptual decommissioning is complete, unless otherwise noted.

The analysis of the effects of the alternatives includes an analysis of potential impacts on identified and yet-to-be-identified aboveground, archaeological, and traditional cultural properties (TCP) historic properties. Minimization measures were proposed to address the identified potential impacts (see Mitigation).

4.18.1 Construction Impact Summary

The construction activities for all proposed alternatives (B, F, G, and the Total Net Benefits Plan) would result in ground disturbance from grading, adding fill material, earth-moving, excavating, drainage, and pile driving. For Alternatives B, F, G, and the TNBP, mitigation measures would be necessary. The EIS takes a conservative approach and discloses that these alternatives would likely have large-scale impacts on aboveground and archaeological historic properties, due to the size of the project and archaeological sensitivity of the San Francisco shoreline, leading to significant and unavoidable impacts.

The proposed alternatives have a potential to affect historic properties, including archeological sites, above ground resources, and TCP. The types of construction activities that have the potential to affect cultural resources include:

Ground-disturbing activities performed as part of construction, operations and maintenance, and field investigations, which could include geotechnical, hydrogeological, agronomic, and construction test projects (i.e., geotechnical investigations).

Construction activities that create increased opportunities for vandalism or looting that would physically disturb or destroy archaeological resources.

Physical damage to or direct demolition of character-defining features of aboveground historic properties.

Physical damage to or direct demolition of contributing elements or character-defining features of multi-component historic built resources.

Direct impacts on individual resources that create significant impacts on historic landscapes (where the individual resource is a constituent element of the historic landscape).

Construction in the vicinity of a resource, including districts, that removes features of the surrounding setting (where the setting is an integral part of the resource).

Construction in the vicinity of a resource, including districts, that introduces new physical features that are incongruent with the setting (where the setting is an integral part of the resource).

Introduction of new permanent sources of sound or activity in the vicinity of a resource, including districts, that would exceed the existing ambient noise level and be inconsistent with the setting (where a quiet or peaceful setting is an integral part of the resource).

Construction activities and techniques across all alternatives would include:

Erection of cast-in-place concrete elements onsite using removable forms and steel for reinforcement,

Construction of cofferdams,

Implementation of a variety of ground improvements and techniques,

Engineering-with-nature (EWN) considerations, and

Sourcing and transporting materials, heavy machinery, and various pieces of support equipment.

Dry floodproofing,

Property acquisition and demolition,

Raising bridges,

Sheet pile wall and T-wall construction,

Building relocation, and

EWN features.

Potential impacts on unidentified and unevaluated aboveground historic properties as well as currently identified and yet-to-be-identified archaeological historic properties resulting from construction and operation applies to all project alternatives.

The San Francisco Planning Department has determined that approximately 544 parcels within the study area are potentially significant historic properties that could be eligible for inclusion in the NRHP. These include parcels in specified registers or surveys, including resources listed in or formally eligible for listing in the CRHR, resources in local registers, resources that appear eligible or may become eligible for the CRHR, and resources designated under Articles 10 and 11 of the City and County of San Francisco Planning Code as landmarks, historic districts, or conservation districts.

Recognition of historical significance under the CRHR, or local criteria, indicates high potential for the historic properties possessing the significance necessary to meet the NRHP threshold. Because a full NRHP evaluation is not being conducted during feasibility, it is difficult to speculate the level of significance (local, state, or national) for each historic property or which aspects of integrity are intact. The historic properties in this category would need to be addressed during the phased identification process, which is detailed in the PA. In addition, approximately 261 parcels require further research to classify them because they are unevaluated and of historic age (i.e., constructed in 1990 or earlier). The National Park Service uses a threshold age of 50 years as a criterion for consideration as to NRHP eligibility (National Park Service 1995:20). For purposes of this report, as well as the flood resilience measures proposed for the 2040s, historic property identification within the study area considers resources that would meet the 50-year threshold as of 2040. Thus, buildings constructed in 1990 and before are considered historic-age resources for the project; they are yet to be evaluated but have the potential to be designated cultural resources.

An additional 214 parcels in the study area have aboveground historic structures that were constructed later than 1990; however, the structures would reach the 50-year threshold during the project's phased implementation. Consequently, it is very likely that many more properties could be associated with important historical themes or persons or possess high creative values; therefore, they are likely to have significance under CRHR and NRHP criteria. Because many of these resources remain intact and retain their urban setting, they are also likely to retain their historical integrity. Mitigation measures would identify these parcels and evaluate potential historic properties as they become of historic age.

Construction of facilities under the alternatives may require the alteration of aboveground historic properties. Construction may also result in material alterations to the integrity of feeling, setting, or association. Changes to the setting would be material alterations because they would either remove the resource or alter the resource's character, resulting in diminishment of the resource's ability to convey its significance.

Therefore, this would have a significant impact. Mitigation measures may lessen these impacts but cannot guarantee they would be entirely avoided. The scale of the alternatives and the constraints imposed by other environmental variables make avoidance of all significant impacts unlikely. For these reasons, even with implementation mitigation measures, the impacts would be ***too speculative for meaningful consideration.***

All the alternatives have the potential to damage previously unidentified archaeological sites or human remains, which may not be identified prior to construction. Although cultural resource inventories would be completed once legal access is secured, no inventory can ensure that all resources would be identified prior to construction. Similarly, the scale of construction makes it technically and economically infeasible to perform the level of sampling necessary to identify all previously unidentified archaeological sites or buried human remains prior to construction.

Because the sites that would be encountered during construction may be eligible for listing in the NRHP or CRHR, damage to these sites may diminish their integrity. Construction has the potential to disturb previously unidentified archaeological sites that qualify as historical resources, historic properties, or unique archaeological resources. Excavation, compaction, or other disturbances may disrupt spatial associations that contain scientifically useful information and alter the potential basis for eligibility, thereby materially altering the resource and resulting in an effect.

If there are known sites in the construction area, USACE would implement mitigation measures, follow stipulations of the PA, and develop HPTPs that would set forth the means for protecting historic properties or specifying treatment measures to minimize or mitigate the adverse effects. USACE may implement mitigation or treatment measures described in the HPTPs prior to construction, during construction, or after construction is completed, as appropriate. If previously unidentified archaeological sites or human remains are found during construction, USACE would implement mitigation and such items would be dealt with in the manner determined in the PHPMP (outlined in the PA). However, given the archaeological sensitivity of the area, even with implementation of mitigation, impacts on archaeological historic properties could be ***significant and unavoidable***.

4.18.2 Operations and Maintenance Impact Summary

The alternatives (B, F, G, and TNBP) would not include meaningful operational impacts to cultural resources because they would consist primarily of the installation of fixed flood improvements, such as levees, seawalls, sheet pile walls, and related infrastructure. The maintenance of implemented measures in the alternatives has the potential to impact cultural resources in the short- to long-term because some alternatives require additional actions in 2090, while others (T-walls, rebuilt wharfs, etc.) may require repairs before the end of the period of consideration (2140) that would result in additional ground disturbance or impacts to aboveground historic properties.

There would be no material change in long-term operational or maintenance impacts to cultural resources in Alternative A, the No Action Alternative, as a result of this project.

4.18.3 Total Net Benefits Plan

The construction activities associated with the TNBP would result in significant ground disturbance with the potential to impact archaeological historic properties, as well as the elevation, modification, or demolition of aboveground historic properties. The large scale of the TNBP, as well as the sensitivity of the San Francisco waterfront for archaeological resources, results in the assessment that the impact remains significant and unavoidable. The TNBP would also have beneficial impacts on cultural resources by limiting water intrusion in the first and second actions by 2090 with the least amount of proposed retreat or demolition. Table 4-45 provides a summary of the cultural resource impacts associated with the TNBP.

Table 4-45. Summary of Cultural Resource Impacts Associated with the TNBP

TNBP Cultural Resource Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint (1st Action)	1	3	5	4	5	1	4	3	4	2	2	2	3	1
Construction/Footprint (2nd Action)	1	4	5	1	5	1	4	3	4	2	2	2	3	3
O&M Assumptions	1	3	3	3	5	1	3	2	2	1	1	1	2	2
Mitigated Rating	1	4	4	4	4	1	3	2	4	1	1	1	2	2

The TNBP combines seismic ground improvements with a series of first and second actions. The TNBP also incorporates various aspects of the different alternatives discussed earlier. This alternative is analyzed by the first action in all four reaches (Figure 4-3 and Figure 4-4), then by the second action in all four reaches (Figure 4-5).

Proposed measures in the first action address rising sea levels to 2040; in Reaches 1 and 2, measures include floodproofing, elevating select buildings, reconstructing and raising bulkhead walls, replacing existing wharves with ductile concrete wharves, and removing select buildings. Proposed measures in the first action to address sea-level rise in Reach 3 include elevating the creek and bay shorelines with levees, floodwalls, and rebuilt wharves and bulkhead walls.

Proposed measures in the first action to address sea-level rise in Reach 4 include raising the shoreline using levees, bulkhead walls, and rebuilt wharves; installing deployable closure structures; and tying into existing or planned high ground. The TNBP's first action also relies on performing ground improvement actions, building infrastructure to manage stormwater, and utilizing EWN measures across all reaches.

Significant proposed first actions in Reaches 1 and 2 include raising the Ferry Building and bulkhead buildings in place, installing 2-foot-tall concrete curbs around the perimeter of Piers 24 to 47, floodproofing part of Fisherman's Wharf (Piers 31, 39, and 45 and the Dolphin Club), raising The Embarcadero shoreline by 3.5 to 7.5 feet, rebuilding wharfs along Piers 1 to 29 and the Downtown Ferry Terminal, and demolishing the San Francisco Sea Scout Base Building at Aquatic Cove. Significant proposed first actions in Reach 3 include using 1.5- to 4.5-foot-tall walls, levees, bulkhead walls, and wharves; installing 2-foot-tall concrete curbs around the perimeter of Piers 26 to 50; installing deployable closure structures at the northern and southern entrances to the 3rd Street/Lefty O'Doul and 4th Street/Channel Street bridges; and demolishing the South Beach Yacht Club building and four buildings in the Union Iron Works Historic District. Significant proposed first actions in Reach 4 include elevating the shoreline 2.5 to 5.5 feet using levees, floodwalls, and curb extensions; installing 2-foot-tall concrete curbs around the perimeter of Pier 80 and Piers 94–96; installing deployable closure structures at the northern and southern entrances to the (modern) Illinois Street Bridge; reconstructing and raising wharves at Pier 90 and 92; potentially removing select buildings south of Islais Creek and west of the bridges; and incorporating existing plans to rebuild the 3rd Street/Islais Creek Bridge at a higher elevation.

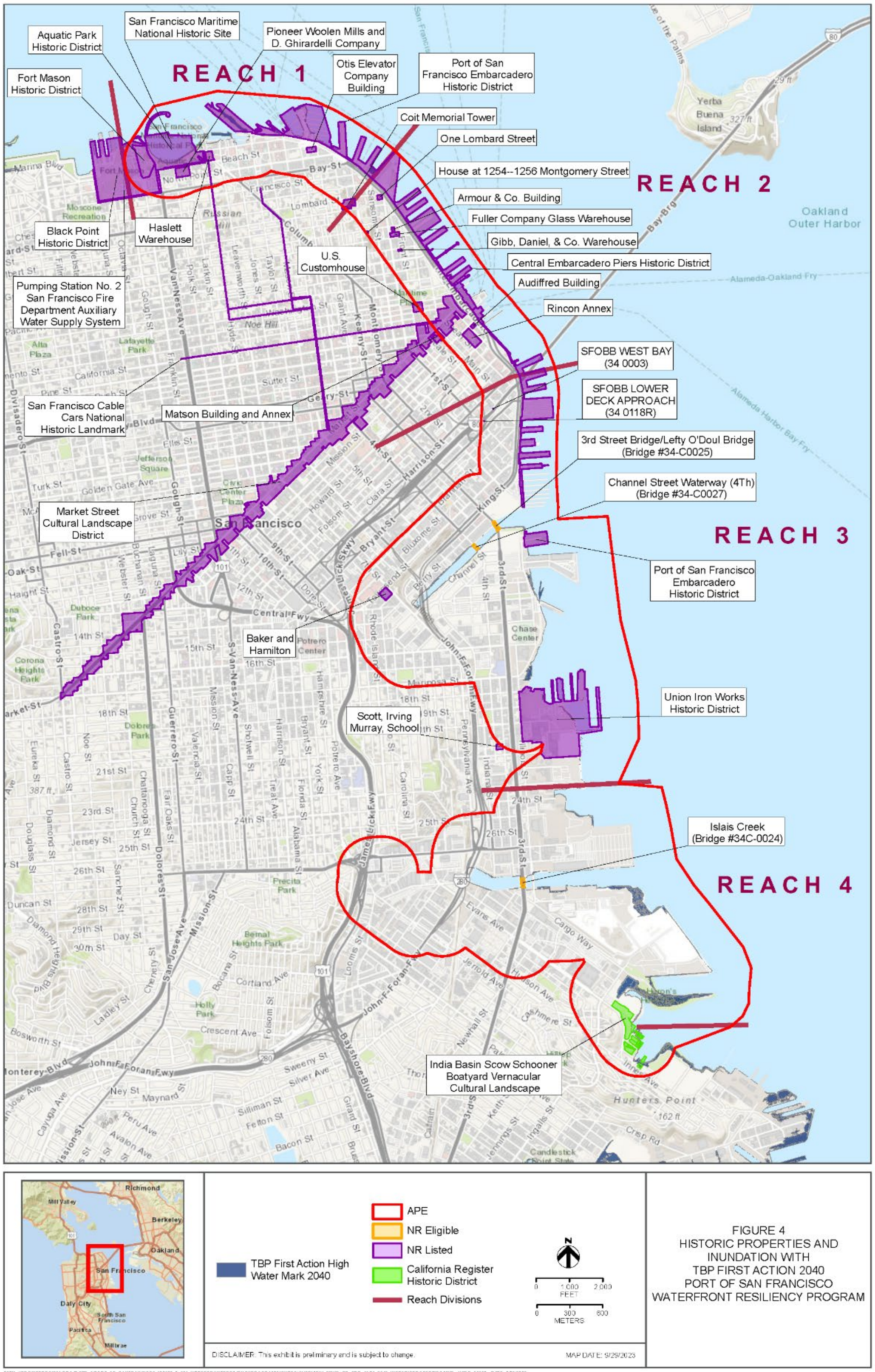


Figure 4-3. Historic Properties and Inundation with the TNBP First Action 2040

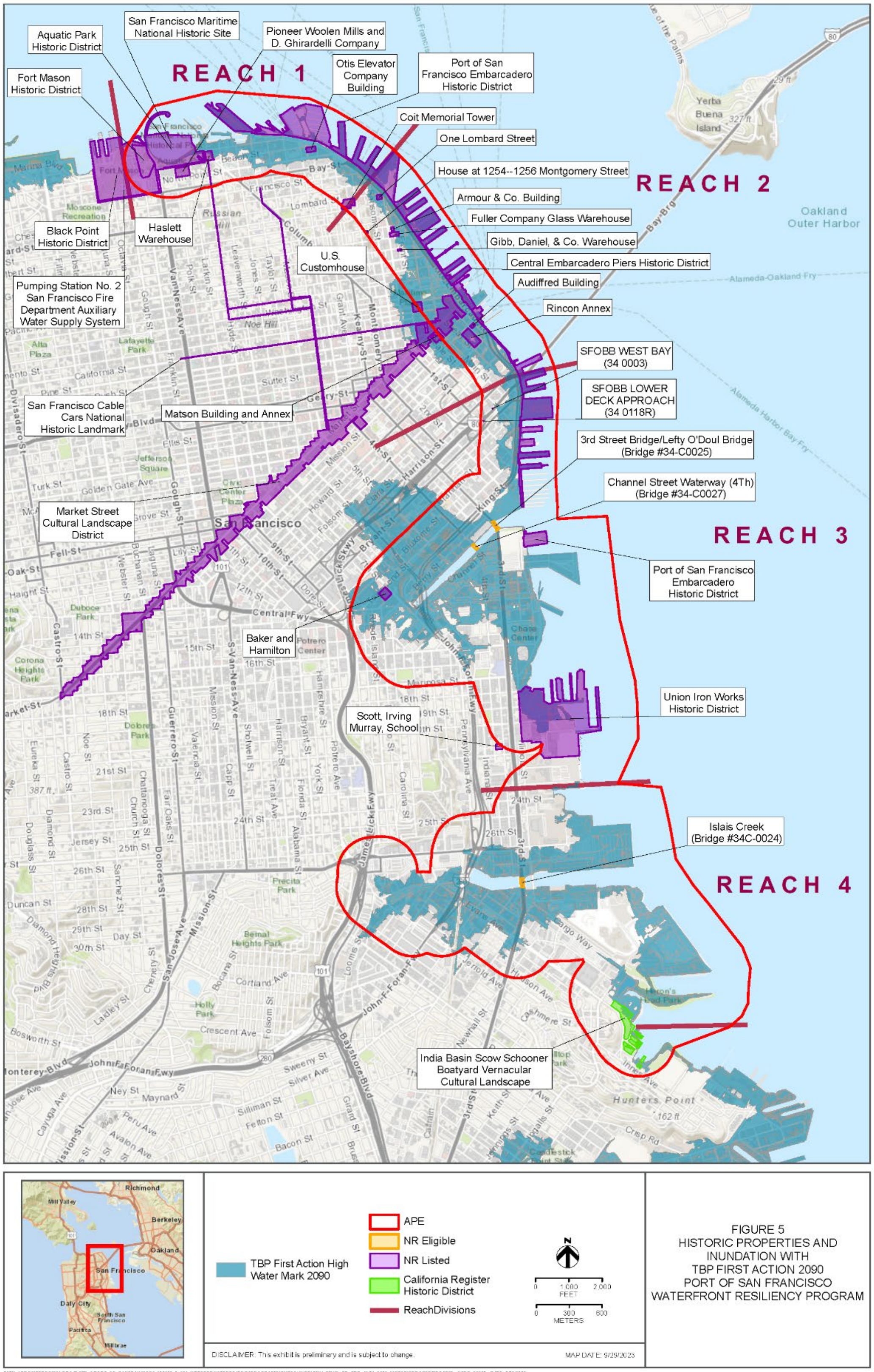


Figure 4-4. Historic Properties and Inundation with the TNBP First Action 2090

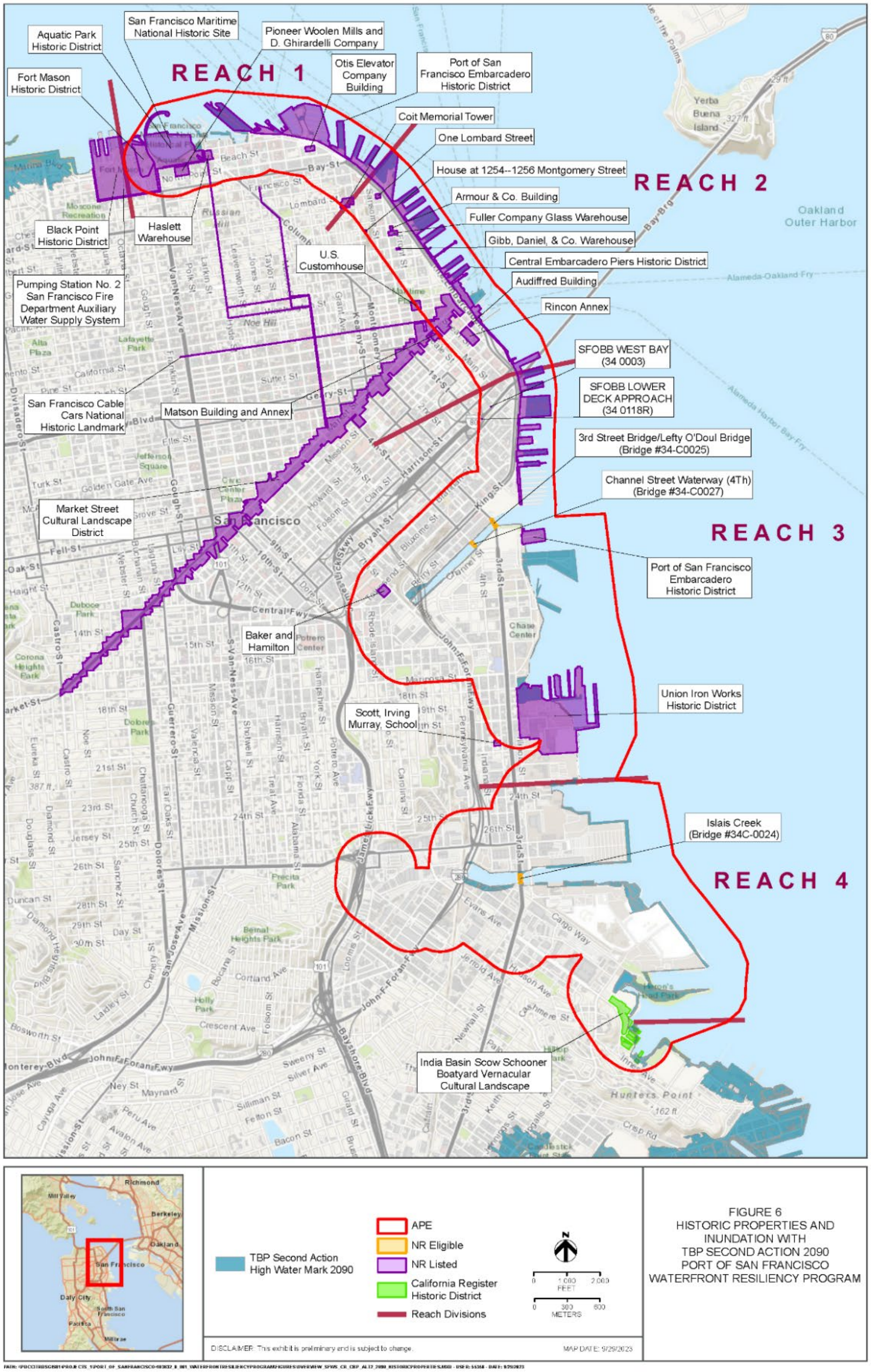


Figure 4-5. Historic Properties and Inundation with the TNBP Second Action 2090

Proposed measures in the second action include adaptation of first-action measures to respond to rising sea levels between 2040 and 2090. Reach 1 and 2 second actions include potential elevation changes, floodproofing, or demolition of buildings bayside of TNBP first actions, along with raising the shoreline north of Piers 9 to 27 by 1.5 to 4.5 feet using floodwalls and rebuilt bulkhead walls and wharves. Proposed measures in the second action in Reach 3 include raising the shoreline 2 feet using levees, walls, and rebuilt bulkhead walls and wharves; reducing roadway capacity along Terry Francois Boulevard; potentially adding bay fill in some areas; and elevating bulkhead buildings from Pier 26 to 50. Proposed measures in the second action in Reach 4 include elevating the shoreline 2 feet using levees, floodwalls, bulkhead walls and wharves; constructing levees along Islais Creek west of the Illinois Street Bridge and from the Illinois Street Bridge to Pier 80; incorporating EWN features along Islais Creek and Pier 94; raising bulkhead walls and wharves; and potentially removing buildings along the new bulkhead wall. The TNBP second action also relies on performing ground improvement actions and building infrastructure to manage stormwater across all reaches.

Significant proposed second actions in Reaches 1 and 2 include potential demolition of several buildings on Hyde Pier and abandonment of others, including the 1850s Tubbs Cordage Building. Significant proposed second actions in Reach 3 include bay fill along Terry Francois Boulevard and along the north bank of Mission Creek from the 4th Street/Channel Street Bridge to South Beach Harbor. Significant proposed second actions in Reach 4 include installing new bulkhead walls and wharves at Pier 80 and Piers 6 to 94.

USACE flood map projections under the TNBP indicate that inundation would result in a loss of integrity for designated aboveground historic properties. However, in 2090, Alternative G would result in inundation of only 250 acres in the study area, compared to FWOP conditions of 1,337 acres, and thus less aboveground historic properties would be affected by inundation. Therefore, the inundation impact on aboveground historic properties of the TNBP for relative to FWOP conditions would be ***less than significant***.

Rising sea levels are largely managed through the TNBP's proposed measures in Reaches 1 through 4 in both the first and second actions (Figure 4-3 through Figure 4-5). However, in 2090, Alternative G would result in inundation of only 250 acres in the study area, compared to FWOP conditions of 1,337 acres, and thus less aboveground historic properties would be affected by inundation. Therefore, the impact of inundation on archaeological historic properties of the TNBP relative to FWOP conditions would be ***less than significant***.

The TNBP proposes measures that incorporate structural improvements and EWN measures; the alternative relies on ground improvements and new infrastructure to manage stormwater. Over time, the TNBP would require significant changes to existing transportation infrastructure and the built environment in some areas as developed areas are elevated, rebuilt, demolished, or abandoned. Examples of the TNBP's first action include elevating buildings on the wharves from Pier 23 to the Ferry Building, with a resulting transportation impact from raising The Embarcadero between 3.5 and 7.5 feet from the Bay Bridge to Pier 27; installing deployable closure structures on the 3rd

Street/Lefty O'Doul and 4th Street/Channel Street bridges; and demolishing three contributing buildings in the Union Iron Works Historic District (buildings 6, 110, and 111).

Examples of the TNBP's second action include raising The Embarcadero by 1.5 to 4.5 feet north of Pier 29; demolishing non-historic buildings bayside of the proposed T-wall at Fisherman's Wharf, with resulting abandonment of other structures (e.g., the Tubbs Cordage Building); constructing a 2- to 3.5-foot-tall seawall on the north bank of the creek between the 4th Street/Channel Street Bridge and China Basin; and implementing levee and EWN measures along the entire shoreline of the Union Iron Works Historic District, which would alter the district's relationship to the water (Figure 4-5). Even with mitigation measures the TNBP proposes extensive alteration to designated and eligible aboveground historic properties across Reaches 1-4 and therefore has the potential for ***significant and unavoidable impacts***.

The TNBP proposes ground-disturbing measures that have the potential to be significant and adverse. Archaeological historic properties along the waterfront could be affected by the proposed levees, walls, and EWN features, along with relocation and demolition measures. Construction into the floor of San Francisco Bay has low potential with respect to encountering Native American archaeological historic properties; however, unknown archaeological historic properties within San Francisco Bay could be affected by levees, walls, and EWN features, along with relocation and demolition measures. The walls along The Embarcadero could extend up to 33 feet below the ground surface, with the potential to affect deeply buried Native American archaeological historic properties. Mission Creek is sensitive for archaeological remains; constructing vertical lift gates at the mouth of this creek could have a significant and adverse effect on unknown archaeological historic properties.

This alternative has the potential to damage previously unidentified archaeological sites or human remains, which may not be identified prior to construction. Although cultural resource inventories would be completed once legal access is secured, no inventory can ensure that all resources would be identified prior to construction. Similarly, the scale of construction makes it technically and economically infeasible to perform the level of sampling necessary to identify all buried human remains prior to construction.

Because the sites that would be encountered during construction may be eligible for listing in the NRHP or CRHR, damage to these sites may diminish their integrity. Construction has the potential to disturb previously unidentified archaeological sites that qualify as historical resources, historic properties, or unique archaeological resources. Excavation, compaction, or other disturbances may disrupt spatial associations that contain scientifically useful information and alter the potential basis for eligibility, thereby materially altering the resource and resulting in an effect.

If there are known sites in the construction area, USACE would implement mitigation measures, follow stipulations of the PA, and develop HPTPs that would set forth means for protecting historic properties or specifying treatment measures to minimize or mitigate adverse effects. USACE may implement mitigation or treatment measures described in the HPTPs prior to construction, during construction, or after construction is completed, as appropriate. If previously unidentified archaeological sites or human remains are found during construction, USACE would implement mitigation measures and such items would be dealt with in the manner determined in the PHPMP (outlined in the PA). However, given the archaeological sensitivity of the area, even with implementation of mitigation, impacts on archaeological historic properties under the TNBP could be ***significant and unavoidable***.

Because no TCPs have been identified at this time, there would be no impact or a negligible impact. If a TCP is identified during ongoing consultation, an addendum would be added to the study. However, at this time, the impacts, as well as the intensity of the physical and cultural loss as a result of the TNBP, cannot be predicted or quantified without speculating on future events. Therefore, the impacts would be ***too speculative for meaningful consideration***.

4.18.4 Alternative B

The construction activities associated with the Alternative B would result in a loss of use and access to physical property, resulting in a ***significant and unavoidable*** impact and mitigation measures would be necessary. Documentation of aboveground and archaeological historic properties prior to construction or inundation is possible but does not protect those resources from long-term damage and the impact remains significant and unavoidable. Alternative B's construction activities (building demolition, pier demolition, and floodproofing measures) would significantly impact aboveground historic resources through demolition, as well as significantly impact archaeological historic resources by taking no action to prevent extreme inundation. Although archaeological historic properties are underground, rising sea levels may result in intrusion of salt water which increases degradation, erosion, and intrusive activities from marine life.

Alternative B proposes nonstructural measures such as floodproofing to reduce risks rather than constructing traditional structural solutions. Actions under this alternative include dry floodproofing as well as property acquisition and demolition. Although buildings would be floodproofed and some relocation, this alternative would have the same sea-level rise inundation levels as Alternative A (Figure 4-6). Construction and operational effects are described below. Likely water intrusion, based on the FWOP, would have residual impacts on historic properties but would be less than the FWOP based on decreased water intrusion into buildings due to floodproofing and relocation.

USACE flood map projections for Alternative B indicate that residual flooding would result a loss of integrity for designated aboveground historic properties through physical damage or change as well as site removal or demolition. However, compared to the FWOP conditions, Alternative B would have result in less effects on historic properties due to the floodproofing of buildings. Therefore, the impact of Alternative B on aboveground historic properties relative to FWOP conditions would be ***less than significant***.

Although archaeological historical properties are underground, which affords a measure of protection, rising sea levels and inundation (which would be in the same areas as the FWOP) may have adverse effects. It is possible that archaeological sites could be researched and documented further before a loss due to encroaching sea-level rise, but the sites cannot be floodproofed or moved without severe damage as well as impacts on significance and integrity. Impacts on potentially significant archaeological resources within the inundation areas would destroy or otherwise render resources unavailable. Low-lying areas such as the Mission, South of Market, and South Bayshore planning districts are most susceptible to damage. Building floodproofing or relocation would not avoid inundation effects which would be the same as the FWOP. Since Alternative B would not increase the level of adverse effects due to flooding to archaeological historical properties relative to FWOP conditions, the impact would be ***less than significant.***

Alternative B proposes nonstructural floodproofing measures for aboveground historic properties that cannot be moved out of high-risk areas. For aboveground historic properties, there is the potential for adverse effects. These include the potential loss of integrity from dry floodproofing measures, such as installing waterproof veneers or deployable gates at building openings. Other proposed measures in Alternative B include property acquisition and demolition, which may result in significant adverse effects on historic properties.

Alternative B also focuses on floodproofing and shifting resources away from the flood risks. This includes working with property owners to floodproof, modify, or remove buildings and infrastructure in areas that are at risk of flooding. Mitigation may lessen these effects but cannot guarantee they would be entirely avoided. The scale of Alternative B and the constraints imposed by other environmental variables would make avoidance of all significant impacts unlikely. As such, even with implementation of mitigation the impact on aboveground historic properties under Alternative B would be ***significant and unavoidable.***

For archaeological historic properties, the effects of Alternative B would occur due to any floodproofing or relocation activities that involve ground disturbance. This alternative has the potential to damage previously unidentified archaeological sites or human remains. Because the sites within the project area may be eligible for listing in the NRHP or CRHR, damage to these sites may diminish their integrity. It is possible that archaeological sites could be researched and documented further before disturbance, but the sites cannot be floodproofed or moved without severe damage and impacts on significance and integrity. Impacts on potentially significant archaeological resources would destroy or otherwise render resources unavailable and the magnitude of the proposed project increases the likelihood of significant unavoidable impacts. As such, even with implementation of mitigation, impacts on archaeological historic properties under Alternative B would be ***significant and unavoidable.***

Because no TCPs have been identified at this time, there is no impact or a negligible impact. If a TCP is identified during ongoing consultation, an addendum would be added to the study. However, at this time, the impacts, as a result of Alternative B, cannot be predicted or quantified without speculating on future events. Therefore, the impacts would be ***too speculative for meaningful consideration***.

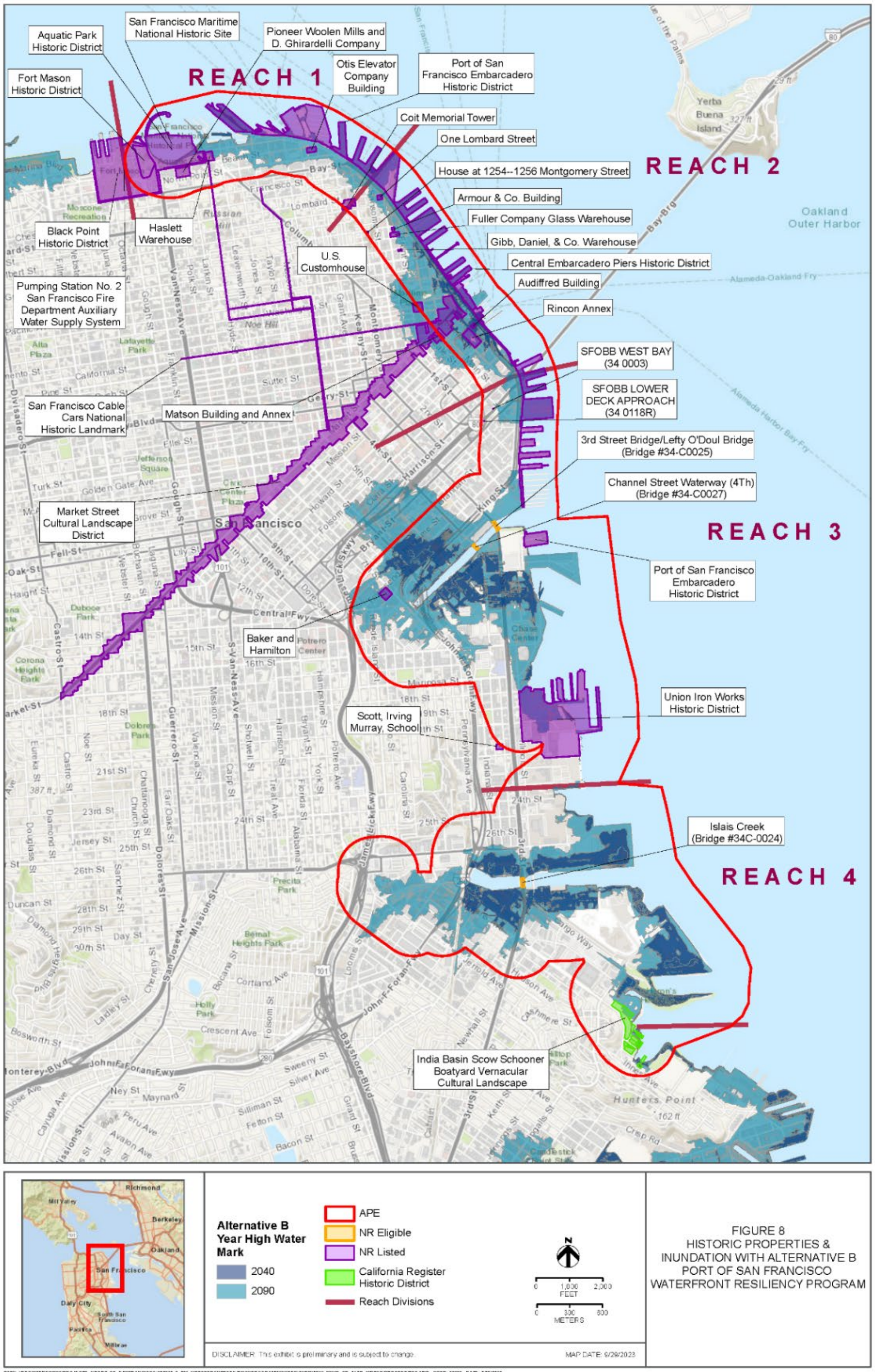


Figure 4-6. Historic Properties and Inundation with Alternative B

4.18.5 Alternative F

The construction activities associated with the Alternative F would result in ground disturbance from grading, adding fill material, earth-moving, excavating, drainage, and pile driving. Other construction impacts include building elevation or demolition, roadway impacts, and engineering with nature measures. Aboveground historic properties would be significantly impacted by construction activities, particularly from the proposed building demolition, which would not be fully mitigated even with implementation of mitigation measures. Due to the large scale of the project and high sensitivity of the San Francisco waterfront for archaeological resources, even with implementation of mitigation, the impact remains ***significant and unavoidable***. Table 4-46 provides a summary of the cultural resource impacts associated with Alternative F.

Table 4-46. Summary of Cultural Resource Impacts Associated with Alternative F

Alternative F Cultural Resource Impact Rating by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	4	4	4	4	4	4	3	4	3	3	3
O&M Assumptions	3	2	3	3	3	3	3	3	1	1	2
Mitigated Rating	4	3	4	3	3	3	3	3	2	2	2

Alternative F proposes a combination of passive flood protection, managed retreat, and new water control structures to avoid reliance on a large-scale overhaul of existing inland drainage systems (Figure 4-7). Proposed measures include levees, T-walls, cantilever walls, tide gates, and EWN features as well as elevation changes, relocation, or demolition for aboveground properties. These proposed measures were designed to be adaptable to projected 2090 sea-level rise. Construction and operational effects are described below. Water intrusion with Alternative F would have residual impacts to historic properties but would be less than the FWOP based on decreased water intrusion into buildings due to passive flood protection, retreat, and drainage improvements.

USACE flood map projections for Alternative F indicate that residual flooding would still result loss of integrity for designated aboveground historic properties through physical damage or change, as well as site removal or demolition. However, inundation in 2090 with Alternative F would only affect 403 acres compared to 1,337 acres under FWOP conditions and would result in less inundation of aboveground historic properties. Therefore, Alternative F would reduce adverse effects related to inundation of aboveground historic properties relative to FWOP conditions and thus this effect would be ***less than significant.***

Rising sea levels are managed through Alternative F's proposed measures in Reaches 1-3. Yet-to-be-identified archaeological historic properties would still be at risk from rising sea levels in Reach 4 (Figure 4-7). Inundation overall in 2090 with Alternative F would only affect 403 acres compared to 1,337 acres under FWOP conditions and would result in less inundation of aboveground historic properties. Therefore, relative to the FWOP, Alternative F would reduce adverse effects related to inundation of archaeologic historic properties and thus this effect would be ***less than significant.***

Alternative F proposes a combination of large structures to prevent water intrusion and control natural drainage. A cantilever wall would stretch from Plaza del California along The Embarcadero south to Pier 40, with the potential for adverse effects on aboveground historic properties within the Port of San Francisco Embarcadero Historic District and the Central Embarcadero Piers Historic District. The proposed cantilever wall would require ground improvements prior to construction. Ground disturbance could extend up to 100 feet below the ground surface. The width of disturbance may be 40 to 300 feet. Other measures that may cause adverse effects on historic properties include constructing vertical lift gates at the mouths of Mission Creek and Islais Creek.

Aboveground historic properties such as the 3rd Street Bridge, Channel Street Waterway, and Islais Creek Bridge may be adversely affected by construction of the vertical lift gates or the resulting direct visual impacts. For these reasons, this alternative would result in a significant impact. MM CRE-1, Prepare and Implement Historic Property Treatment Plans in Consultation with Interested Parties, may mitigate these effects but cannot guarantee they would be entirely avoided.

The scale of Alternative F and the constraints imposed by other environmental variables would make avoidance of all significant impacts unlikely. As such, even with implementation of MM CRE-1, the impact on aboveground historic properties under Alternative F would be ***significant and unavoidable.***

Alternative F proposes ground-disturbing measures that have the potential to be significant and adverse. Archaeological historic properties along the waterfront could be affected by the proposed levees, walls, and EWN features, along with elevation, relocation, and demolition measures. Any construction into the floor of San Francisco Bay has the potential to encounter Native American archaeological historic properties, and the magnitude of the proposed project increases the likelihood of significant unavoidable impacts. Unknown archaeological historic properties within San Francisco Bay could be affected by levees, walls, and EWN features, along with relocation and demolition measures.

The cantilever wall could extend up to 100 feet below the ground surface, with the potential to affect deeply buried Native American archaeological historic properties, including burial properties. Some burial properties in San Francisco are among the oldest in California. Furthermore, Mission Creek and Islais Creek are sensitive for archaeological remains. Constructing vertical lift gates at the mouths of these creeks could have a significant and adverse effect on unknown archaeological historic properties. Archaeological resources within Alternative F's proposed bay fill areas would be destroyed or otherwise rendered unavailable.

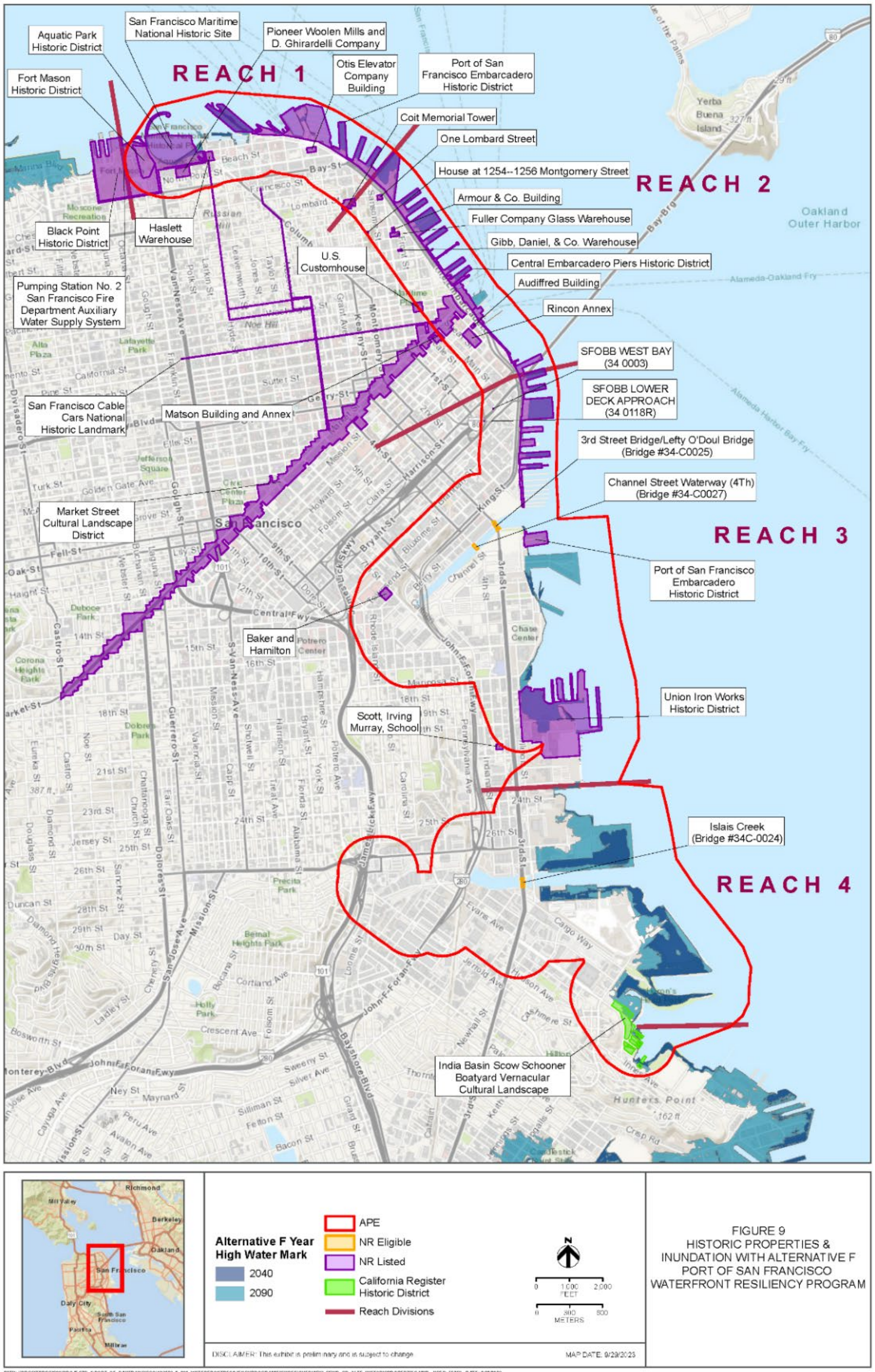


Figure 4-7. Historic Properties and Inundation with Alternative F

This alternative has the potential to damage previously unidentified archaeological sites or human remains, which may not be identified prior to construction. Although cultural resource inventories would be completed once legal access was secured, no inventory can ensure that all resources would be identified prior to construction. Similarly, the scale of construction makes it technically and economically infeasible to perform the level of sampling necessary to identify all buried human remains prior to construction.

Because the sites that would be encountered during construction may be eligible for listing in the NRHP or CRHR, damage to these sites may diminish their integrity. Construction has the potential to disturb previously unidentified archaeological sites that qualify as historical resources, historic properties, or unique archaeological resources. Excavation, compaction, or other disturbances may disrupt spatial associations that contain scientifically useful information and alter the potential basis for eligibility, thereby materially altering the resource and resulting in an effect.

Because the resources would not be identified prior to construction, they would not be recorded and the effects would not be managed through construction treatments. Similarly, buried human remains may be damaged by the action alternatives because such remains may occur either in isolation or as part of identified and previously unidentified archaeological resources in areas where construction would occur. As such, even with implementation of mitigation measures, impacts on archaeological historic properties under Alternative F would be ***significant and unavoidable*****.**

Because no TCPs have been identified at this time, there would be no impact or a negligible impact. If a TCP is identified during ongoing consultation, an addendum would be added to the study. However, at this time, the impacts, as well as the intensity of the physical and cultural loss as a result of Alternative F, cannot be predicted or quantified without speculating on future events. Therefore, the impacts would be ***too speculative for meaningful consideration***.

4.18.6 Alternative G

The construction activities associated with the Alternative G would result in ground disturbance from grading, adding fill material, earth-moving, excavating, drainage, and pile driving. Other construction impacts include building elevation or demolition, roadway impacts, and engineering with nature measures. Aboveground historic properties would be significantly impacted by construction activities, particularly from the proposed building demolition and engineering with nature measures, which would not be fully mitigated even with implementation of mitigation measures (see Mitigation). Due to the large scale of the project and high sensitivity of the San Francisco waterfront for archaeological resources, even with implementation of mitigation, the impact remains ***significant and unavoidable***. Table 4-47 provides a summary of the cultural resource impacts associated with Alternative G.

Table 4-47. Summary of Cultural Resource Impacts Associated with Alternative G

Alternative G Cultural Resource Impact Rating by Measure	Levee	Bridge raise	Bulkhead wall/Seawall	Roadway Impact	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint	3	3	4	4	3	4	4	2	3	2	4	3
O&M Assumptions	2	2	4	3	2	3	2	1	1	1	2	2
Mitigated Rating	3	3	3	4	3	2	4	1	2	1	4	2

Alternative G proposes measures that rely on natural drainage rather than large pumping systems by retreating farther inland and leaving resources to flood that are within historic watersheds (Figure 4-8). Proposed measures include raising bridges or incorporating levees, T-walls, walls, and EWN features. The EWN features involve ecotone levees, ecological armoring, and embankment shorelines. Like measures under Alternative F, these proposed measures were designed to be adaptable to projected 2090 sea-level rise. Unlike previous alternatives, Alternative G proposes significant changes to transportation infrastructure and land use, given the retreat away from existing development, especially in the Mission Bay area and The Embarcadero. Construction and operations effects are described in this section.

USACE flood map projections under Alternative G would result in a loss of integrity for designated aboveground historic properties through inundation. However, in 2090, Alternative G would result in inundation of only 719 acres in the study area, compared to FWOP conditions of 1,337 acres, and thus less aboveground historic properties would be affected by inundation. Therefore, the impact on aboveground historic properties of Alternative G for inundation relative to FWOP conditions would be ***less than significant***.

Rising sea levels are managed through Alternative G's proposed measures in Reaches 1 and 2, but large areas in Reaches 3 and 4 would be inundated (Figure 4-8). Inundation overall in 2090 with Alternative F would only affect 719 acres compared to 1,337 acres under FWOP conditions and would result in less inundation of archaeology historic properties. Therefore, relative to the FWOP, Alternative g would reduce adverse effects related to inundation of archaeologic historic properties and thus this effect would be ***less than significant.***

Alternative G proposes measures that rely on natural drainage rather than large pumping systems; such measures would be highly adaptable in the future but also most transformative to parts of the existing waterfront. Alternative G would establish new open spaces and wetlands but, over time, would require significant changes to existing transportation infrastructure and the built environment in response to retreating from some developed areas, with associated building demolition in areas of retreat. Examples include constructing 17-foot-high walls and elevating wharf buildings along the northern waterfront, from Fisherman's Wharf to The Embarcadero, including the NRHP-listed Ferry Building; raising the bridges over Mission Creek and Islais Creek; and demolishing NRHP-listed historic properties, including buildings 6 and 111 in the

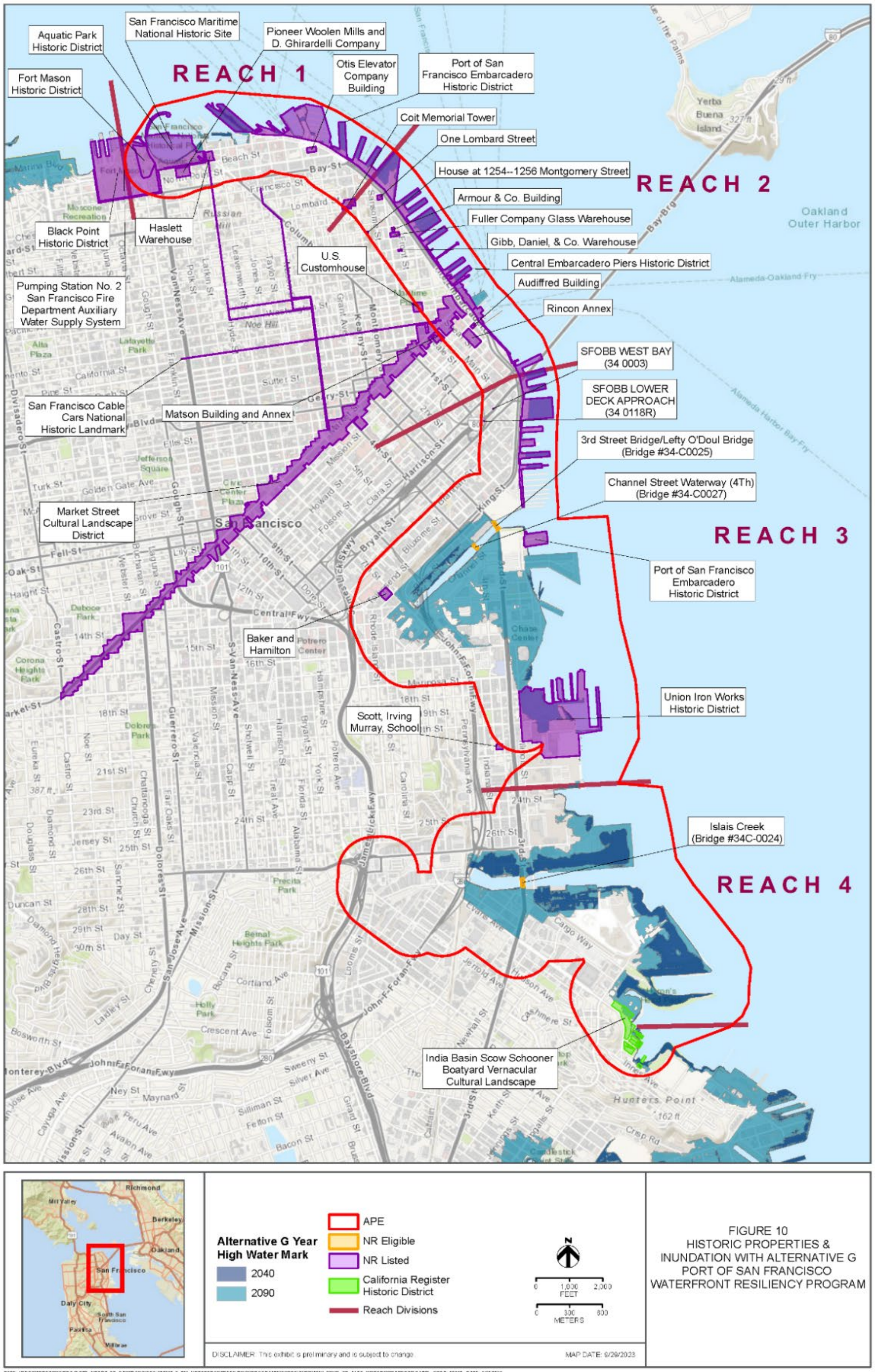


Figure 4-8. Historic Properties and Inundation with Alternative G

Union Iron Works Historic District. An example of an area proposed for retreat is the 1850s Tubbs Cordage Building on Hyde Pier. In addition, demolition or abandonment could occur within 752 acres along the shoreline from the north side of Mission Creek to Heron's Head Park, including portions of two NRHP-listed historic districts, three NRHP-eligible bridges, and one NRHP-eligible historic district. For these reasons, this alternative would result in a ***significant*** impact.

Mitigation may lessen these effects but cannot guarantee they would be entirely avoided. The scale of Alternative G and the constraints imposed by other environmental variables would make avoidance of all significant impacts unlikely. As such, even with implementation of mitigation measures, the impact on aboveground historic properties under Alternative G would be ***significant and unavoidable.***

Alternative G proposes ground-disturbing measures that have the potential to be significant and adverse. Archaeological historic properties along the waterfront could be affected by proposed levees, walls, and EWN features, along with relocation and demolition measures. Construction into the floor of San Francisco Bay has low potential with respect to encountering Native American archaeological historic properties; however, unknown archaeological historic properties within San Francisco Bay could be affected by levees, walls, and EWN features, along with relocation and demolition measures. The walls along The Embarcadero could extend up to 33 feet below the ground surface, with the potential to affect deeply buried Native American archaeological historic properties. Mission Creek is sensitive for archaeological remains; constructing vertical lift gates at the mouth of this creek could have a ***significant*** and adverse effect on unknown archaeological historic properties.

This alternative has the potential to damage previously unidentified archaeological sites or human remains, which may not be identified prior to construction. Although cultural resource inventories would be completed once legal access is secured, no inventory can ensure that all resources would be identified prior to construction. Similarly, the scale of construction makes it technically and economically infeasible to perform the level of sampling necessary to identify all buried human remains prior to construction.

Because the sites that would be encountered during construction may be eligible for listing in the NRHP or CRHR, damage to these sites may diminish their integrity. Construction has the potential to disturb previously unidentified archaeological sites that qualify as historical resources, historic properties, or unique archaeological resources. Excavation, compaction, or other disturbances may disrupt spatial associations that contain scientifically useful information and alter the potential basis for eligibility, thereby materially altering the resource and resulting in an effect.

If known sites are located within the construction area, USACE would implement mitigation measures, follow stipulations of the PA, and develop Historic Property Treatment Plans (HPTPs) that set forth the means for protecting historic properties or specifying treatment measures to minimize or mitigate the adverse effects. USACE may implement mitigation or treatment measures described in the HPTPs prior to construction, during construction, or after construction is completed, as appropriate. If previously unidentified archaeological sites or human remains are found during construction, USACE would implement mitigation measures and such items would be dealt with in the manner determined in the Programmatic Historic Properties Management Plan (PHPMP) (outlined in the PA). However, given the archaeological sensitivity of the area, even with implementation of mitigation measures, impacts on archaeological historic properties under Alternative G could be ***significant and unavoidable***.

Because no TCPs have been identified at this time, there would be no impact or a negligible impact. If a TCP is identified during ongoing consultation, an addendum would be added to the study. However, at this time, the impacts, as well as the intensity of the physical and cultural loss as a result of Alternative G, cannot be predicted or quantified without speculating on future events. Therefore, the impacts would be ***too speculative for meaningful consideration***.

4.18.7 Independent Measures for Consideration

The construction activities associated with the independent measures would result in ground disturbance from grading, adding fill material, earth-moving, excavating, and drainage. Construction for some measures (2A, 3A, and Vertical Shoreline) would have significant impacts on aboveground and archaeological historic properties that would not be fully mitigated even with implementation of mitigation measures. Construction for other measures (2B, 3B, 3C, and 4A) would result in low to moderate impacts on aboveground and archaeological historic properties, even with implementation of the mitigation measures. Table 4-48 provides a summary of the cultural resource impacts associated with the independent measures.

Table 4-48. Summary of Cultural Resource Impacts Associated with the Independent Measures

Independent Measures Cultural Resource Impact Rating	2A	2B	3A	3B	3C	4A	Vertical Shoreline*
Construction/Footprint	4	3	4	2	2	3	4
O&M Assumptions	3	2	3	2	2	2	4
Mitigated Rating	3	3	3	2	2	3	3

Independent measures were included in one or more of the alternatives but were not codified in the alternatives; thus, the independent measures are to be considered and analyzed as separate measures for potential effects on cultural resources. The proposed independent measures are outlined below.

The independent measures propose a variation of land and shoreline redesigns or construction efforts to reduce wave hazards, improve coastal flood defenses, provide public water access, and achieve various ecological benefits. The various independent measures may adversely affect aboveground historic properties such as the Ferry Building, Agriculture Building, and Islais Creek Bridge; properties in the Port of San Francisco Embarcadero Historic District; and historic-age unevaluated properties. The measures would result in one or more construction impacts on the aboveground historic properties related to bay fill, the rebuilt wharf, roadway construction, EWN features, levees, seawall construction, seismic ground improvements, and the resulting direct visual impacts. The impact on aboveground historic properties from the independent measures would depend on which measures were implemented and have therefore been analyzed individually below.

Measure 2A would be designed to realign the coastal flood defense structure adjacent to the bayside edge of the Ferry Building and possibly the Agriculture Building. The structures would be raised in place, with a basement structure or some solid fill underneath. This measure would directly affect the associated buildings of the Port of San Francisco Embarcadero Historic District. Disturbance caused by raising the structures in place, with a basement structure or some solid fill underneath, may cause adverse effects on the aboveground historic properties, including material alteration, structural instability, and loss of integrity of design and setting through physical damage. Even with the implementation of MM CRE-1, the impact of construction activity on the Ferry Building and possibly the Agriculture Building and other features of the Port of San Francisco Embarcadero Historic District would be notable, and avoiding all significant impacts is unlikely. Therefore, the impact on aboveground historic properties under Independent Measure 2A would be ***significant and unavoidable.*** Measure 2A has the potential for adverse effects on known and as-yet-unknown archaeological historic resources. This area is highly sensitive for historical archaeological resources. It is not considered highly sensitive for pre-contact archaeological resources.

Measure 2B would be designed to reduce wave hazards, support nearshore ecology, and provide public water access. Some new bay fill would be included in this measure to address the space constraints of the transportation network at this site. This measure would directly affect the associated landscape features of the Port of San Francisco Embarcadero Historic District at Rincon Park. The proposed coarse beach would include bay fill and EWN features that would result in ground disturbance, a roadway impact, and related construction that may cause adverse effects on the setting and adjacent aboveground historic properties of the historic district. The implementation of mitigation measures, and particularly the preparation of HPTPs, for aboveground historic properties that may be subject to direct effects, such as vibration or subsequent and inadvertent structural damage or a loss of physical material, would help minimize the impacts on features of the Port of San Francisco Embarcadero Historic District. USACE may implement treatment measures described in the HPTPs prior to project construction, during construction, or after construction is completed (as appropriate) to reduce project impacts by developing a clear plan to stabilize resources, resulting in avoidance or minimization of potential impacts on a resource's integrity of design, materials, or workmanship. Therefore, the moderate impact on aboveground historic properties under Independent Measure 2B would be ***less than significant with mitigation.*** Measure 2B has the potential for adverse effects on known and as-yet-unknown archaeological historic resources. This area is highly sensitive for historical archaeological resources. It is not considered highly sensitive for pre-contact archaeological resources.

Measure 3A would raise the current shoreline (rather than extending the shoreline into the bay) from the Bay Bridge to the mouth of Mission Creek. It would require redesign of the northbound lanes of The Embarcadero roadway (in collaboration with the San Francisco Municipal Transportation Agency and The Embarcadero Enhancement Project) to avoid reconstruction of the light rail track. This measure would begin at the Ferry Building and include the stretch from Pier 22½ (near the Bay Bridge) along The Embarcadero south to the mouth of Mission Creek, with the potential for adverse effects on aboveground historic properties within the Port of San Francisco Embarcadero Historic District, and possibly, the South End Historic District. The proposed raised shoreline and rebuilt wharves would result in ground disturbance, construction, and a roadway impact, including a redesign of the northbound lanes of The Embarcadero roadway. Even with the implementation of mitigation measures, the impact of construction activity, including ground disturbance and the loss of integrity for designated aboveground historic properties through physical damage or change to the design, setting, materials, and workmanship to the Port of San Francisco Embarcadero Historic District features would be notable, and avoiding all significant impacts is unlikely. Therefore, the impact on aboveground historic properties under Independent Measure 3A would be ***significant and unavoidable.*** Measure 3A has the potential for adverse effects on known and as-yet-unknown archaeological historic resources. From the Ferry Building to the mouth of Mission Creek, there is high historic sensitivity from the inland limit of the project to the water. There is high pre-contact sensitivity on the west side of The Embarcadero from Rincon Park to Brannan Street Wharf Park and on both sides of Mission Creek at the Third Street Bridge.

Measure 3B would raise the shoreline in line with the current shoreline edge on the north side of McCovey Cove (along the Oracle Park baseball stadium) rather than add fill and extend the shoreline into the creek. This measure would raise the shoreline to the current shoreline edge on the north side of McCovey Cove, with the potential for adverse effects on the seawall, a feature of the Port of San Francisco Embarcadero Historic District. Seismic ground improvements and the impact on the seawall resulting from the north curb extension may cause adverse effects but could be minimized by implementing mitigation measures. HPTP preparation and implementation would include preconstruction condition assessments for aboveground historic properties adjacent to the project site and historic structure reports to develop protection measures for buildings and structures adjacent to construction and, therefore, potentially sensitive to construction-related effects such as vibration. As applicable, these mitigation measures may be implemented to sustain low to no impact on the resource. Therefore, the minor impacts on aboveground historic properties under Independent Measure 3B would be ***less than significant.*** Measure 3B has the potential for adverse effects on known and as-yet-unknown archaeological historic resources. The area has high historic sensitivity; therefore, resources could be affected by the north curb extension. There is high pre-contact sensitivity on both sides of Mission Creek at the Third Street Bridge.

Measure 3C would design the area south of Pier 50 to reduce wave hazards, support nearshore ecology, and provide public water access. This measure would stretch from south of Pier 50 along the shoreline to Pier 54. The planted levee would result in EWN features, roadway impacts, and seismic ground improvements. The associated area is not included in a potential or designated historic district; however, it does include historic-age unevaluated piers. Thus, the measure may cause potential adverse impacts on unidentified and unevaluated aboveground historic properties. Implementation of mitigation measures, specifically the procedures for a phased assessment of effects and resolution of adverse effects would ensure proper evaluation and treatment of aboveground historic properties and avoid, minimize, or mitigate adverse effects prior to project construction, during construction, or after construction is completed, as appropriate. As applicable, these mitigation measures may be implemented to sustain low to no impact on the resource. Therefore, the minor impacts on aboveground historic properties under Independent Measure 3C would be ***less than significant.*** Measure 3C has the potential for adverse effects on known and as-yet-unknown archaeological historic resources; however, this area is not considered highly sensitive for historical or pre-contact resources.

Measure 4A would include conversion of some industrial lands and public facilities to provide public water access, open space, and ecological benefits. It would also result in a more permanent flood risk reduction due to a small area of gradual retreat along the creek. This measure would be bounded by Islais Street to the north, 3rd Street to the east, Evans Avenue to the south, and the John F. Foran Freeway to the west. The proposed flood defense measure would result in demolition at multiple buildings, EWN features, levees, a curb extension, and seismic ground improvements with potential adverse effects on the adjacent Islais Creek Bridge and historic-age unevaluated properties. The implementation of mitigation measures, and specifically the preparation of HPTPs and a PHPMP, would determine the potential adverse effects on historic properties during a particular phase of the project, identify mitigation measures to eliminate or minimize the effects, and guide the overall technical work throughout phased identification of potential aboveground historic properties. USACE may implement treatment measures described in the HPTPs prior to project construction, during construction, or after construction is completed (as appropriate) to reduce project impacts by developing a clear plan to stabilize resources, resulting in avoidance or minimization of potential impacts on aboveground historic property's integrity of design, materials, or workmanship. Implementing mitigation measures would be critical before the proposed physical damage and demolition of historic-age unevaluated properties to mitigate potential significant impacts. Therefore, the moderate impact on aboveground historic properties under Independent Measure 4A would be ***less than significant with mitigation.*** Measure 4A has the potential for adverse effects on known and as-yet-unknown archaeological historic resources; however, most of this area is not considered highly sensitive for historical or pre-contact resources. Third Street, one of the boundaries of this area, has high historic-period sensitivity. The southern end of this area, from the intersection of Davidson Street and Third Street due west to Evans Avenue and south to the intersection of Third Street and Evans Avenue, has high sensitivity for pre-contact remains. Pre-contact sensitivity continues to the northwest along Evans Avenue.

The vertical shoreline would be designed to reduce wave hazards while supporting nearshore ecology wherever current maritime uses and pier configurations allow. This measure would begin at the Ferry Building and include the stretch from Pier 22½ along The Embarcadero south to Pier 40, with the potential for adverse effects on aboveground historic properties within the Port of San Francisco Embarcadero Historic

District. The proposed vertical seawalls may cause construction and operational damage to the existing seawall, piers, and buildings. Even with the implementation of mitigation measures, the impact of construction activity, including ground disturbance and the loss of integrity for designated aboveground historic properties through physical damage or change to the design, setting, materials, and workmanship to the Port of San Francisco Embarcadero Historic District features would be notable, and avoiding all significant impacts is unlikely. Therefore, the impact on aboveground historic properties under Independent Measure Vertical Shoreline would be ***significant and unavoidable.*** This measure has the potential for adverse effects on known and as-yet-unknown archaeological historic resources. From the Ferry Building to the mouth of Mission Creek, there is high historic sensitivity from the inland limit of the project to the water. The area from the Bay Bridge to Pier 40 is considered sensitive for historic archaeological resources, including areas within and west of The Embarcadero. There is high pre-contact sensitivity on the west side of The Embarcadero from Rincon Park to Brannan Street Wharf Park.

The independent measures have the potential to damage previously unidentified archaeological sites or human remains, which may not be identified prior to construction. Although cultural resource inventories would be completed once legal access is secured, no inventory can ensure that all resources would be identified prior to construction. Similarly, the scale of construction makes it technically and economically infeasible to perform the level of sampling necessary to identify all buried human remains prior to construction.

Because the sites that would be encountered during construction may be eligible for listing in the NRHP or CRHR, damage to these sites may diminish their integrity. Construction has the potential to disturb previously unidentified archaeological sites that qualify as historical resources, historic properties, or unique archaeological resources. Excavation, compaction, or other disturbances may disrupt spatial associations that contain scientifically useful information and alter the potential basis for eligibility, thereby materially altering the resource and resulting in an effect.

If there are known sites in the construction area, USACE would implement mitigation measures, follow stipulations of the PA, and develop HPTPs that would set forth means for protecting historic properties or specifying treatment measures to minimize or mitigate the adverse effects. USACE may implement mitigation or treatment measures described in the HPTPs prior to construction, during construction, or after construction is completed, as appropriate. If previously unidentified archaeological sites or human remains are found during construction, USACE would implement mitigation measures and such items would be dealt with in the manner determined in the PHPMP (outlined in the PA). However, given the archaeological sensitivity of the area, even with implementation of mitigation, potential impacts on archaeological historic properties as a result of each independent measure could be ***significant and unavoidable***.

Because no TCPs have been identified at this time, there would be ***no impact*** or a negligible impact for all independent measures. If a TCP is identified during ongoing consultation, an addendum would be added to the study. However, at this time, the impacts, as well as the intensity of the physical and cultural loss as a result of independent measures, cannot be predicted or quantified without speculating on future events. Therefore, the impacts would be ***too speculative for meaningful consideration***.

4.18.8 Mitigation

The USACE and the Port of San Francisco have conducted a preliminary inventory of known historic properties. Investigations to be conducted prior to construction may result in the identification of previously unrecorded historic properties. Furthermore, construction activities may result in the discovery of historic properties. The mitigation of historic properties may be necessary following an evaluation of impacts to determine if any historic properties would be adversely affected. Adverse effects may include direct physical impacts from construction, noise, changes to resource settings, degradation of resource integrity, and other impacts that may affect the character of historic properties.

The USACE is executing a Programmatic Agreement (PA) that outlines the procedures for the identification, discovery, evaluation, and mitigation of historic properties. The PA stipulates that after the initiation of the Preconstruction Engineering and Design (PED) Phase, and upon receipt of funding, the USACE would prepare a Programmatic Historic Properties Treatment plan (PHPMP) that would provide an overarching research framework for Section 106 compliance and agreement implementation undertaken for the project. The PHPMP would be developed in consultation with the SHPO, the Tribes, and all consulting parties. The PHPMP would also provide implementation guidelines for developing historic property treatment plans, which would be used to address resource specific mitigation measures.

Because the project includes non-federal lands, it must conform to State of California procedures for the treatment of human remains. Therefore, any human remains, or related items, discovered during implementation of this project would be treated in accordance with the requirements of Section 7050.5(b) of the California Health and Safety Code. If, pursuant to Section 7050.5(c) of the California Health and Safety Code, the county coroner/medical examiner determines that the human remains are or may be of Native American origin, then the discovery would be treated in accordance with the provisions of Section 5097.98(a)–(d) of the Public Resources Code. USACE shall ensure that the remains are not damaged or disturbed further until all stipulations in Section 7050.5 and Section 5097.98 have been met.

4.19 Socioeconomics and Community

See Appendix D-1-3 for a discussion of impacts of the alternatives on socioeconomics and community.

4.20 Environmental Justice

See Appendix D-1-3 for a discussion of impacts of the alternatives on environmental justice.

4.21 Transportation

See Appendix D-1-4 for a discussion of impacts of the alternatives on transportation.

4.22 Utilities

This section qualitatively describes the impacts expected to utilities in the study area.

Significance Criteria

An alternative is considered significant if:

UT-01: interferes with operations of, cause damage to, or otherwise disrupt the use of any buried underwater cable, buried underwater pipeline, or overhead power transmission lines.

4.22.1 Construction Impact Summary

Temporary adverse impacts to utilities would occur during shore-based and in-water construction activities. Utilities would likely require modification and/or relocation during construction activities within the construction area. This could result in temporary loss or intermittent availability of some utilities (such as telecommunications, water) during immediate relocation. Temporary services would be provided within the construction area if a utility were to be expected to be compromised for any longer than a few hours. No area of impact would be expected to be without access to sewer, water, or electricity for any length of time (e.g., more than a few hours) as a result of construction. After relocation, all utility access would be restored upon construction completion.

In the long-term, CFRM features are likely to have ***beneficial*** impacts to utilities by protecting them from repeated inundation during storm events that could result in damage or loss of the infrastructure. This would have far greater adverse impacts to the study area than the temporary adverse impacts expected to occur during construction.

Wastewater generation would occur periodically throughout the construction period as a result of dewatering and demand from onsite construction workers. This demand would be temporary and nominal. Construction dewatering discharges would result in short-term increases in demand on existing wastewater or storm drainage facilities, but proposing dewatering discharge methods would include options for direct discharge to the bay under a NPDES general permit if certain criteria were met. This would ensure that any discharges to the combined sewer system would be within the capacity of existing facilities and would not require the construction or expansion of existing facilities. All wastewater flows would be treated at the Southeast Treatment Plan or the North Point Wet-Weather Facility prior to discharge through an existing outfall or overflow structure to the bay. The volume of wastewater flow would be directly related to the amount of water used for construction purposes.

No stormwater utility infrastructure upgrades are anticipated with implementation of the study.

Pacific Gas and Electric Company and SPFUC provide electricity and natural gas to the project site, and various private companies provide telecommunications facilities. Construction of CFRM features would result in an incremental increase in the demand for electricity, natural gas, and telecommunications. This increase in demand is not expected to result in loss or failure of electricity or telecommunications facilities and would be temporary, only lasting as long as construction.

4.22.2 Operations and Maintenance Impact Summary

Wastewater associated with operations and maintenance of CFRM features in the study area would flow to the city's combined stormwater and sewer system and be treated to the standards of the city's NPDES permit for the Southeast Treatment Plant. Temporary adverse impacts like those described in the construction impact summary could occur but are expected to be on a much smaller scale. The most likely impacts to utilities during O&M is increased usage of water, wastewater, and electricity during the activities; however, these increased demands would cease when the activity is complete. Impacts from operations and maintenance of any action alternative are likely to be minimal.

4.22.3 Tentatively Selected Plan

Adverse impacts are anticipated to be low for construction of CFRM features (Table 4-49).

Table 4-49. Summary of Utilities Impacts associated with the TNBP

TNBP Utilities Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint (1st Action)	1	2	2	2	2	2	2	2	2	2	2	2	2	1

TNBP Utilities Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint (2nd Action)	2	2	2	1	2	1	2	1	2	2	2	2	2	2
O&M Assumptions	1	2	2	2	1	2	2	2	2	2	2	2	2	2
Mitigated Rating	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*

Impacts are not expected to differ from those described in the Construction Impact Summary and the Operations and Maintenance Impact Summary. No additional impacts to utilities are expected under the TSP and are expected to be ***less than significant***.

4.22.4 Alternative B

Impacts during construction activities are not expected to differ from those described in the Construction Impact Summary and the Operations and Maintenance Impact Summary and are expected to be ***less than significant***. No additional impacts to utilities are expected under Alternative B; however, it would be anticipated that utilities would be relocated as SLR increases flooding into the study area. Utilities would be moved to reduce impacts from repeated inundation to limit loss and potential damage during storm events.

4.22.5 Alternative F

Adverse impacts are anticipated to be low for construction of CFRM features (Table 4-50).

Table 4-50. Summary of Utilities Impacts associated with Alternative F

Alternative F Utilities Impact Rating by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	2	2	2	2	2	2	2	2	2	2	2
O&M Assumptions	1	2	2	1	2	2	2	2	2	2	2
Mitigated Rating	2	2	2	2	2	2	2	2	2	2	2

Impacts are not expected to differ from those described in the Construction Impact Summary and the Operations and Maintenance Impact Summary. No additional impacts to utilities are expected under Alternative F and are expected to be ***less than significant***.

4.22.6 Alternative G

Adverse impacts are anticipated to be low for construction of CFRM features (Table 4-51).

Table 4-51. Summary of Utilities Impacts associated with Alternative G

Alternative G Utilities Impact Rating by Measure	**Levee**	**Bridge raise**	**Bulkhead wall/Seawall**	**Roadway Impact**	**T-wall**	**Vertical Wall/Curb**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint	2	2	2	2	2	2	2	2	2	2	2	2
O&M Assumptions	2	2	2	1	2	2	2	2	2	2	2	2

Alternative G Utilities Impact Rating by Measure	Levee	Bridge raise	Bulkhead wall/Seawall	Roadway Impact	T-wall	Vertical Wall/Curb	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Mitigated Rating	2	2	2	2	2	2	2	2	2	2	2	2

Impacts are not expected to differ from those described in the Construction Impact Summary and the Operations and Maintenance Impact Summary. No additional impacts to utilities are expected under the Alternative G and are expected to be ***less than significant***.

4.22.7 Independent Measures for Consideration

Adverse impacts are anticipated to be low for construction of CFRM features (Table 4-52).

Table 4-52. Summary of Utilities Impacts associated with the Independent Measures for Consideration

Independent Measures Utilities Impact Rating	2A	2B	3A	3B	3C	4A	Vertical Shoreline*
Construction/Footprint	2	2	2	2	2	2	2
O&M Assumptions	2	2	2	2	2	2	2
Mitigated Rating	2	2	2	2	2	2	2

Impacts are not expected to differ from those described in the Construction Impact Summary and the Operations and Maintenance Impact Summary. No additional impacts to utilities are expected under any of the independent measures and are expected to be ***less than significant***.

4.22.8 Mitigation

No mitigation for utilities would be needed for implementation of this project.

4.23 Recreation and Access

This section describes the adverse and beneficial impacts expected to recreation and access in the study area.

Significance Criteria

Adverse effects on recreation were considered significant if implementation of an alternative plan would result in any of the following:

REC-01: Substantially disrupt any institutionally recognized recreational facility or activity.

REC-02: Substantially reduce availability of and access to recreational or open space areas.

4.23.1 Construction Impact Summary

Temporary adverse impacts on recreational value from construction and ground disturbance are certain under any of the action alternatives; however, the significance of such impacts is subjective by nature and difficult to quantify. Short-term impacts are likely to occur in the immediate vicinity of the project area where construction related equipment, activities, and dust could be visible and audible to observers. During the construction period, recreationists would experience an increase in noise from operation of equipment that could impact their ability to seek solitude or may reduce the success of wildlife-dependent recreation activities. However, similar recreation opportunities would remain available on adjacent lands and elsewhere in the study area that could be accessed during times of construction. Public access to public lands would be maintained during construction with temporary access routes. Detours around construction areas would be included where appropriate. Recreation would resume in a manner like the existing condition after construction is complete.

4.23.2 Operations and Maintenance Impact Summary

Operations and maintenance activities may generate dust, and visible or audible disturbances that may be unpleasant in the vicinity of the action area. Overall, these would be minimal and be on a much smaller scale than the construction impacts. Recreation and access should not be readily disturbed during these actions, but it is likely that detours may be set where appropriate or restricted access during activities may be instilled for public safety. Once maintenance is complete, recreation activities would resume normally.

4.23.3 Tentatively selected plan

Adverse impacts to recreation and access are anticipated to be low for construction of CFRM features in the TSP (Table 4-53).

Table 4-53. Summary of Recreation and Access Impacts associated with the TNBP

TNBP Recreation and Access Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint (1st Action)	1	2	2	2	2	2	2	2	2	2+	2+	2+	2+	1
Construction/Footprint (2nd Action)	2	2	2	1	2	1	2	1	2	2+	2+	2+	2+	2+
O&M Assumptions	1	2	2	2	1	2	2	2	2	2	2	2	2	2
Mitigated Rating	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*

Impacts are anticipated to be the same as those described in the Construction Impact Summary and the Operations and Maintenance Impact Summary. Adverse impacts would be temporary and localized to construction sites, in which other recreation spaces would be available for use. No CFRM feature is proposed to be constructed over or through a large park (e.g., Mission Bay Park System, Sue Bierman Park) which occupy several acres in the study area. The most recreational impacts would be realized at the waterfront during wharf replacement, seawall construction, and roadway impacts. During this time, the wharfs and areas of the waterfront that are undergoing construction may be inaccessible, depending on the type of construction activity, for public safety concerns. If required, temporary access would be granted to some of these areas where active construction was not being undertaken. Once construction is complete, recreationists would have access to the waterfront and wharfs normally. Adverse impacts from the construction of CFRM features are anticipated to be ***less than significant***.

This alternative would likely have a long-term ***beneficial*** impacts to recreation and access by protecting recreational features from erosion, damage, and loss by repeated storm events and SLR. Additionally, EWN features would increase the acreage of available space for recreational activities.

4.23.4 Alternative B

Recreation resources may experience temporary, adverse impacts during building demolition, relocation, pier removal, and floodproofing, though these are anticipated to be low overall. Impacts during relocation, demolition, and floodproofing are expected to be the same as those described in the Construction Impact Summary.

During pier removal, private boats would not be allowed to enter the immediate area due to public safety concerns. The permanent removal of this pier would eliminate access for recreational purposes; however, other piers would remain accessible during and after construction that could be utilized by recreational boaters. Access restrictions would temporarily reduce recreation opportunities during the construction phase. Recreational resources near the construction area, such as boat landings, private marinas, etc. would continue their operations during construction.

Long-term recreational opportunities near the piers are not expected to change. By removing the piers, shade structure and potentially contaminated pilings would be removed, which may improve fish habitat locally. This could allow for improved recreational fishing opportunities or would sustain the baseline condition.

In the long-term, some recreational spaces may be lost or relocated in Alternative B. For those being relocated, access to these would be temporarily disrupted while infrastructure was being moved elsewhere. For areas requiring demolition, these areas would increase the recreation space available as they are de-paved and converted to green space upon removal of infrastructure. These areas would be subject to flooding during storm events and may sustain damage as a result of that, but most of the time would be available for recreational opportunities. Overall, Alternative B is expected to have ***less than significant*** short-term and long-term impacts to recreation and access.

4.23.5 Alternative F

Adverse impacts to recreation and access are anticipated to be low for construction of CFRM features in Alternative F (Table 4-54).

Table 4-54. Summary of Recreation and Access Impacts associated with Alternative F

Alternative F Recreation and Access Impact Rating by Measure	Bay fill	Levee	Bulkhead wall/Seawall	Roadway Impact	Tide Gate	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Marsh Enhancement*
Construction Footprint	2	2	2	2	2	2	2	2	2	2	2
O&M Assumptions	1	2	2	1	2	2	2	2	2	2	2
Mitigated Rating	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*

Impacts are anticipated to be the same as those described in the Construction Impact Summary and the Operations and Maintenance Impact Summary. Adverse impacts would be temporary and localized to construction sites, in which other recreation spaces would be available for use. No CFRM feature is proposed to be constructed over or through a large park (e.g., Mission Bay Park System, Sue Bierman Park) which occupy several acres in the study area. The most recreational impacts would be realized at the waterfront during wharf replacement, seawall construction, and roadway impacts. During this time, the wharfs and areas of the waterfront that are undergoing construction may be inaccessible, depending on the type of construction activity, for public safety concerns. If required, temporary access would be granted to some of these areas where active construction was not being undertaken. Once construction is complete, recreationists would have access to the waterfront and wharfs normally. Adverse impacts from the construction of CFRM features are anticipated to be ***less than significant***.

Operation of the tidal gates would likely provide the greatest impact during operations and maintenance of any CFRM feature. It is assumed it would undergo annual operation to ensure proper functioning of the mechanisms. During this time, increased noise and visual disruption would occur while the gates are operating (a few hours). Recreationists in the vicinity of the gate structure would experience temporary, adverse disturbances during this operation. Once gates were re-opened and maintenance was complete, any adverse impacts would cease.

This alternative would likely have a long-term ***beneficial*** impacts to recreation and access by protecting recreational features from erosion, damage, and loss by repeated storm events and SLR. Additionally, EWN features would increase the acreage of available space for recreational activities.

4.23.6 Alternative G

Adverse impacts to recreation and access are anticipated to be low for construction of CFRM features in Alternative G (Table 4-55).

Table 4-55. Summary of Recreation and Access Impacts associated with Alternative G

Alternative G Recreation and Access Impact Rating by Measure	**Levee**	**Bridge raise**	**Bulkhead wall/Seawall**	**Roadway Impact**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint	2	2	2	2	2	2	2	2+	2+	2+	2+	2+
O&M Assumptions	2	2	2	1	2	2	2	2	2	2	2	2
Mitigated Rating	2	2	2	2	2	2	2	2	2	2	2	2

Impacts are anticipated to be the same as those described in the Construction Impact Summary and the Operations and Maintenance Impact Summary. Adverse impacts would be temporary and localized to construction sites, in which other recreation spaces would be available for use. No CFRM feature is proposed to be constructed over or through a large park (e.g., Mission Bay Park System, Sue Bierman Park) which occupy several acres in the study area. The most recreational impacts would be realized at the waterfront during wharf replacement, seawall construction, and roadway impacts. During this time, the wharfs and areas of the waterfront that are undergoing construction may be inaccessible, depending on the type of construction activity, for public safety concerns. If required, temporary access would be granted to some of these areas where active construction was not being undertaken. Once construction is complete, recreationists would have access to the waterfront and wharfs normally. Adverse impacts from the construction of CFRM features are anticipated to be ***less than significant***.

Any direct impacts to recreational opportunities during construction of EWN features would be temporary and only last during construction. Recreationists that frequent Heron's Head Park or Pier 94 wetlands for wildlife viewing, may have to circumvent the action area when traveling due to construction limiting or delaying access. During sediment delivery to construction units (i.e., marsh enhancement, naturalized shorelines, ecotone levees), increased turbidity (e.g., marsh) and disturbance (e.g., ecotone levees) from construction equipment may deter fish and wildlife from the action area and neighboring areas, which may result in a temporary degradation of recreational opportunities outside the action area.

In general, construction of EWN features would have long-term ***beneficial*** impacts to recreation opportunities by providing 700+ additional acres of habitat over the total life of the project that are suitable for waterfowl and other birds, fish, and mammals which would enhance opportunities for wildlife observing. Enhanced marsh habitat could also improve fishing in areas as marshes are productive nursery habitat for fish.

4.23.7 Independent Measures for Consideration

Adverse impacts to recreation and access are anticipated to be low for construction of CFRM features with Independent Measures (Table 4-56).

Table 4-56. Summary of Recreation and Access Impacts associated with the Independent Measures for Consideration

Independent Measures Recreation and Access Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	2	2	2	2	2	2	2
O&M Assumptions	2	2	2	2	2	2	2
Mitigated Rating	2	2	2	2	2	2	2

Impacts are anticipated to be the same as those described in the Construction Impact Summary and the Operations and Maintenance Impact Summary. Adverse impacts are expected to be ***less than significant*** for any of the independent measures.

4.23.8 Mitigation

No mitigation for recreation and access would be needed for implementation of the project.

4.24 Aesthetics

This section describes the impacts of the alternatives on visual resources in and around the project area. Landscape changes are difficult to quantify and subjective in terms of impact significance, being influenced by individual perceptions, uses, familiarities, and expectations for viewsheds.

Aesthetic resources can briefly be defined as those natural and man-made features of the environment that can be perceived by all the senses, not just sight. Aesthetic resources include the unified combination of water resources, landforms, vegetation, and user characteristics at a site. An aesthetic resource may be a particular landscape, viewshed, or view as perceived with all the senses. Visual resources are defined as those natural and cultural features of the environment that can be potentially viewed.

Significance Criteria

The factors used to analyze the potential impacts of the alternative must consider a wide variety of perspectives to determine significance of impacts to aesthetic values. The alternative would pose a significant impact to aesthetic resources if it would:

AES-01: Substantial changes to views of any creek, bayou, or open space area from existing viewpoints including trails, over crossings, buildings, and residences

AES-02: Substantial changes to views of other significant environmental resources such as mid-ground and background views of the overall landscape

AES-03: Substantial changes to significant landmarks or defining features

AES-04: Substantial obstruction of significant public views or view corridors

AES-05: Development that is not harmonious with the surrounding visual setting (i.e. introducing a form, line, color, or texture that contrasts with the visual setting)

4.24.1 Construction Impact Summary

The construction activity view would be visually and audibly intrusive to the surrounding viewscape and have ***significant and unavoidable*** impacts during construction (multi-year) for Alternatives F, G, the TSP, and independent measures. In general, the adverse impacts during construction would come from the presence of heavy machinery, construction-related debris, temporary fencing used to restrict access, increase in noise from equipment use, etc. This would be visually and audibly disturbing near the construction zones, but also outside of the construction zones from areas that would have the construction within the viewshed. The experience of land use and general user activity would also be disturbed near the construction zone from noise and the visual disturbance of the presence of equipment. Areas may be inaccessible during times of construction for safety purposes that would also disrupt access to visual resources; however, this is anticipated to be temporary, only lasting until construction is completed.

The study area is urban in character and includes a diverse and intermixed combination of modern and historic buildings and structures, maritime and industrial facilities, vehicular streets, recreational trails, parks and public spaces, and natural areas along its shoreline. The linear stretch of the study area extends through several San Francisco districts and neighborhoods, contributing to its diverse visual character. The study area has and continues to experience physical and visual transformation in the form of redevelopment and infill development. This process of transformation has created a visual environment that includes a wide variety of architectural styles. As a result of this ongoing evolution, the massing, scale, materials, and architectural character (with respect to age and style) of the buildings and structures do not conform to any strongly discernible overall pattern. Open spaces in the Plan area also vary in character and are largely related to the physical form of the waterfront edge.

CFRM features would limit some existing views of visual resources from specific locations, but not to an extent that would be substantially adverse. Abundant views of scenic and visual resources that are currently available from different vantage points within the study area would remain with the new CFRM features being proposed with this study. Design elements of each feature incorporate the use of materials and architecture that blends with the surrounding landscape and with what was historically present, where appropriate (e.g., historic districts, along the Embarcadero). Some coastal views may be impacted or diminished but would still be available from other vantage points along the LOD. With the design elements, the impacts are anticipated to be ***less than significant*** over the long-term.

4.24.2 Operations and Maintenance Summary

O&M is anticipated to have minor and temporary impacts to visual resources. Given maintenance operations would be very localized for project features and are likely to occur infrequently, over short periods of time, it is anticipated this would have ***less than significant*** impacts. Temporary adverse impacts would be realized while work crews are present, and depending on the maintenance needed, noise and visual disturbances or reduced access to visual resources in a concentrated area may occur; however, this would not raise to the same level as impacts incurred during construction.

4.24.3 Tentatively Selected Plan

Adverse impacts to aesthetic resources are anticipated to be moderate to high for construction of CFRM features in the TSP (Table 4-57).

Table 4-57. Summary of Aesthetic Impacts associated with the TNBP

TNBP Recreation and Access Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint (1st Action)	1	4	4	4	4	4	4	4	4	4	4	4	4	1
Construction/Footprint (2nd Action)	4	4	4	1	4	1	4	1	4	4	4	4	4	4
O&M Assumptions	1	2	2	2	1	2	2	2	2	2	2	2	2	2
Mitigated Rating	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*

Construction of the TNBP would have similar impacts to those described in the construction impact summary. Changes to vegetation cover and diversity would be similar to those described for Alternative F.

Access to views of natural features such as marshes and large waterbodies (i.e., San Francisco Bay) would remain accessible during construction, as well as after construction completes. No protection is proposed for Heron's Head Marsh, thus it would be expected that overtime, depending on severity of SLR, this resource would be degraded and may eventually be lost. Pier 94 wetlands are proposed to be augmented in 2090 with marsh restoration and enhancement that would reliably improve the aesthetic experience of that coastal landform. In general, aesthetic resources of the San Francisco Bay would remain mostly unchanged in the long-term. Areas visited for views of the water would be more persistent and reliably accessible due to the protection provided by the CFRM features upon construction completion, but the aesthetic experience of the water may be different. The differences would vary by location but may include: the Bay may be similarly visible, visible but more screened, and/or no longer visible. Note that more than one of these may simultaneously be true in the same location, dependent upon the viewer's vantage point. Overall, the impacts are expected to be ***less than significant*** once construction is completed, as views of natural features would remain available from multiple vantage points.

4.24.4 Alternative B

There would be a temporary increase in construction equipment and support vehicles in the immediate area of the floodproofing or demolition sites that would likely last only a couple of months resulting in ***less than significant*** impacts. Over the long-term, floodproofing would not change the viewscape of the structure or the surrounding environment as the materials would blend with the structure's original form, color, and texture. Pier and building demolition would create a viewscape change that could be perceived as beneficial by some and adverse by others depending on their bias towards the quality and historic value of the site. Coastal views in general would be unaffected except for the demolition which may open new visual pathways. Long-term impacts are anticipated to be ***less than significant***.

4.24.5 Alternative F

Adverse impacts to aesthetics are anticipated to be moderate to high for construction of CFRM features in Alternative F (Table 4-58).

Table 4-58. Summary of Aesthetic Impacts associated with Alternative F

Alternative F Recreation and Access Impact Rating by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	4	4	4	4	4	4	4	4	4	4	4
O&M Assumptions	1	2	2	1	2	2	2	2	2	2	2
Mitigated Rating	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*

Construction of Alternative F would have similar impacts to those described in the construction impact summary.

Vegetation cover and diversity varies but is mostly landscaping amongst infrastructure. Natural vegetation occurs at coastal landforms such as Heron's Head Park. Vegetation that exists outside of the LOD would remain exposed to coastal flood risks that could change presence or condition over time, but vegetation behind the LOD would remain unchanged or could have improved condition due to the reduction of damage from coastal flooding events and SLR. The aesthetic experience of vegetation may be differ after construction is completed such that it may be similar, may be partially changed, or may be lost. During construction, it is assumed vegetation within the direct construction footprint of CFRM features would be lost; however, this would be returned upon construction completion. Overall, impacts would be ***less than significant*** once construction is completed.

Implementation of a tidal gates would result in a permanent landscape feature, that is likely to be interpreted by many to be significant and obtrusive. Tidal gates are typically dominant and often only somewhat compatible with the view scape, if at all. The gates, being intended to close during operations, would block views of the Bay and creeks depending on the vantage point, and would become the dominant feature in the enclosed landscape. When not in operation, the tidal gates could be considered an “eye sore” feature that may obstruct views of the bay partially or completely depending on final design and view vantage point. The gates are characterized as somewhat compatible because it is likely to disrupt the harmony of the existing landform, causing the broad and open experience at the mouth of the creeks currently available to be lost. Some coastal views may be impacted or diminished by the gates but would still be available from other vantage points along the LOD. With design elements, the impacts are anticipated to be ***less than significant*** over the long-term.

4.24.6 Alternative G

Adverse impacts to aesthetics are anticipated to be moderate to high for construction of CFRM features in Alternative G (Table 4-59).

Table 4-59. Summary of Aesthetic Impacts associated with Alternative G

Alternative G Recreation and Access Impact Rating by Measure	**Levee**	**Bridge raise**	**Bulkhead wall/Seawall**	**Roadway Impact**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint	4	4	4	4	4	4	4	4	4	4	4	4
O&M Assumptions	2	2	2	1	2	2	2	2	2	2	2	2
Mitigated Rating	2	2	2	2	2	2	2	2	2	2	2	2

Construction of Alternative G would have similar impacts to those described in the construction impact summary.

Changes to vegetation cover in reaches 2 and 3 would be similar to that described for Alternative F. In Reaches 3 and 4, incorporation of EWN and retreat of the LOD would convert existing pavement and grey infrastructure to green space, improving the vegetation viewshed. Incorporation of important ecological habitat and open space would create new visual pathways for coastal views, as well as incorporate new vegetation views, that may be perceived as beneficial by some, but adverse to others. Overall, the impacts are anticipated to be ***less than significant*** over the long-term.

Access to views of natural features such as marshes and large waterbodies (i.e., San Francisco Bay) would remain accessible during construction, as well as after construction completes. Similar to vegetation cover, views of natural features would be enhanced with the addition of EWN, particularly in reaches 3 and 4. The expansion of natural features, by augmentation of existing wetlands, and creation of new habitat (e.g., ecotone levees, naturalized shorelines) would improve visual resources within the reach as well as for other parts of the study area that may have the features within the viewshed. For some, it would be considered beneficial while others may consider it adverse. Overall, the impacts are expected to be ***less than significant*** once construction is completed, as views of natural features would remain available from multiple vantage points.

4.24.7 Independent Measures for Consideration

Adverse impacts to aesthetics are anticipated to be moderate to high for construction of CFRM features with Independent Measures (Table 4-60).

Table 4-60. Summary of Aesthic Impacts associated with the Independent Measures for Consideration

Independent Measures Recreation and Access Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	4	4	4	4	4	4	4
O&M Assumptions	2	2	2	2	2	2	2
Mitigated Rating	2	2	2	2	2	2	2

Construction of the independent measures would have similar impacts to those described in the construction impact summary, particularly for the grey features being proposed. Measure 2B proposes to overlay bay fill with a coarse beach which would change the views of natural features in reach 2 of the waterfront. The addition of ecological features could be considered beneficial for some viewers, but adverse to others. Similarly, measure 4A includes addition of EWN that would permanently change vegetation cover and the viewscape of natural features by including new green space.

Access to views of natural features such as marshes and large waterbodies (i.e., San Francisco Bay) would remain accessible during construction, as well as after construction completes. No protection is proposed for Heron's Head Marsh, thus it would be expected that overtime, depending on severity of SLR, this resource would be degraded and may eventually be lost.

4.24.8 Mitigation

No mitigation measures were identified for aesthetic resources. Elements were considered during the design of the features that would mitigate overall aesthetic impacts.

4.25 Hazardous, Toxic, and Radioactive Waste

Appendix D-1-6 details the environmental consequences anticipated with HTRW.

4.26 Land Use Planning

See Appendix D-1-7 for a discussion of impacts of the alternatives on land use planning.

4.27 Public Health and Safety

This section describes the adverse and beneficial impacts expected to public health and safety in the study area.

Significance Criteria

The alternative would pose a significant impact to public health and safety if:

PH-01: create a significant hazard to the public or the environment by disrupting the routine transport, use, or placement or storage of hazardous materials or wastes.

PH-02: Impair implementation of, or physically interfere with, an adopted emergency response plan or emergency evacuation plan.

4.27.1 Construction Impact Summary

It is not expected that CFRM measures would directly impact public facilities or services; however, public facilities could have temporarily interrupted services during construction activities. Increased vehicular congestion along roads, highways, and streets during construction could temporarily impede access of public services; however, detours and alternative access routes would be established to minimize these impacts. Site security (e.g., fencing) would be included around all construction areas to deter the public from accessing active construction sites for safety and health concerns.

Features such as new or relocated driveways, transit corridors, on-street loading zones, etc. would not impede emergency vehicles. None of the plans are anticipated to result in inadequate emergency access. No access would be cut off to emergency service infrastructure (e.g., hospitals, police stations), nor would emergency services be cut off from accessing areas to perform regular or emergency duties.

The police department evaluates performance, based on response times and, when appropriate, reallocate resources to meet the need for services in specific parts of the city if and when conditions warrant. Although routes may change temporarily during construction, none of the alternatives would necessitate the construction of new or expanded police department facilities to maintain acceptable service ratios, response times, or other performance objectives.

The study area is serviced by several fire stations. The fire department conducts ongoing assessments of its service capacity and response times and would continue to do so in response to construction related impacts and changes following construction completion. None of the alternatives would necessitate the construction of new or expanded fire department facilities to maintain acceptable service ratios, response times, or other performance objectives.

Construction is not expected to increase demand for emergency response and emergency medical services. Instead, construction of an action alternative is expected to have long-term ***beneficial*** impacts to emergency services by reducing flooding risks and damages that would occur during a storm event. This is expected to benefit emergency response time for these services, as well as reduce damages or loss that may occur to emergency response facilities following a storm event.

4.27.2 Operations and Maintenance Impact Summary

Operations and maintenance activities are not anticipated to have adverse impacts to emergency or public health services, response, or infrastructure.

4.27.3 Tentatively selected plan

Adverse impacts to public health and safety are anticipated to range from no to low for construction of the TSP (Table 4-61).

Table 4-61. Summary of Public Health and Safety Impacts associated with the TNBP

TNBP Public Health and Safety Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint (1st Action)	1	2	2	2	2	2	2	2	2	1	1	1	1	1
Construction/Footprint (2nd Action)	2	2	2	1	2	1	2	1	2	1	1	1	1	1
O&M Assumptions	1	2	2	2	1	2	2	2	2	1	1	1	1	1
Mitigated Rating	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*1*	*1*	*1*	*1*	*1*

CFRM features that would be constructed along the waterfront such as levees, t-walls, wharfs, vertical walls, seawall, roadway, and bay fill are anticipated to have low adverse impacts to public health and safety. The majority of adverse impacts would be realized with the need for traffic detours and reduced access during construction in localized areas that may increase response times in some instances. The actual construction of these features should not impose a public health and safety concern as active construction zones would be fenced off to prevent public access. In the long-term, these features would have ***beneficial*** impacts to public health and safety by reducing the likelihood of damage, loss, or injury from coastal storm events. The increased protection from CFRM features would improve public health and safety overall.

Construction of EWN features is anticipated to have no impacts to public health and safety, rather would be beneficial in the long-term. EWN features are not proposed to be constructed in locations that would impede access or response of emergency services and do not occur near public safety infrastructure. As such, it is not likely that construction would have adverse impacts to the operability of these services. Long-term benefits can be realized with the improved and expanded access to natural spaces that improve overall well-being of individuals.

Construction of any CFRM or EWN feature would have ***less than significant*** impacts to public health and safety.

4.27.4 Alternative B

Alternative B is not anticipated to have impacts beyond those described in the Construction Impact Summary. Any emergency service infrastructure that required relocation would be temporarily unavailable from the previous operating location; however, services would still be provided from neighboring facilities. This may increase volume of operations to other facilities temporarily, but it is assumed these facilities would be provided the necessary support to complete tasks without causing significant delays or issues with response to emergency services.

4.27.5 Alternative F

Adverse impacts to public health and safety are anticipated to range from no to low for construction of Alternative F (Table 4-62).

Table 4-62. Summary of Public Health and Safety Impacts associated with Alternative G

Alternative F Public Health and Safety Impact Rating by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	2	2	2	2	2	2	2	2	1	1	1
O&M Assumptions	1	2	2	2	2	2	2	2	1	1	1
Mitigated Rating	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*1*	*1*	*1*

CFRM features that would be constructed along the waterfront such as levees, t-walls, wharfs, vertical walls, seawall, roadway, and bay fill are anticipated to have low adverse impacts to public health and safety. The majority of adverse impacts would be realized with the need for traffic detours and reduced access during construction in localized areas that may increase response times in some instances. The actual construction of these features should not impose a public health and safety concern as active construction zones would be fenced off to prevent public access. In the long-term, these features would have ***beneficial*** impacts to public health and safety by reducing the likelihood of damage, loss, or injury from coastal storm events. The increased protection from CFRM features would improve public health and safety overall.

Construction of EWN features is anticipated to have no impacts to public health and safety, rather would be beneficial in the long-term. EWN features are not proposed to be constructed in locations that would impede access or response of emergency services and do not occur near public safety infrastructure. As such, it is not likely that construction would have adverse impacts to the operability of these services. Long-term benefits can be realized with the improved and expanded access to natural spaces that improve overall well-being of individuals.

Construction of any CFRM or EWN feature would have ***less than significant*** impacts to public health and safety.

4.27.6 Alternative G

Adverse impacts to public health and safety are anticipated to range from no to low for construction of Alternative G (Table 4-63).

Table 4-63. Summary of Public Health and Safety Impacts associated with Alternative G

Alternative G Recreation and Access Impact Rating by Measure	Levee	Bridge raise	Bulkhead wall/Seawall	Roadway Impact	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint	2	2	2	2	2	2	2	1	2	3	3	1
O&M Assumptions	2	2	2	1	2	2	2	1	1	2	2	1
Mitigated Rating	2	2	2	2	2	2	2	1	1	2	2	1

CFRM features that would be constructed along the waterfront such as levees, t-walls, wharfs, vertical walls, seawall, roadway, and bay fill are anticipated to have low adverse impacts to public health and safety. The majority of adverse impacts would be realized with the need for traffic detours and reduced access during construction in localized areas that may increase response times in some instances. The actual construction of these features should not impose a public health and safety concern as active construction zones would be fenced off to prevent public access. In the long-term, these features would have ***beneficial*** impacts to public health and safety by reducing the likelihood of damage, loss, or injury from coastal storm events. The increased protection from CFRM features would improve public health and safety overall.

For the construction of most EWN features, impacts are anticipated to range from no to low impacts to public health and safety. In 2040, most EWN features are not proposed to be constructed in locations that would impede access or response of emergency services and do not occur near public safety infrastructure. As such, it is not likely that construction would have adverse impacts to the operability of these services. In 2090, EWN features are expected to cover an expansive area (700+ acres) that would eliminate some roadways and areas that were previously serviced by emergency response. The EWN features that are anticipated to have greater adverse impacts during construction include those that would occur inland (i.e., ecotone levees, naturalized shorelines), while shore-based features (i.e., ecological armoring, marsh) would occur outside of areas that would impact emergency services.

Moderate impacts during the construction of embankment and naturalized shorelines are anticipated during the 2090 construction phase. In 2090, UCSF Medical Center at Mission Bay (hospital) and Kaiser Permanente San Francisco Mission Bay Medical Offices would be demolished when the land it occupies is converted to EWN features. Another two hospitals, UCSF Benioff Children’s Hospital and Maternidad UCSF, are located approximately 1,200 feet to the southeast of these buildings, that would be available to accommodate emergency medical services when the hospital and medical offices are lost. This may temporarily increase the volume of patients attending the available hospitals; however, the population within this area is expected to lower given the conversion of large acres of grey infrastructure to natural spaces.

Construction of any CFRM or EWN feature would have ***less than significant*** impacts to public health and safety. In general, long-term benefits can be realized with the improved and expanded access to natural spaces that improve overall well-being of individuals.

4.27.7 Independent Measures for Consideration

Adverse impacts to public health and safety are anticipated to range from no to low for construction of CFRM features with Independent Measures (Table 4-64).

Table 4-64. Summary of Public Health and Safety Impacts associated with the Independent Measures

Independent Measures Public Health and Safety Impact Rating	2A	2B	3A	3B	3C	4A	Vertical Shoreline*
Construction/Footprint	2	2	2	2	2	1	1
O&M Assumptions	2	2	2	2	2	1	1

Mitigated Rating	2	2	2	2	2	1	1

Impacts are anticipated to be the same as those described in the Construction Impact Summary and the Operations and Maintenance Impact Summary, and any of the action alternatives with overlapping measures. Adverse impacts are expected to be ***less than significant*** for any of the independent measures.

4.27.8 Mitigation

No mitigation for public health and safety would be needed for implementation of the project.

4.28 Cumulative Effects

NEPA regulations require that cumulative impacts of a proposed action be assessed and disclosed in an EIS or Environmental Assessment (EA). The CEQ regulations define cumulative impacts as:

> "…the impacts on the environment which result from the incremental impact of the action (project) when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

For purposes of this analysis, cumulative impacts are evaluated if the indirect and direct impacts of the federal action have substantial temporary adverse or positive impacts to the resource, when considering past, present, and reasonably foreseeable future actions. Potential impacts of the past, present, and reasonably foreseeable future actions include both potential direct effects (caused by the action sand occurring at the same time and place as the TSP), and indirect effects (caused by the action but removed in distance and later in time, and reasonably foreseeable).

The cumulative effects analysis considers the magnitude of the cumulative effect on the resource health, which refers to the overall condition, stability, or vitality of the resource and the trend of that condition. Laws, regulations, policies, or other factors that may change or sustain the resource trend were considered to determine if stress on the resource is likely in the foreseeable future. Cumulative impacts may also occur when the occurrence of disturbances is so close that the effects of one are not dissipated before the next occurs, or when the timings of disturbances are so close that their effects overlap. The general approach provided in the CEQ's Considering Cumulative Effects Under the NEPA was used to conduct the analysis (CEQ 1997).

This cumulative impact analysis was scoped with a temporal boundary approximately 100 years in the past (1920), from the beginning of the study, and approximately 50 years into the future (2190), from construction completion. This period of analysis captures a timeframe when a significant number of environmental laws were enacted in which resource protection became a priority (past). Additionally, the period of analysis tracks the H&H modelling for RSLC threats, as well as future SLR trajectories.

For a spatial boundary to scope this cumulative impact analysis, projects or actions considered were mostly within the same county and/or in San Francisco Bay.

This study is one of many ongoing efforts to improve flooding, coastal storm damages and disaster resilience along the San Francisco waterfront. The San Francisco Waterfront Plan and the Waterfront Resilience Program are led by the Port and include the study area, as well as areas both north and south of this study boundary.

4.28.1 Past or Present Actions

San Francisco Harbor Project. San Francisco Bay is one of the critical maritime thoroughfares in the nation, supporting international trade, commercial and recreational fishing, and recreation. For over a century, navigational channels were created, deepened, and maintained by dredging to enable ships to navigate safely into and out of ports, harbors, and marinas without running aground. Successfully accomplishing this mission, which requires maintaining the federal channels to their regulatory depths, is critical to the region's maritime trade and to the regional and national economies. Over 60 million tons of waterborne commerce traverse the San Francisco Bar entrance channel annually. Regular dredging the region's channels, ports and associated docking, and berthing and other facilities is needed to maintain adequate depths for vessels to maneuver in a safe and efficient manner.

The San Francisco Harbor project consists of a deep-draft navigation channel (the Main Ship Channel) immediately offshore San Francisco Bay on the San Francisco Bar and in-Bay components. The original project was adopted by various Congressional Acts from 1868 to 1922 and provided for channel dredging and rock removal. The project was modified to existing dimensions by Rivers and Harbors Acts of 1927, 1935, 1937,1939, and 1965. The San Francisco Bar entrance is located approximately five miles west of the Golden Gate Bridge in the waters leading into San Francisco Bay and was last deepened in 1974 to a 55-foot project depth at Mean Lower Low Water (MLLW). This high use, deep draft channel requires annual maintenance dredging to be performed to maintain the 55-foot project depth. This critical channel, which is the gateway to San Francisco Bay, is 2,000 feet wide by 16,000 feet long (USACE and RWQCB, 2015). In addition to the San Francisco Bar entrance channel, there are eleven in-Bay components. These components are dredged infrequently.

The Islais Creek entrance channel is located 2.5 miles south of the Bay Bridge. The original channel was adopted by the Rivers and Harbors Act of 1927 and modified by the Rivers and Harbors Act of 1935 and consists of a flared channel approaching the mouth of Islais Creek, 3,300 feet wide at the Bay end and 500 feet wide at the U.S. Pipehead Line end, and 35 feet deep. The primary users of the channel were commercial shipping firms operating out of Piers 80, 84, 86, 88, 90, 92, and 96 (USACE, 1975). Dredging of the channel was very infrequent. Enlargement of the entrance channel was considered, and a draft environmental impact statement issued in October 1973.

Fisherman's Wharf. This project provides protection to the existing fishing fleet and the federally-owned historic fleet (National Park Service) at Fisherman's Wharf, San Francisco, California. Originally constructed in 1988, the project includes a 1,509-foot -long solid concrete sheet-pile breakwater, which is located along the west side of Pier 45, and a segmented concrete sheet-pile breakwater, which is located on the northeastern side of Pier 45. The latter has one 252-foot-long segment and one 150-foot-long segment. A Section 216 study was conducted in FY 07 to identify relationships and impacts between the Corps' project and the National Park Service's San Francisco Municipal Pier.

Final Environmental Assessment/Environmental Impact Report for Maintenance Dredging of the Federal Navigation Channels in San Francisco Bay, 2015-2024. Sediment accumulation in these channels can impede navigability. Maintenance dredging removes this sediment and returns the channels to regulatory depths to provide safe, reliable, and efficient waterborne transportation systems (channels, harbors, and waterways) for the movement of commerce, national security needs, and recreation. Therefore, USACE's purpose in this project is to continue maintenance dredging of the Federal navigation channels in San Francisco Bay consistent with the goals and adopted plans of the LTMS, while adequately protecting the environment, including listed species.

San Francisco Waterfront Seawall Section 103 Study. This study was initiated in 2013 under the continuing authority of Section 103 of the River and Harbor Act of 1962, as amended. The study included the a portion of the Embarcadero area of the San Francisco waterfront. The study focused on two areas of concern – a low point approximately 40 feet wide between two buildings near Pier 5 and a half-mile low section of seawall between the Agricultural Building and Pier 22 1/2. The study was put on hold in 2018 due to the funding and initiation of this Congressionally authorized feasibility study under the Investigations account that includes the entire 7.5-mile waterfront.

Pier Repair/Removal Program. Section 5051 of WRDA 2007 provides discretionary authority to the Secretary of the Army, in cooperation with POSF, to carry out a project for repair and removal, as appropriate, of Piers 30-32, 35, 36, 70 (including Wharves 7 and 8) and 80 in San Francisco, California, substantially in accordance with the Port's Redevelopment Plan. The first phase of the project consisted of removing the deteriorated and partially collapsed Pier 36 using funding provided in FY 2010. Built in 1909 of both reinforced concrete and wood elements, Pier 36 was originally 721-feet long and 201-feet wide. Removal of Pier 36 made way for construction of the Brannan Street Wharf public park, the centerpiece of the South Beach Waterfront neighborhood redevelopment plan. A letter report on the removal of Pier 70 was completed in 2016, but the work was not undertaken due to the redevelopment of Pier 70.

Pier 70 Central Basin Section 107 Study. This study was conducted under the continuing authority of Section 107 of the Rivers and Harbors Act of 1960, as amended. The purpose of the study was to determine the feasibility of dredging the central basin at Pier 70 to an increased depth to reduce the impacts of shoaling to allow vessels to access the Pier 70 shipyard safely and efficiently without the use of high tide. A draft integrated Detailed Project Report and EA was completed in 2017 but the study was terminated after the dry dock closed.

Pier 48/Seawall Lot 337/Mission Rock Special Use District Project is a 3.6-million-square-foot mixed-use development project that would include retail, commercial, residential, and parking uses as well as eight acres of parks and open space and historic rehabilitation of Pier 48. The project would include a parking structure with 2,300 spaces, 1.7 million square feet of commercial, 150,000 to 250,000 square feet of retail, and between 650 and 1,500 residential units. Phase 1 of this project currently is under construction.

Pier 70 Mixed-Use District Project is a multi-phase 28-acre mixed-use development including parking spaces, parks, roads, public access, shoreline improvement and utility infrastructure. Mixed uses include residential (1,712,000 to 903,000 gross square feet), commercial (1.8 million gross square feet), retail and arts spaces (400,000 gross square feet) and research/development space. Phase 1 of this project is currently under construction.

Potrero Power Station Mixed-Use Development Project is a 5.4-million-square-foot mixed-use development that would include hotel, commercial, entertainment, residential, and parking uses as well as seven acres of open space. The project would include 2,600 residential units, 250 hotel rooms, 1.6 million square feet of commercial (office, research and development, PDR, and retail), 50,000 square feet of community facilities, 25,000 square feet of entertainment/assembly, and 2,700 parking spaces. The buildings would range in height between 65 and 240 feet. Phase 1 of this project is currently under construction.

The Better Market Street Project would revitalize Market Street from Octavia Boulevard to The Embarcadero by optimizing sustainable mobility modes (transit, walking, rolling, and cycling) so that Market Street would be pleasant, reliable, efficient, and safe for all users. The first phase of the project, between Fifth and Eighth streets, began in October 2023.

The Embarcadero Enhancement Program, Central Embarcadero Phase 1 would improve safety, mobility, connectivity, and accessibility for all users of The Embarcadero, which serves as a major transit corridor, tourist destination, marine-oriented commercial district, and public recreation area. The first phase of the project completed in 2022.

4.28.2 Reasonable Foreseeable Actions

TZK Broadway and Teatro ZinZanni Project includes a boutique hotel with approximately 192 rooms with ancillary retail and commercial spaces and a new theater to serve as the permanent home for Teatro ZinZanni and its historic “Spiegeltent”; and an approximately 14,000-square-foot privately financed park at the northern end of the site. Construction has not yet begun.

The Port of San Francisco's Waterfront Resilience Program would include developing a series of coordinated projects working to ensure a resilient waterfront in the face of seismic and sea-level rise, climate change-related hazards, and includes an U.S. Army Corps of Engineers Flood Study for the entire Port waterfront and a program to strengthen the three-mile-long Embarcadero seawall. A project application has not yet been submitted.

The San Francisco Housing Element 2022 Update42 would modify the policies of the general plan's housing element. The goals, policies, and actions are required to plan for the regional housing targets allocated to San Francisco by regional agencies for the 2023–2031 cycle and meet future housing demand in San Francisco. The housing element update includes policies designed to improve housing affordability and advance racial and social equity and would shift an increased share of the city's future housing growth to transit corridors and low-density residential districts within certain areas of the city. It would not include specific changes to existing land use controls (e.g., zoning) or approve any physical development, but the Environmental Impact Report would evaluate the potential physical environmental impacts that could result from future actions regarding implementation of the policies proposed under the housing element. The Draft Environmental Impact Report was published in 2022 and the plan was adopted in January 2023.

The Mission Bay Ferry Landing project (Phase 2) would provide regional ferry service to and from the Mission Bay neighborhood, as well as the Dogpatch, Potrero Hill, Pier 70, and the Central Waterfront neighborhoods. The Mission Bay Ferry Landing would provide capability to berth two ferry boats simultaneously. Cumulative Impact Analysis

The measures included in the TSP would continue the trend of projects designed to make the region more resilient to coastal hazards and climate change, and to protect infrastructure. The majority of measures in the TSP would have temporary adverse impacts that are anticipated during construction; however, permanent impacts are also expected with limited resources. Temporary impacts would end soon after the construction phase is over and be minimized with the use of BMP's, while permanent impacts would be offset with compensatory mitigation. The cumulative impact analysis is presented by resources grouped into the natural, physical, built, and human environment. Cumulative impacts of past projects and actions are captured in the Affected Environment (Section 3.0) as these would have contributed to the present state of resources in the project area.

4.28.2.1 Natural Environment

Temporary impacts are expected to natural resources as a result of construction activities for this project, present actions, and reasonable and foreseeable actions.

Temporary impacts include turbidity, water quality disturbance, physical impacts from construction equipment, and the potential injury or harassment of organisms by construction activities. All of these impacts would be minimized with the use of BMP's and avoidance and minimization measures to the greatest extent practicable. The cumulative impacts could be heightened at any given time if more than one project is occurring within the same area at the same time. The majority of adverse impacts to the natural environment would be realized with in-water construction activities which are planned with this project, the Mission Bay Ferry landing, and as components of the Waterfront Resiliency Program. It is unlikely that all of these projects would have construction activities occurring at the same time, but in the event this occurred, impacts to natural resources would be elevated.

Permanent impacts are also expected to the natural environment from this project and future actions, such as the Mission Bay Ferry Landing with the addition of hardened structures in San Francisco Bay and bay fill. These permanent impacts are not expected to result in net loss as compensatory mitigation would be used to fully account for this impact of construction. However, cumulatively, these projects would result in the permanent modification of bay habitat that is within the direct construction footprint.

There are also beneficial cumulative impacts anticipated as a result of this project and several of the present and reasonably foreseeable actions with the inclusion of EWN features and increase in open space. This project proposes construction of EWN features that would benefit state and federally protected species, while the Potrero Power Station and Embarcadero Enhancement projects would provide additional recreation and open spaces that could be frequented by local fauna. The increase in naturalized spaces would provide new areas for fauna in an otherwise highly urbanized location.

4.28.2.2 Physical Environment

The San Francisco Bay Area Air Basin is the cumulative study area for air quality, while global atmosphere is the cumulative study area for GHGs. Consequently, there are numerous past, present and reasonably foreseeable projects within these study areas. Implementation of avoidance and minimization measures would reduce criteria pollutant emissions generated by this project but would not avoid the exposure of sensitive receptors to substantial pollutant concentrations in localized areas. Other projects in the cumulative impacts area may implement comparable mitigation measures, such as using water or dust control chemicals to reduce fugitive dust or complying with relevant air quality regulations. Other cumulative projects may also contribute pollutant concentrations in the same localized areas affected by project construction. Thus, construction of the project would cumulatively contribute to existing localized air quality impacts in the study area but would not cumulatively contribute to regional air quality impacts.

Construction activities under this project could coincide with construction activities associated with reasonably foreseeable projects, resulting in a combined increase in construction noise. In general, the potential for projects to overlap, resulting in combined or prolonged increases in ambient noise, is more likely when the construction noise of two or more projects overlaps. As such, the cumulative noise from simultaneous construction activity in proximity to one another could result in higher noise levels than would otherwise occur with one project under construction. Construction of multiple projects consecutively could increase the duration of construction noise levels that would be 10 dBA above the ambient noise level or 90 dBA at sensitive receptors. Given that the adaptations constructed under the TSP would occur along the shoreline in the vicinity of Embarcadero Early Projects and other ongoing construction, this would make a considerable contribution to the significant cumulative construction noise impact. Implementation of avoidance and minimization measures would help to alleviate the level of noise impact if multiple construction projects were underway at the same time and area. Alternatively, construction phases between projects could be coordinated to occur at different times to spatially spread noise disturbance; however, this could result in prolonged noise disturbance for a longer period. It is unlikely that multiple projects generating vibration disturbances would occur at the same time in the same locations, thus it is not expected to contribute to cumulative impacts.

This project is considering seismic hazards for design and construction, as such, long-term beneficial impacts to geologic resources would be anticipated. It is assumed the reasonable and foreseeable actions would be designing features with seismic loading factored to ensure construction of a stable building or other infrastructure. With that, projects would be expected to be beneficially impacting geologic resources by creating more stable subsurface conditions.

Some cultural resources would be permanently impacted during construction of the TSP as many are proposed to be elevated to remain in place while being protected from coastal flood hazards. Additionally, many others would be protected with addition of floodwalls or other CFRM features in close proximity that would likely change the visible characteristics of many cultural resources. Many of these impacts would be minimized to the greatest extent practicable; however, it is also understood these impacts would remain in perpetuity. This project in combination with the reasonable and foreseeable actions would cumulatively impact cultural resources, either temporarily or permanently, but overall have a goal of protecting the resources with improvements to infrastructure to combat threats of coastal flooding exacerbated by climate change. In this respect, many cultural resources would also have beneficial impacts with the protection from flooding and future damages.

This project is proposed to occur in a historically, heavily industrialized area that has resulted in a relatively extensive distribution of contamination throughout the study area. USACE regulations require sites to be free of contamination prior to construction begins. In this regard, construction would be expected to have a long-term beneficial impact to HTRW by potentially reducing the levels of contamination and thereby risks of future exposure. For this analysis, it was assumed the reasonable and foreseeable actions would be working with a clean site or would not be disturbing HTRW areas, thus would not contribute to any cumulative adverse impacts associated with contamination.

4.28.2.3 Built Environment

Temporary adverse impacts would occur during construction to infrastructure, both with this project and other current and future proposed projects and actions. Construction impacts are anticipated to cease with construction completion and minimized with the use of mitigation and BMP’s. In the long-term beneficial impacts would be realized for infrastructure that is being protected from coastal flooding with the addition of CFRM features. Other projects proposed for the study area would contribute to the benefit of infrastructure such as housing, recreation and access, maritime facilities, and hospitality. It is assumed utilities would be adjusted for this project and others to continue provision of important services, and thereby, often improve the service availability and access. Aesthetics would result in a permanent change to waterfront views, particularly in areas where new infrastructure is proposed or modified. These are assumed to be mostly beneficial as consideration would be given to visual impacts and designs would be modified to minimize those impacts.

Cumulative impacts of other construction projects that could be taking place when construction starts, and cumulative effects to transit or transportation users, would be considered as part of the construction and traffic management plans to be prepared for elements of the project as work progresses to limit overall impacts.

4.28.2.4 Human Environment

The cumulative impacts from this project and the present and reasonably foreseeable actions were assumed to overall improve the human environment by enhancing protection from coastal storm risks. Temporary impacts during construction would be realized from any of the projects, which would be assumed to be heightened if more than one project was occurring in the same area(s) at the same time. However, generally the plans are designed to enhance the human environment either by improving safety, living standards, recreation, and/or housing and transit availability in the project area.

4.29 Probable Adverse Environmental Effects That Cannot Be Avoided

This section describes the TNBP’s long-term adverse impacts that may be unavoidable and the rationale for proceeding notwithstanding the unavoidable effects.

Air Quality: During construction, there will be unavoidable air quality impacts associated with construction activities, operation of heavy equipment, and transport of personnel and materials into and out of the project area. Operation of heavy equipment would result in the release of exhaust emissions. Additionally, dust could be generated during grading and excavation activities. Mitigation measures have been incorporated and are fully described in Appendix D-1-1 Section 2.3.4. Mitigation would include: implementation of BAAQMD’s Basic and Enhanced BMPs for Construction, utilizing the highest tier equipment available at the time of construction where practicable, and creating barriers between the construction site and sensitive receptors. As of now, no compensatory mitigation is necessary. However, if modeling indicates emissions are greater than *de minimus* levels once the designs have been refined, compensatory mitigation will need to be considered and would likely include funding an off-site emission reduction project.

Aquatic Resources: Wharf raising/rebuilding and construction of a coarse beach will result in approximately 9.0 acres of bay fill that will require compensatory mitigation in the form of old pile and pier removal from the bay. Loss of fringe wetlands and inter-tidal habitat is expected during construction of the ecotone levee and marsh enhancements, however, these habitats would be restored as a feature of the design that would over the long-term enhance the aquatic habitats at these locations, resulting in no net loss. Additional mitigation measures have been incorporated to minimize unavoidable impacts and are described in section 4.14.8 of this appendix.

Noise: During construction, there will likely be unavoidable noise impacts associated with construction activities, operation of heavy equipment, and movement of personnel and material into and out of the project area. Mitigation measures have been incorporated to minimize construction-related noise impacts, such as limiting heavy equipment use to daytime hours not regulated by the City the greatest extent practicable, conducting noise and vibration monitoring, employing common construction BMPs, and complying with all Federal and State noise control regulations. Mitigation measures are described in Appendix D-1-2 Section 2.3.

Transportation: The project will disrupt traffic patterns, result in transportation corridor closures, loss of access and parking, detours and increased construction traffic and congestion near staging and construction areas. These impacts are expected to be temporary but long-term lasting until construction is complete. Permanent unavoidable impacts resulting from changed traffic patterns would be realized with roadway, bike path, sidewalk, and transit redesign, and re-routing in areas of raised elevation or narrowing of roadways to accommodate the levees and floodwalls. Mitigation has been incorporated to minimize the impacts and have been described in Appendix D-1-4 Section 2.2.4 and include but are not limited to preparing construction traffic management plans to minimize cumulative effects from other projects, maintaining or providing pedestrian and bicycle access to the waterfront to the greatest extent practicable, and providing alternative transit access and stops where necessary.

4.30 Irreversible or Irretrievable Commitments of Resources

NEPA 40 CFR 1502.16(a)(4) requires that the environmental analysis include identification of “any irreversible and irretrievable commitments of resources which would be involved in the proposal should it be implemented.” Irreversible and irretrievable resource commitments are related to the use of nonrenewable resources and the effects that the use of these resources have on future generations. Irreversible effects primarily result from use or destruction of a specific resource (e.g. energy and minerals) that cannot be replaced within a reasonable time frame. If a wetland is filled to build a parking lot, that habitat is irretrievable as long as the parking lot remains. Irretrievable resource commitments involve the loss in value of an affected resource that cannot be restored as a result of the action (e.g. extinction of a threatened or endangered species).

Should the proposed action be implemented, there would be some irreversible or irretrievable commitments of natural and built resources that would be expended in the construction and operation of any of the action alternatives. These resources include:

- Materials used to construct new flood risk management structures, seismic improvements, and modifications to the existing stormwater and transportation systems (e.g. concrete, stone, steel, pavement, etc.);
- Energy in the form of fossil fuels and electricity consumed during operation of heavy equipment, production of construction materials, and transport of equipment, materials, and personnel to and from the project site; and,
- Capital and labor resources required to develop, construction and operate various components of the flood risk management system.

Some components, such as existing structures, pavements, utility lines, or other features requiring removal to construct the new structures, may be recycled upon removal which would offset some of the material consumed and introduce a minor amount of material that would be available to others. Similarly, any new materials and components placed as part of the new structure may be recycled upon decommissioning, but in the near team, these materials would not be available to others.

Land and aquatic habitats (e.g. intertidal and subtidal habitats) that would be physically altered by construction would be committed to the new use for the foreseeable future and would represent an irreversible commitment of those areas for the life of the project. Should, however, a greater need arise for the use of the land, or should the proposed project no longer be needed, the land and aquatic habitats could be restored to the original condition or be committed to for another use. However, there is no indication that such a need for conversion could develop or would be desirable.

4.31 Relationship Between Short-Term Uses of Environment and the Maintenance and Enhancement of Long-Term Productivity

NEPA also requires that an EIS include a discussion of the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. This section describes how the proposed action would affect the short-term use and the long-term productivity of the environment.

For this analysis, “short-term” refers to the temporary phase of construction of the proposed project while “long-term” refers to the operational life of the proposed project and beyond. The preceding sections in this chapter evaluate the short- and long-term impacts of implementing each of the alternatives in more detail for each resource.

Construction of the any of the alternatives would result in short-term construction related impacts within the project areas and would include increased air emissions and ambient noise; disturbances to fisheries and wildlife; loss of public access, recreational opportunities, and aesthetic value; interruptions and delays in transportation and access in and around the project area; and decreased water quality such as higher turbidity levels and lower dissolved oxygen. These impacts would be temporary and would occur only during construction and are not expected to alter the long-term productivity of the natural or built environment.

Over the long-term, adverse impacts including encroachment/fragmentation of aquatic habitats; changes in hydrologic flows, land use, aesthetic qualities of the iconic landscape, recreation opportunities, public access, and the transportation system; and potential loss or degradation of historic resources or other culturally or socially significant resources. However, most of these adverse impacts can, and have been, avoided or minimized through the design of the structures or incorporation of compensatory mitigation. The alternatives themselves present trade-offs between the long-term productivity impacts on different resource categories.

The long-term benefits of each of the alternatives include an overall enhancement of the quality of life and reduction in damages caused by coastal storms, SLR, and seismic events throughout the 7.5-mile San Francisco Waterfront.

5.0 Environmental Compliance

The draft IFR-EIS has been prepared to satisfy the requirements of all applicable environmental laws and regulations, where possible, and has been prepared using the Council on Environmental Quality (CEQ) NEPA regulations (40 CFR Part 1500–1508) and the USACE's regulation ER 200-2-2 – Environmental Quality: Policy and Procedures for Implementing NEPA, 33 CFR Part 230. In implementing the Recommended Plan, any compliance that could not be completed during the feasibility phase will be secured during the PED phase and the USACE would continue to follow the provisions of all applicable laws, regulations, and policies related to the proposed actions.

Based on agency feedback, demonstration of full compliance of the first action measures during feasibility is likely for the following laws and executive orders (EOs): Fish and Wildlife Coordination Act (FWCA), Endangered Species Act (ESA), Clean Water Act (CWA) Section 404, National Historic Preservation Act (NHPA), E.O. 12898 (Environmental Justice), E.O. 11988 (Floodplain Management), and E.O. 11990 (Protection of Wetlands). Full compliance may not be possible for the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and CWA Section 401. There are a few measures in the project that may preclude full compliance if the agencies determine there is not sufficient level of design detail for them to make a determination. Since the TNBP is a system, the agencies will not likely make a determination on only parts of the project because their policies require considering the whole project and would not allow a multi-part review. Full compliance cannot be achieved and must be addressed during PED for the following laws: Marine Mammal Protection Act (MMPA), Clean Air Act (CAA), and Coastal Zone Management Act (CZMA) due to lack of detailed design required to complete the analysis. Table 5-1 shows the likely compliance status at the end of the feasibility study.

The following data gaps have been identified by the agencies as being needed to secure full compliance for actionable measures:

- Field verification of bay habitats to confirm the assumptions made and data used during feasibility is an accurate reflection of site-specific conditions to correctly quantify and mitigate impacts. (MSA, CWA-401, CZMA)
- Bay-wide modeling is needed to better understand how engineered structures like seawalls affect hydrodynamics in the bay. The modeling will need to assess changes in tidal amplitude and how that affects erosion and the magnitude and spatial distribution of peak water levels and inundation around the bay. (CZMA)
- Water quality and chemistry modeling, including interior drainage and outflow paths, demonstrating the recommended plan would not contribute to

temporary or permanent degradation of biological habitats. (CWA-401, CZMA)

- Impervious surface modeling based on measure specific design details such as surface area and material used. (CWA-401)
- Air quality modeling to quantify criteria pollutant and greenhouse gas emission based on site-specific details for construction timing, duration, equipment used, modes of transport, etc. (CAA)
- Determination of final detailed footprint, designs, and construction methods that will inform short- and long-term impacts, including:
    - Duration, timing, and methodology of all construction actions but of particular interest in water work, pile driving actions, and temporary relocation of structures (MSA, CWA-401, CZMA, MMPA);
    - Source of construction material (e.g. dredged material or commercial) (MSA, CWA-401, CZMA);
    - Extent and methodology of completing ground improvements for seismic-related issues (MSA, CWA-401, CZMA, MMPA);
    - Confirmation of assumptions regarding pier retention or abandonment (MSA, CWA-401, CZMA); and
    - Location of public access points including configuration of transportation, bike lanes, and walk paths (CZMA).

For the second action/adaptive measures, full compliance cannot be demonstrated for any law or EO during feasibility. In addition to the above data gaps, to secure compliance for the second action/adaptive measures, there must be more certainty in the timing of the action as well as the construction methodology, alignment and design of the features, the affected environment at the time of the action, and the regulatory rules in place at that time.

Where compliance cannot be achieved, the compliance documentation in IFR-EIS will define a protocol for how compliance will be achieved during PED. This protocol will define a strategy including procedures to be followed to determine compliance, mitigate impacts where possible, and dismiss sites that cannot be made compliant. For example, if the IFR-EIS covers an area that is partially in the Coastal Zone and considers activities that could impact the Coastal Zone but the detail required for a complete review is not available, a determination cannot be made at the broad level that the project is in compliance with the Coastal Zone Management Act. In that case, the compliance documentation in the IFR-EIS would estimate the maximum impacts that may be realized as a result of the project to establish a range of impacts in order to have a reasonable level of confidence that the proposed project would not be environmentally unacceptable. Following this, the review would then outline the procedures to be followed to determine whether each specific site is in the Coastal Zone and, if so, how determinations of compliance and any necessary consultation with the Bay Conservation and Development Commission will proceed.

Table 5-1: Ability to Secure Compliance During Feasibility

Measure	NEPA	FWCA	ESA: FWS	ESA: NMFS	MSA: EFH	MMPA	CWA: 404	CWA: 401	CAA	CBRA	CZMA	NHPA
1st Action												
Reach 1												
Retreat	✓	✓	✓	✓	✓	☑	✓	☑	✗	--	✗	✓
Pier Demolition	✓	✓	✓	✓	☑	✗	✓	✗	✗	--	✗	✓
Building Demolition	✓	✓	✓	✓	☑	✗	--	☑	✗	--	✗	✓
Floodproofing	✓	✓	✓	✓	✓	✓	--	☑	✗	--	☑	✓
2-ft wall extension	✓	✓	✓	✓	☑	☑	--	☑	✗	--	✗	✓
Reach 2												
Seawall	✓	✓	✓	✓	✓	✗	--	✗	✗	--	☑	✓
Wharf Rebuild	✓	✓	✓	✓	✓	✗	✓	✗	✗	--	✗	✓
Seismic Ground Improvements	✓	✓	✓	✓	✓	✗	--	✗	✗	--	☑	✓
Building Move	✓	✓	✓	✓	✓	☑	--	☑	✗	--	✗	✓
Planted Berm	✓	✓	✓	✓	✓	☑	✓	☑	✗	--	☑	✓
2-ft wall extension	✓	✓	✓	✓	☑	☑	--	☑	✗	--	✗	✓
Reach 3												
T-wall	✓	✓	✓	✓	✓	✗	--	✗	✗	--	☑	✓

Measure	NEPA	FWCA	ESA: FWS	ESA: NMFS	MSA: EFH	MMPA	CWA: 404	CWA: 401	CAA	CBRA	CZMA	NHPA
Seismic Ground Improvements	✓	✓	✓	✓	✓	✗	--	✗	✗	--	☑	✓
Wharf Rebuild	✓	✓	✓	✓	✓	✗	✓	✗	✗	--	✗	✓
Building Demolition	✓	✓	✓	✓	✓	✗	--	☑	✗	--	✗	✓
2-ft wall extension	✓	✓	✓	✓	☑	☑	--	☑	✗	--	✗	✓
Deployables	✓	✓	✓	✓	✓	✓	--	☑	✗	--	✗	✓
Paved berm	✓	✓	✓	✓	✓	☑	--	☑	✗	--	✗	✓
Planted Berm	✓	✓	✓	✓	✓	☑	--	☑	✗	--	✗	✓
Eco-Berm	✓	✓	✓	✓	☑	☑	✓	✗	✗	--	✗	✓
Floodproofing	✓	✓	✓	✓	✓	✓	--	☑	✗	--	✗	✓
Reach 4												
T-wall	✓	✓	✓	✓	✓	✗	--	✗	✗	--	✗	✓
Sheetpile	✓	✓	✓	✓	✓	✗	--	✗	✗	--	✗	✓
Wharf Rebuild	✓	✓	✓	✓	✓	✗	✓	✗	✗	--	✗	✓
Seismic Ground Improvements	✓	✓	✓	✓	✓	✗	--	✗	✗	--	✗	✓
Paved Berm	✓	✓	✓	✓	✓	☑	--	☑	✗	--	✗	✓
Planted Berm	✓	✓	✓	✓	✓	☑	--	☑	✗	--	✗	✓

Measure	NEPA	FWCA	ESA: FWS	ESA: NMFS	MSA: EFH	MMPA	CWA: 404	CWA: 401	CAA	CBRA	CZMA	NHPA
Eco-Berm	✓	✓	✓	✓	☑	☑	✓	✗	✗	--	✗	✓
Deployables	✓	✓	✓	✓	✓	✓	--	☑	✗	--	✗	✓
Building Demolition	✓	✓	✓	✓	✓	☑	--	☑	✗	--	✗	✓
2-ft wall extension	✓	✓	✓	✓	☑	☑	--	☑	✗	--	✗	✓
2nd Action (Adaptive Features Completed in 50+ years)												
Reach 1												
T-wall	✗	✗	✗	✗	✗	✗	✗	✗	✗	--	✗	✗
Seawall/Wharf Rebuild	✗	✗	✗	✗	✗	✗	✗	✗	✗	--	✗	✗
Seismic Ground Improvements	✗	✗	✗	✗	✗	✗	✗	✗	✗	--	✗	✗
Paved Berm	✗	✗	✗	✗	✗	✗	✗	✗	✗	--	✗	✗
Floodproofing	✗	✗	✗	✗	✗	✗	✗	✗	✗	--	✗	✗
Building Demolition	✗	✗	✗	✗	✗	✗	✗	✗	✗	--	✗	✗
Building Move	✗	✗	✗	✗	✗	✗	✗	✗	✗	--	✗	✗
Reach 2												
Curb Wall Extension	✗	--	--	--	--	--	--	--	--	--	--	--
Reach 3												

Measure	NEPA	FWCA	ESA: FWS	ESA: NMFS	MSA: EFH	MMPA	CWA: 404	CWA: 401	CAA	CBRA	CZMA	NHPA
Seawall/Wharf Rebuild	✕	✕	✕	✕	✕	✕	✕	✕	✕	--	✕	✕
Seismic Ground Improvements	✕	✕	✕	✕	✕	✕	✕	✕	✕	--	✕	✕
Planted Berm	✕	✕	✕	✕	✕	✕	✕	✕	✕	--	✕	✕
Eco-Berm	✕	✕	✕	✕	✕	✕	✕	✕	✕	--	✕	✕
Building Move	✕	✕	✕	✕	✕	✕	✕	✕	✕	--	✕	✕
Building Demolition	✕	✕	✕	✕	✕	✕	✕	✕	✕	--	✕	✕
Reach 4												
Seawall/Wharf Rebuild	✕	✕	✕	✕	✕	✕	✕	✕	✕	--	✕	✕
Seawall	✕	✕	✕	✕	✕	✕	✕	✕	✕	--	✕	✕
Paved Berm	✕	✕	✕	✕	✕	✕	✕	✕	✕	--	✕	✕
Planted Berm	✕	✕	✕	✕	✕	✕	✕	✕	✕	--	✕	✕
Eco-Berm	✕	✕	✕	✕	✕	✕	✕	✕	✕	--	✕	✕
EWN (wetlands)	✕	✕	✕	✕	✕	✕	✕	✕	✕	--	✕	✕
Building Demolition	✕	✕	✕	✕	✕	✕	✕	✕	✕	--	✕	✕

--: Not applicable ✓: Full compliance likely during feasibility ✕: Not likely to securing full compliance during feasibility
☑: Full compliance possible, unless the agency treats the project, rather than looking at individual components, in which case full compliance may not be possible during feasibility

The following sections present brief summaries of Federal environmental laws, regulations, and coordination requirements applicable to the proposed action.

5.1 National Environmental Policy Act

NEPA requires that all Federal agencies use a systematic, interdisciplinary approach to protect the human environment. This approach promotes the integrated use of natural and social sciences in planning and decision-making that could have an impact on the environment.

NEPA requires the preparation of an EIS for any major Federal action that could have a significant impact on the environment (42 United States Code [USC] 4321–4347). The EIS must address any adverse environmental effects that cannot be avoided or mitigated, alternatives to the proposed action, the relationship between short-term resources and long-term productivity, and irreversible and irretrievable commitments of resources. According to 40 CFR 1502.9, a supplement to either a DEIS or FEIS must be prepared if an agency makes substantial changes in the proposed action that are relevant to environmental concerns, or there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.

The NEPA regulations provide for the use of the NEPA process to identify and assess reasonable alternatives to proposed actions that avoid or minimize adverse effects of these actions upon the quality of the human environment. “Scoping” is used to identify the range and significance of environmental issues associated with a proposed Federal action through coordination with Federal, State, and local agencies; the general public; and any interested individuals and organizations prior to the development of an EIS. The process also identifies and eliminates, from further detailed study, issues that are not significant or have been addressed by prior environmental review.

The Council on Environmental Quality (CEQ) issued guidance and interpreting regulations that implement NEPA’s procedural requirements. The CEQ completed a comprehensive update to its NEPA implementing regulations at 40 CFR 1500-1508 to modernize provisions, streamline infrastructure project development, and promote better decision making by the Federal government. The implementing regulations were published in the Federal Register on July 16, 2020 and then amended on April 20, 2022 as part of the first phase of a two phased review of the 2020 regulations, superseding the original 1978 regulations and the 1986 and 2005 amendments.

The CEQ published a proposed rulemaking notice on July 28, 2023 to initiate Phase 2; however, at the time of publication of this draft IFR-EIS, the amendment has not been formalized and this DIFR-EIS is being prepared in accordance with the 2022 CEQ the environmental impacts associated with the alternatives as best known with the level of detail available and using best available science.

Scoping began with publication of a Notice of Early Scoping in the Federal Register (FR) on August 20, 2020 and a Notice of Intent to Prepare an EIS published in the FR on July 27, 2023. Thirty-day comment periods were opened for both of these sessions and multiple public meetings and other engagements were held to solicit feedback on the study purpose, alternatives that should be considered, potential impacts and analyses that should be completed and any resources of significance or concern. This DIFR-EIS will be released to the public on January 26, 2024 for review and comment. A 60-day comment and review period will commence with publication of a Notice of Availability in the FR. During the comment period, multiple public meetings and additional public engagement will be completed to solicit feedback on the EIS and TSP. All comments received during the comment period will be incorporated into the final IFR-EIS (FIFR-EIS) and include a matrix with agency response to each substantial comment. It is anticipated the FIFR-EIS will be published in the Fall of 2025 and a Record of Decision (ROD) will be signed in Fall of 2025 or in early 2026.

An Integrated Feasibility Report and EIS (IFR-EIS) has prepared to provide the basis for a decision to recommend to Congress for authorization of the recommended plan as described in the Chief's Report, which would include only the first action measures. The IFR-EIS provides a site-specific NEPA review of the first action measures and general overview of the impacts anticipated for the second actions if the conditions, construction methodologies, timing, etc. that exist today continue to exist at the time of construction (50+ years in the future). The IFR-EIS includes disclosure of all direct, indirect, and cumulative effects to the human and natural environment. It documents the ways that impacts have been avoided and minimized throughout feasibility because of design considerations, inclusion of conservation measures and best management practices (BMPs), and agency and public input, so that these commitments are carried forward to PED. For unavoidable adverse impacts that require compensatory mitigation, the mitigation need has been identified based on the best available information and resource agency coordination.

The DIFR-EIS includes an analysis of both the first and second actions even though only the first action is being recommended for authorization and funding. The purpose of including both actions was to present sufficient information regarding overall impacts of the second action so that decision-makers can make a reasoned judgment on the merits of the overall potential flood defense system being considered (e.g., "hard look requirement") and make a reasoned choice among alternatives in consideration of potential adaptation in the future. This follows the CEQ guidance to consider connected actions or reasonably foreseeable actions even though the second action is expected to occur more than 50 years in the future. Since the authorization would not include a second action, the ROD would only describe cover the first actions. Once the triggers for adaptation are reached, USACE will begin subsequent NEPA reviews of any proposed second actions, which involves preparation of one or more additional NEPA documents (either an EIS or Environmental Assessment) prepared in accordance with

CEQ regulations in place at that time, which would include providing for additional public review periods and resource agency coordination.

If during PED any project changes are found to be outside the scope of the recommended plan and the Chief's Discretionary Authority, a re-review of the original decision and authority will need to be completed following USACE policies at the time the change is identified. If design changes induce impacts greater than those described in the FIFR-EIS, supplementation of the IFR-EIS may be required following the CEQ regulations at the time the change is identified, and a new ROD signed.

Sequencing Strategy

Step 1. Prepare Draft IFR- EIS – A draft IFR-EIS will be prepared for public release. The draft IFR-EIS will undergo district quality control and legal review before public release. The draft IFR-EIS will be used as the vehicle to elicit comments from resource agencies, the public and stakeholders. Acknowledging that the impact analysis on a study scope of this size is constrained by budget, timing and available information and level of design, the impact analysis approach will be geared towards the most significant resources and issues, and towards that which is necessary to recommend a TSP. In the draft IFR-EIS, all reasonable alternatives would be discussed at comparable levels of detail. The draft IFR-EIS will include the array of alternatives with sufficient detail for USACE to be able to make a decision. The information will include locations, direct, indirect, and cumulative impacts and benefits, and potential compliance issues.

- The DIFR-EIS will be released for a 60-day public and agency review to solicit input which will be used to inform the refinement of the TSP. Comments will also be used to better address information for resource agencies and identify all needed compliance for the TSP in the final IFR-EIS.

Step 2. Prepare Final IFR-EIS – Subsequent to the ADM, the PDT, specifically Engineering will begin to optimize the TSP. USACE will update the IFR-EIS with details and refinements from optimization, as well as respond to and incorporate comments in order to finalize the final IFR- EIS. The final IFR-EIS will present sufficient information regarding overall impacts of the proposed action so that the decision-makers can make a reasoned judgment on the merits of the action at the present stage of planning or development.

- If the refinement of the TSP design by Engineering causes significant changes to the alternative, and its associated environmental impact analysis, a Final IFR-EIS will detail the evolution of those refinements and their relative impacts, consistent with the level of detail available, and will be released for a another 45-day comment period.
- The detailed engineering information available at the conclusion of the final IFR-EIS will be utilized for finalizing the Mitigation and Adaptive Management Plan(s).
- The draft Record of Decision (ROD) and final IFR-EIS would be published for a 30-day waiting period in which no comments will be accepted. The ROD language for a FIFR-EIS asserts that the USACE finds that the report adequately

defends that the Recommended Plan, is engineeringly feasible, economically justified, and environmentally acceptable and approves it for construction. It also summarizes the major components of the plan, asserts that all efforts with existing information and commensurate to the level of design have been made to avoid, minimize or mitigate environmental consequences, and describes that a compensatory mitigation plan would address all unavoidable impacts.

Step 3. Sign the Chief’s Report and Record of Decision – The Chief of Engineers will sign the Chief’s Report and submit the final IFR-EIS to Congress for Authorization. The ROD would be signed by the Assistance Secretary of the Army (Civil Works).

Step 4. Congress Authorizes the Project

Step 5. Congress Funds PED for First Actions – What gets funded by Congress will dictate the timing of and how many times subsequent steps occur. This begins the PED phase. A review of the IFR-PEIS will be completed to ensure the first action and affected environment has not changed substantially from what was described and supplemental NEPA is not required. Additionally, as designs are developed, environmental compliance for any laws not secured during feasibility will be completed.

Step 6. Congress Funds Construction of First Action.

Step 7. Begin Construction of First Action – Any mitigation needs identified must be completed before the unavoidable impact can be realized.

Step 8. Operations and Maintenance of the Measure(s) and Long-term Monitoring of RSLC.

Step 9. RSLC Triggers Adaptive Actions – The need for the adaptive action is expected to be approximately 50 years after the first action was constructed, but the timing is uncertain and could be further in the future or sooner than 50 years.

Subsequent NEPA Review(s)

Step 10. Congress Funds Study for Adaptive Actions (Assumes Federal Involvement)

Step 10a Scoping – Scoping, following the CEQ, Army and USACE regulations in effect at the time of completing this step, will be completed to seek public and agency feedback on the scope of the subsequent NEPA review and concerns that should be addressed beyond those not identified previously.

Step 10b. Release of Draft NEPA Document – Complete draft subsequent NEPA review using the appropriate level NEPA document to disclose the site-specific impacts and mitigation needs based on detailed design refinements.

- A public commenting period as established by CEQ regulations or as recommended by the PDT will be held to seek feedback on the subsequent NEPA review.

Step 10c. Release of Final NEPA Document – Similar to Step 2, the subsequent NEPA review will incorporate any refinements made to the design since the draft

NEPA document was released including addressing public and agency comments. Final compliance documentation, including all necessary permits and authorizations must be secured and included with the final document.

Step 11. Congress Funds Construction of Adaptive Actions.

Step 12. Begin Construction of the Adaptive Actions – Any mitigation needs identified during the subsequent NEPA review(s) must be complete before the unavoidable impact can be realized.

Step 13. Operations and Maintenance of the Adaptive Actions

5.2 Clean Water Act

The Federal Water Pollution Control Act of 1972, as amended in 1977 via the Clean Water Act (CWA), authorizes the EPA to regulate activities resulting in a discharge of pollutants into waters of the U.S. This section discusses compliance requirements for water quality policies embodied in Sections 401 and 404 of the Federal Water Pollution Control Act.

The feasibility analysis for the SFWCFS was conducted using the formulation process for Civil Works projects to identify the TNBP. The TNBP reasonably maximizes net benefits in all four planning accounts (national and regional economics, environmental quality, and other social effects) compared to costs.

5.2.1 Compliance with the 404(b)(1) Guidelines (40 CFR 230)

The goal of the 404(b)(1) Guidelines is “to restore and maintain, the chemical, physical, and biological integrity of waters of the United States (waters of the US) through the control of discharges of dredged or fill material.” The regulations set forth in 40 CFR Part 230 are the substantive criteria issued by the US Environment Protection Agency (USEPA), used in evaluating discharges of dredged of fill material into waters of the US. The Guidelines provide regulations outlining measures to avoid, minimize and compensate for impacts.

Only one structural measure (wharf raise/rebuild) and three EWN features (ecotone levees, marsh enhancements, coarse beach and living seawall) in the TSP include the discharge of dredged or fill material into waters of the U.S. All other measures were designed and would be constructed landward of the existing shoreline to avoid discharge of fill materials and impacts to waters of the U.S. TNBP and the independent measures have been developed in accordance with the Guidelines.

For the wharf raise/rebuild measures old pier pilings (creosote covered wood or concrete and rebar) and decking (wood, concrete, and rebar) would be removed and replaced with new pilings (concrete) and decking (rebar, concrete, grates, etc.) that would facilitate a higher elevation wharf. There would be no increase in the footprint of the wharf and fewer piles would be necessary per square foot than currently exists resulting in a net decrease in bay fill and overall benefit from removal of old materials (e.g. creosote piles) that contribute to poor water quality and are toxic to marine life. Since the decking footprint would not change, it is anticipated that at a minimum the current light and temperature of the intertidal and subtidal habitat would remain the same. During PED, the designs will be refined to incorporate features that allow more light and air flow, where appropriate, than the current wharf allows, which would also be a long-term benefit to the marine environment.

For the ecotone levees, marsh enhancements (second action), and coarse beach EWN features, fill materials would primarily involve natural materials free of any contaminants or eco-friendly concrete that supports vegetative growth. Fill material would be placed between the MLLW and MHHW water line to achieve the target elevation that would support the desired community, such as tidal marsh or beach. Any existing fringe wetland or intertidal habitat would be filled with material and then restored. The length between loss and restoration is dependent on how long construction takes at the immediate site, type of plants used, and growing conditions, but is anticipated to reach pre-construction conditions or better within one to three growing seasons after a one year period of construction or two to five years. At each of these EWN locations, the purpose of the measure is to support the overall performance of the flood defense feature using natural processes. As a result, these features also provide habitat enhancements that result in a net increase in quantity and quality of intertidal, beach, and marsh habitats and overall benefit to the waters of the U.S. over the life of the project.

For the living seawall EWN feature, the fill material (most likely concrete) would be placed directly onto the existing seawall by bolting on or building into the design of another feature (e.g. new seawall) to create surface complexity (for example, surface texture, grooves, crevices, and nooks) to traditionally smooth surfaces. The living seawall is a relatively flat form of fill that would be placed from the bay bottom elevation to MHHW. This EWN feature will increase habitat diversity to the intertidal and sub-tidal environments where only open water currently exists resulting in an overall net benefit.

One measure (pier demolition) will remove approximately 1.0 acre of fill previously placed in waters of the U.S. including historic piles, bay fill, and pier decking and allow the area to restore to higher quality open water and subtidal habitat.

There is no anticipated long-term loss of wetlands that would require compensatory mitigation. Approximately 9.0 acres of bay fill will from construction of the independent measures will require compensatory mitigation in the form of old and unused pier and piling removal. A conceptual compensatory mitigation plan has been developed and will continue to be refined through the final IFR-EIS and in PED as the designs are further refined.

The placement of any of these fill materials will not violate any applicable State or Federal water quality criteria or toxic effluent standards of Section 307 of the Clean Water Act. The proposed discharge will not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife will not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic and economic values will not occur. For most measures, the aquatic ecosystem, recreation, and aesthetics would be enhanced over the existing condition.

The complete analysis, consistent with the 404(b)(1) guidelines, can be found in Appendix D-4-1 (Clean Water Act Compliance). No significant adaptations of the guidelines were made with respect to the evaluation completed for this project.

5.2.2 Section 401 of the CWA and Section 404(r)

Section 401 of the CWA sets forth requirements and procedures for obtaining State water quality certification (WQC) for activities which result in any discharge into navigable waters. The USACE plans to seek State water quality certification for this project during PED when more detailed designs are available. Coordination has been ongoing with the Water Board in which they have identified impact analyzes that need to be completed in order to meet the Water Board requirements for issuing a WQC. Some of these analyses include: impervious surface analysis, a complete 404(b)(1), baywide modeling, and groundwater and discharge modeling. The Water Board has also identified a number of criteria that they will want to see in order to issue a WQC including mitigation for any and all unavoidable adverse impacts to aquatic habitats that replace the quality and quantity of habitat lost, incorporation of runoff and surface water management measures for all new or modified impervious surfaces, and water quality management features.

5.2.3 Evaluation of Availability of Practicable Alternatives to the Proposed Discharge Site Which Would Have Less Adverse Impact on the Aquatic Ecosystem (LEPDA discussion)

Detailed documentation of the plan formulation process and alternatives analysis can be found in Chapter 3 of the main report and in Appendix A (Plan Formulation). As stated earlier in this Section, this feasibility analysis was conducted using the formulation process for Civil Works projects to identify the TNBP. The analysis was also performed on a regional basis to aid with the identification and comparison of project measures across the project area. The following section documents the analysis which resulted in the identification of the LEDPA.

The alternatives identified as the final array all performed well in terms of costs and benefits and meeting the study goals and objectives and the purpose and need. Each are considered practicable and reasonable. From these alternatives, the PDT determined that the LEDPA is Alternative B- Nonstructural Plan. This plan avoids all any beneficial or adverse impacts to aquatic habitats and waters of the U.S. since there would be no in-water work. Alternative B was not selected for recommendation because while reasonable and practicable, there are life safety risks and disruptions to the daily use of the waterfront (e.g., impacts to the transportation system, movement of people and goods, availability of services, tourism, and recreational opportunities; ability of emergency services to render aid) from allowing floodwaters to enter the study area and defense happens on a structure by structure basis. The remaining three final array alternatives (TNBP, Alternative F, and Alternative G) all minimize life safety risks but each have varying levels of aquatic environment impact.

The PDT reviewed the next least environmentally damaging plan, which was identified as the TNBP. The TNBP has the least amount of aquatic impacts of the plans that defend the waterfront from floodwaters and minimize life safety risks. This alternative avoids and minimizes aquatic impacts to the greatest extent possible by aligning the flood defenses landward of the existing shoreline. The TNBP has approximately 9 acres of unavoidable adverse impacts as described above; however, the other two practicable alternatives that minimize life safety risk each have greater unavoidable impacts. Additionally, the TNBP incorporates NNBF into the designs which would improve the quality and increase the quantity of aquatic habitats in the study area over the long-term.

5.3 Clean Air Act of 1970

The federal CAA of 1970 authorized the establishment of national health-based air quality standards, and also set deadlines for their attainment. The Federal CAA Amendments of 1990 (1990 CAAA) made major changes in deadlines for attaining National Ambient Air Quality Standards (NAAQS) and in the actions required of areas of the nation that exceeded these standards. Under the CAA, state and local agencies in areas that exceed the NAAQS are required to develop SIPs to show how they will achieve the NAAQS for nonattainment criteria air pollutants by specific dates. SIPs are not single documents; rather, they are a compilation of new and previously submitted plans, programs (such as monitoring, modeling, permitting, etc.), district rules, state regulations and federal controls. The United States Environmental Protection Agency (USEPA) is responsible for enforcing the NAAQS primarily through reviewing SIPs that are prepared by each state.

Pursuant to CAA Section 176(c) requirements, USEPA promulgated the General Conformity Rule (GCR), which applies to most federal actions, including the TNBP. The GCR is used to determine if federal actions meet the requirements of the CAA and the applicable SIP by ensuring that pollutant emissions related to the action do not cause or contribute to new violations of a NAAQS, increase the frequency or severity of any existing violation of a NAAQS, or delay timely attainment of a NAAQS or interim emissions reduction.

The TNBP falls within San Francisco County, which has been designated as a nonattainment area for three NAAQS: 8-hour ozone (2008 standard), 8-hour ozone

(2015 standard), and 24-hour fine particulate matter (PM2.5) (2006 standard). These designations vary in severity, with the classifications being “marginal” nonattainment for the 2008 and 2015 8-hour ozone standards, and moderate nonattainment for the 24-hour PM2.5 standard. Because the action is in a nonattainment area, general conformity applies to the project.

The quantitative and qualitative analyses for the first and second actions of the TNBP indicate that construction emissions may not exceed the *de minimis* levels that currently apply to the action area indicating that as of now a GCD may not be necessary. However, given that construction would not begin until 2030 for the first actions and more than 50 years in the future for the subsequent actions, the information currently available to support the emissions analysis lacks the necessary precision to make a reliable and defensible conclusion with respect to CAA consistency. As a result, compliance with the CAA has been delayed until PED, when a comprehensive emissions analysis will be conducted with more accurate information and data are available to define expected construction activities and project conditions. Based on the results of that analysis, a GCD may be required to satisfy general conformity at that time. In any case, it is reasonable to assume that compliance with the CAA is achievable with minimal to no mitigation needs.

5.4 National Historic Preservation Act of 1966

Compliance with the National Historic Preservation Act of 1966, as amended (54 U.S.C. § 306108), requires the consideration of effects of the undertaking on all historic properties in the project area and development of mitigation measures for those adversely affected properties in coordination with the State Historic Preservation Officer (SHPO), Tribal Nations, and the Advisory Council on Historic Preservation (ACHP). It has been determined that there is a potential for new construction, improvements to existing facilities, and maintenance of existing facilities to cause effects to historic properties. Therefore, in accordance with 36 CFR 800.14, the USACE has developed a Programmatic Agreement among the USACE and the California SHPO to address the identification and discovery of cultural resources that may occur during the construction and maintenance of proposed or existing facilities (Appendix D-3). The USACE also invited the ACHP and Tribal Nations to participate as signatories to the Programmatic Agreement. It is anticipated that the PA will be executed prior to the release of the final IFR-EIS.

5.5 Endangered Species Act

The Endangered Species Act (ESA), as amended, establishes a national policy designed to protect and conserve threatened and endangered species and the ecosystems upon which they depend (16 U.S.C. 1531–1543). The ESA is administered by the Department of the Interior, through the U.S. Fish and Wildlife Service (USFWS), which oversees protection of non-marine species or marine species when not in the marine environment, and by the Department of Commerce, through the National Marine Fisheries Service (NMFS), which oversees marine species in the marine environment, collectively referred to as the Services. The ESA ensures that federal agencies and departments use their authorities to protect and conserve endangered and threatened species. Section 7 of ESA requires federal agencies prevent or modify any projects authorized, funded, or carried out by the agencies that are “likely to jeopardize the continued existence of any endangered species or threatened species, or result in the destruction or adverse modification of critical habitat of such species.”

The procedures for Section 7 consultation are defined in regulations issued by the Services (50 CFR Part 402). A draft Biological Assessment (BA) has been prepared to analyze the potential impact(s) a measure(s) would have on listed species and critical habitat (CH). If the analysis determines that all effects of the measure or action are insignificant (i.e., so small they cannot be meaningfully measured, detected, or evaluated), discountable (i.e., extremely unlikely to occur), or wholly beneficial (positive effects with no associated negative effects) a not likely to adversely affect (NLAA) determination can be made and informal consultation can be initiated. If the action is reasonably expected to result in measurable adverse effects, then a “likely to adversely affect” (LAA) determination is made for the affected species and formal consultation is initiated.

For USFWS managed species, the TSP is NLAA three listed species due to their proximity to construction activities, but with their presence outside the construction footprint. The remaining species were found to be outside the known range or no suitable habitat exists and therefore there would be no effect to those species. Informal consultation with the USFWS will be initiated after the draft IFR-EIS release. If the USFWS agrees with the USACE determinations, consultation will be complete with the issuance of a Concurrence Letter.

For NMFS managed species, the nature of the work required in and near the water is expected to have adverse effects on listed species leading to a LAA determination. Formal consultation will be initiated after the release of the draft IFR-EIS. If the NMFS can complete their review based on the information available at this time and the consultation will conclude when NMFS issues a Biological Opinion (BO) that states whether the USACE has ensured that its action is not likely to jeopardize the continues existence of a listed species and will likely include conservation recommendations to further the recovery of the species. If the action is reasonably certain to result in the “take” of a listed species, NMFS will issue an Incidental Take Statement (ITS) with Reasonable and Prudent Measures (RPMs) and Terms and Conditions (T&Cs), exempting a certain amount of “take” of listed species based on the project specifications and analysis.

Even with concurrence letters and BOs, Section 7 consultation may need to be reinitiated if the project changes or a new species or CH is listed that could be affected by the action. During PED or the construction phase, TSP first action measures may need to be modified depending on any unforeseen changes to the designs. On actions of this scale, some alterations in the design and construction phases are expected and normal. Each change to the action would be reviewed against the most recent consultation compliance document to confirm the change does not rise beyond the level and/or type of effects that that were previously considered in the consultation. If species or CH are listed after the most recent consultation, the USACE must demonstrate how the action would affect the species or CH. If changes are greater than previously described or a new species or CH is listed, the USACE would request reinitiation of Section 7 consultation. Whether the consultation is formal or informal will depend on the original consultation method and the extent of change in impacts. After consultation is initiated the process described above for informal and formal consultation would be followed depending on the consultation type requested.

It is anticipated that the TSP will be fully compliant with the ESA and all consultations completed prior to the release of the final IFR-EIS.

5.6 Migratory Bird Treaty Act and Migratory Bird Conservation Act and Executive Order 13186

The MBTA of 1918 (as amended) extends Federal protection to migratory bird species; among other activities non-regulated “take” of migratory birds is prohibited under this MBTA in a manner similar to the ESA prohibition of “take” of threatened and endangered species. Additionally, EO 13186 “Responsibility of Federal Agencies to Protect Migratory Birds” requires Federal activities to assess and consider potential effects of their actions on migratory birds (including, but not limited to, cranes, ducks, geese, shorebirds, hawks, and songbirds).

The effect of the TSP on migratory bird species has been assessed. Impacts to migratory birds are expected to be temporary and limited to migratory bird species near the immediate construction area. Minimal nesting trees are present in the project area; however, the trees that are present may be removed during construction and would remove nesting locations over the long-term. Any trees removed would be replaced after construction, however, the planted trees will not be mature enough for several years, thus creating a long-term impact. All tree removal will be completed outside the nesting season where possible and if not a survey of the tree will be completed to ensure no active nests are present before removal. For migratory birds more sensitive to disturbances, in particular those in wetland environments at Heron’s Head or Pier 94, construction noise may disrupt their foraging and nesting ability forcing them to avoid the area until construction is complete. For migratory birds use to the noise and disturbance of an urbanized environment, individuals may temporarily avoid the area until they become familiar or use to the disturbance at which time it is expected they would resume pre-construction behaviors and use of the area.

Over the long-term, new flood defenses should not create impediments to migratory bird movements or result in increases in bird strikes. City-required bird-safe building design standards would be implemented for any required lighting, building modifications, or structure raising measures, as appropriate. Migratory birds would benefit from the NNBF measures by protecting and creating foraging, nesting, and roosting habitat. Improved coastal resiliency is expected to improve bird habitat and increase productivity in the project area.

Compliance with the MBTA and EO 13186 are complete and at this time, no compensatory mitigation is anticipated; however, coordination with USFWS on migratory birds will continue into PED for the first actions to aid in refinement of designs to avoid and minimize the potential for bird-strikes, loss of nesting, roosting or foraging habitat, or construction disturbance. Designs may also be refined to protect, restore, or create foraging, nesting, and roosting habitat.

5.7 Fish and Wildlife Coordination Act of 1958

The Fish and Wildlife Coordination Act (FWCA) provides for consultation with the USFWS, NMFS and, in California, with California Department of Fish and Wildlife (CDFW) whenever the waters or channel of a body of water are modified by a department or agency of the United States. The intent of this consultation is to help prevent the loss of and damage to wildlife resources from water development projects.

Pursuant to FWCA, the USFWS and NMFS (collectively the Services) will provide a joint Fish and Wildlife Coordination Act Report (FWCAR) prior to the final report and will be added as a sub-appendix to Appendix D. The FWCAR will provide the Services' comments and recommendations to avoid adverse impacts to fish and wildlife resources that could occur due to implementation of the TSP, while identifying planning constraints that may influence the Service's ability to fulfill their reporting responsibilities under Section 2(b) of the FWCA (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

From the start of the study, multiple coordination meetings were held with the Services. For USFWS, their main concerns centered around any work or impacts that could occur within existing marsh lands near Pier 94 or at Heron's Head and indicated where possible, these areas should be avoided or mitigation and conservation measures may be necessary. No structural features are proposed for construction in existing marsh areas for the first or second actions. As part of the second action, open water areas and degraded marsh would be improved or restored to function as a Natural and Nature-Based feature to aid in the performance of the flood defense system within this reach. USFWS did not have other concerns due to the urbanized nature of San Francisco shoreline.

The NMFS had multiple recommendations in support of plan formulation and measure identification. They recommended wherever possible to avoid bay fill and in-water work. They also strongly encouraged incorporating Engineering with Nature features where possible in lieu of "gray" or engineered infrastructure that could also support enhancement opportunities for habitat diversity and conservation of trust species.

The agency recommended if USACE was going to consider tide gates, a thorough analysis of how the structure would operate and affect water quality and dissolved oxygen levels would be necessary. Additionally, the designs and operation of a structure should it be considered should balance fish passage, water quality, and the need for flood management.

The NMFS also identified a number of trust resources that should be considered when designing and analyzing the project including but not limited to: Chinook and Pacific salmon, Pacific herring, Pacific coast groundfish, and coastal pelagic species; marine mammals such as sea lions, harbor seals, harbor porpoises, and the occasional gray whale or humpback whale; and habitats including open water, wetlands, eelgrass, and shallow bay bottoms. Some of the analyses and conservation measures they would like to see to support any alternative and consultation include:

Analyses:

- Effects of any overwater structures for the life of the structure (e.g. seawalls, bulkheads, tide gates, etc.) including light penetration, current/wave motion, temperature changes, changes in bay bottom bathymetry, impediments to movement, etc.
- Effects of construction activities on aquatic species, marine mammals, and water quality including those from pile driving, dewatering, cofferdam construction, placement or removal of fill material, in-water work, etc.
- Effects of hardened shoreline (replacement or addition of seawalls) on the overall Bay function and quality of habitat for fisheries over the life of the structure.

Conservation Measures:

- Incorporate construction materials that facilitate light penetration for any overwater structures.
- Incorporate living seawalls or materials and designs that facilitate fish habitat (e.g. promote growth of aquatic vegetation, provides cover or forage areas).
- Remove contaminated creosote piling and replace with eco-friendly concrete or other materials.
- Consider seasonal timing restrictions for in-water work and pile driving.
- Integrate Natural and Nature-Based Features where possible.

5.8 Marine Mammal Protection Act of 1972

The Marine Mammal Protection Act of 1972 (16 U.S.C. 1361 et seq.) established a national policy to prevent marine mammal species and population stocks from declining beyond the point where they ceased to be significant functioning elements of the ecosystems of which they are a part. The Marine Mammal Protection Act prohibits, with certain exceptions, the “take” of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States. In the Marine Mammal Protection Act, “take” is defined “as harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." The Department of Commerce, through the NMFS, is charged with protecting species that are known to occur in the Texas Gulf region such as whales, dolphins, and porpoises. Manatees are protected by the Department of the Interior through the USFWS. The Animal and Plant Health Inspection Service, a part of the Department of Agriculture, is responsible for regulations managing marine mammals in captivity.

Under the law, responsible parties conducting any activities that would result in the incidental take of marine mammals are required to have an Incidental Take Authorization, in the form of an Incidental Harassment Authorization (IHA) or Letter of Authorization (LOA) issued by the NMFS. Incidental Take Authorization applications must include detailed information regarding each discreet project activity, projected environmental impact, potentially affected marine mammal populations, mitigation of negative impacts, and a comprehensive monitoring and reporting plan. Additionally, the ITAs are generally only valid for a maximum of 5-years.

It is expected that construction activities related to pile driving and in water work may result in the incidental take of marine mammals, as defined under the Marine Mammal Protection Act. The anticipated impacts include harassment, serious injury or mortality of marine mammals and would require a LOA be issued. However, the design and construction details required to submit an application are unavailable during feasibility and must be delayed until the PED phase. Additionally, construction is not anticipated to occur within the 5-year time limit even if a LOA could be issued now and would need to be reapplied for at the time of construction.

Continued coordination with NMFS will occur between draft report release and the final report. Coordination will help to identify additional impacts and avoidance and minimization measures that can be built into the designs and construction methodologies and better understand potential compensatory mitigation needs.

5.9 Magnuson Stevens Fishery Conservation and Management Act

The MSFCMA (PL 94-265), as amended, provides for the conservation and management of the Nation's fishery resources through the preparation and implementation of Fishery Management Plans (FMPs) (16 U.S.C. 1801 et seq.). The MSFCMA calls for NOAA fisheries to work with regional Fishery Management Councils to develop FMPs for each fishery under their jurisdiction. The study area is within or near EFH designated habitats and could impact federally-managed species, as documented in section 3.11.2.6.

One of the required provisions of FMP specifies that essential fish habitat (EFH) be identified and described for the fishery, adverse fishing impacts on EFH be minimized to the extent practicable, and other actions to conserve and enhance EFH be identified. The MSFCMA also mandates that NMFS coordinate with and provide information to Federal agencies to further the conservation and enhancement of EFH. Federal agencies must consult with NMFS on any action that may adversely affect EFH. When

NMFS finds that a Federal or State action would adversely affect EFH, it is required to provide conservation recommendations.

The USACE prepared a draft EFH assessment to document the potential effects of implementing the TSP on EFH and Federally-managed fish species and their habitat. The assessment concludes that TSP measures that involve in-water work or bay fill would have temporary and long-term adverse direct and indirect impacts to EFH in the action area through the loss of habitat and changes in habitat quality. Consultation will be initiated after the release of the draft IFR-EIS and it is anticipated that compliance can be secured by the release of the final IFR-EIS. Coordination with NMFS to date and their suggestions and concerns are documented in Section 5.7 of this appendix under the Fish and Wildlife Coordination Act coordination efforts.

5.10 Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) of 1972, as amended, (16 U.S.C. § 1451 et seq.) provides for the management of the nation’s coastal resources. The Act is administered by NOAA; however, regulating authorities have been delegated to the State of California. Due to the unique nature and needs of the San Francisco Bay, the State of California created the San Francisco Bay Conservation and Development Commission (BCDC) to regulate the CZMA in the San Francisco Bay Region. The BCDC developed a Coastal Zone Management Plan, the San Francisco Bay Plan to guide the protection and use of the bay and its shoreline. The Bay Plan provides policy direction for BCDC’s permit authority regarding the placement of fill, extraction of materials, determining substantial changes in use of land, water, or structures within its jurisdiction, protection of the bay habitat and shoreline, and maximizing public access to the bay. The Study area is part of the Bay Plan Maps 4 and 5 identified as Central Bay North and Central Bay, respectively. The maps identify several Port Priority Use Areas at China Basin (Piers 48 and 50), Central Basin (Pier 68), and surrounding the Islais Creek Channel (Piers 80, 90, 92, 94, and 96).

Part IV of the Bay Plan contains findings and policies that pertain to development of the bay and shoreline. These findings and policies address the many facets that comprise the uses, needs, and design issues associated with balancing the environmental, ecological, economic, recreational and social objectives of development within or along the shoreline of the bay. They include: (1) Safety of Fills; (2) Protection of the Shoreline; (3) Dredging; (4) Water-Related Industry; (5) Ports; (6) Airports; (7) Transportation; (8) Commercial Fishing; (9) Recreation (including Marinas); (10) Public Access; (11) Appearance, Design and Scenic Views; (12) Salt Ponds and Other Managed Wetlands; and (13) Other Uses. All of these policies are applicable to the study except airports, salt ponds and other managed wetlands.

In addition to the Bay Plan, the BCDC developed and adopted the San Francisco Waterfront Special Area Plan (SAP) and the San Francisco Bay Seaport Plan. The SAP and Seaport Plan set forth specific policies for uses, fill, public access, and design for piers and shoreline areas between Hyde Street Pier in Fisherman’s Wharf to India Basin, including all Port piers and pile-supported facilities. The Seaport Plan specifically sets policies for areas determined to be necessary for future port development and are designated as port priority use areas. These areas are reserved for port -related and other uses that will not impede development of the sites for port purposes. Both plans include general policies that apply to all areas covered by the Study, as well as geographic- or site-specific policies.

Under these regulations, USACE is responsible for managing its projects within the coastal zone jurisdiction in a manner that is consistent, to the maximum extent practicable, with the Bay Plan, Seaport Plan, and Special Area Management Plan. Overall, the TSP has been developed to avoid and minimize adverse impacts to aquatic resources, water quality, recreation, and public access, to the greatest extent practicable while improving the future conditions under climate change to preserve the current and future uses of the entire waterfront. Unavoidable adverse impacts are anticipated for transportation, bay fill, air quality, and water quality. For each of these resources, mitigation has been incorporated into the plan to minimize the impacts and where not possible to compensatory mitigation has been incorporated, as is the case for the bay fill.

The BCDC, pursuant to the CZMA and the implementing Federal Regulations in 15 CFR Part 930, is required to review Federal projects within San Francisco Bay and agree or disagree with the Federal agency's determination that the project is consistent with the Commission's Amended Coastal Zone Management Program for San Francisco Bay. It is anticipated that the TSP will be consistent with the policies set forth in the Bay Plan, SAP, and Seaport Plan and has prepared a draft Consistency Determination for the project with the information available at this time. The draft will be coordinated with the BCDC between the draft and final IFR-EIS to identify any data gaps or additional conservation or mitigation measures that should be considered. The BCDC has informed the agency that the project design details are not sufficient to support a formal review and issuance of consistency during feasibility and, therefore, compliance with the Act is delayed until PED when a greater level of design is available.

5.11 Bald and Golden Eagle Act of 1940

The Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c), enacted in 1940, as amended, prohibits anyone, without a permit issued by the Secretary of the Interior, from “taking” bald eagles, including their parts, nests, or eggs. The Act defines “take” as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb.” Disturb means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

Populations of bald and golden eagles are found in the less urbanized areas of San Francisco Bay and coastal range. While individual eagles may migrate through the area, the project area does not support nesting habitat for eagles as it generally lacks large mature trees. If nesting were to occur, the nest would need to be placed on man-made structures which would present its own set of challenges to survival, although not unheard of in other parts of the county. The chance of this occurring is relatively low since more suitable nesting habitat is available throughout the Bay or in more vegetated areas of the City. Following the MBTA protocols, surveys of trees would be completed prior to removal to ensure no active nests are present. During construction, increased noise may cause individuals to steer clear of the shoreline, roost in a different area or fly a different path. Construction and long-term operation of the TSP is not expected to cause adverse impacts that would rise to the level of take.

5.12 Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act (33 U.S.C.§ . 403) prohibits the unauthorized obstruction or alteration of any navigable water of the U.S. This section provides that the construction of any structure in or over any navigable water of the U.S., or the accomplishment of any other work affecting the course, location, condition, or physical capacity of such waters is unlawful unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army.

San Francisco Bay and the associated docks and shoreline in the project area are considered navigable waters of the U.S. Since the TSP involves bay fill, wharf raise/rebuild, pier demolition, and other permanent obstructions this Act is applicable to the study. During plan formulation, maintaining navigability and maritime function was considered a constraint and as a result of the measures that were developed and being considered support a flood defense system that is largely landward of the existing shoreline and maintains the existing wharfs and piers in their current location and footprint even though they are being raised to a higher elevation. Approximately 9 acres of bay fill is necessary to accommodate one location of wharf rebuilding and construction of a coarse beach, in which both locations would not support any maritime function and would not be an obstruction to the movement of vessels.

The proposed action is subject to public notice and other evaluations normally conducted for activities subject to the Act. The TSP is compliant with the Act.

5.13 Federal Aviation Administration – Hazardous Wildlife Attractants on or Near Airports

In accordance with FAA AC 150/5200-33C and the Memorandum of Agreement among the FAA, the USACE, and other Federal agencies (July 2003), the TSP was evaluated to determine if proposed land uses could increase wildlife hazards to aircraft using public use airports in the study area. The nearest airport (San Francisco International Airport [SFO]) is approximately 8.0 miles south of the project area in San Mateo County. The infrastructure associated with the project is not expected to attract wildlife; however, the NNBF measures could have the potential to attract birds and increase the incidence of wildlife strikes. Since, the NNBF would be implemented greater than five miles from the airport, the circular assumes there would be no impact from the project on the potential from bird strikes during approach, departure, or circling airspace. As a result, a wildlife hazard assessment and associated consultation is not necessary.

5.14 Executive Order 11988, Floodplain Management

EO 11988 requires Federal agencies avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities."

The Water Resources Council Floodplain Management Guidelines for implementation of EO 11988, as referenced in USACE ER 1165-2-26, requires an eight-step process that agencies should carry out as part of their decision making on projects that have potential impacts to, or are within the floodplain. The eight steps and project-specific responses to them are summarized below.

Step 1: Determine if a proposed action is in the base floodplain (that area which has a one percent of greater chance of flooding in any given year).

> The proposed action is within the base floodplain. The base floodplain is at the immediate shoreline in reaches 1, 2, and most of 3 due to existing sea walls, floodwalls, levees and berms and all areas landward of these feature are outside the base floodplain. In reach 4, the base floodplain goes further inland but is still retained within the industrial properties directly connected to the shoreline. The project is designed to reduce damages to existing infrastructure located landward of the proposed project.

Step 2: If the action is in the base floodplain, identify and evaluate practicable alternatives to the action or to location of the action in the base flood plain. Section 5 of this document presents an analysis of potential alternatives.

> Practicable measures and alternatives were formulated and evaluated against the USACE guidance, including nonstructural measures such as retreat, demolition and land acquisition.

Step 3: If the action must be in the floodplain, advise the general public in the affected area and obtain their views and comments.

There has been extensive coordination with pertinent Federal, State and local agencies, as well as the public. Two public commenting periods have already been completed on the study and included multiple public meetings, outreach events, and published media. See Appendix H for a complete description of public engagement completed to date. Once the draft report is released, public meetings will be scheduled in the study area during the public review period for additional coordination. During PED, the NFS intends to host a number of additional public engagement sessions to inform the public of the plans.

Step 4: Identify beneficial and adverse impacts due to the action and any expected losses of natural and beneficial flood plain values. Where actions proposed to be located outside the base flood plain will affect the base flood plain, impacts resulting from these actions should also be identified.

Currently, the San Francisco shoreline in reaches 1, 2 and partially in 3 do not currently contain any floodplain characteristics as the urbanized environment is built up to the existing wall and even extends onto wharves and piers. The area generally lacks any trees or vegetation that could function as a floodplain bench. In reach 3 and 4, areas with floodplain characteristics are present, albeit it many areas are altered by the presence of levees, berms, and constructed infrastructure already constructed. TNBP measures in these areas were designed to align with existing levees and berms or along existing property boundaries where the floodplain has already been altered and avoids intrusion into areas that support natural floodplain characteristics such as at Pier 94 or Heron's Head. NNBF, such as eco-armoring will be added to the berms in these areas or restoration of wetlands, will be incorporated to facilitate a more natural functioning floodplain while also reducing the flood risk. The project would not alter or impact the natural or beneficial flood plain values and would enhance it where NNBF are incorporated.

Step 5: If the action is likely to induce development in the base flood plain, determine if a practicable non-flood plain alternative for the development exists.

The project enhances function of the existing shoreline features to address risk as SLR occurs over the long period of analysis and is not likely to induce development. The study area is already densely developed, and any additional development would likely be redevelopment of an existing area. Areas that might develop in response to growing workforce needs might expand southward and replace industrial areas if the need arises (as of now that is not believed to be the case and was not considered as part of the costs or benefits of the project, but could occur in the future decades). The developments would be required to comply with already stringent building standards that are currently in place or under revision by the City of San Francisco.

Step 6: As part of the planning process under the Principles and Guidelines, determine viable methods to minimize any adverse impacts of the action including any likely induced development for which there is no practicable alternative and methods to restore and preserve the natural and beneficial flood plain values. This should include reevaluation of the “no-action” alternative.

> There is no mitigation to be expected for the Selected Plan. The project would not induce development in the flood plain and the project will not impact the natural or beneficial floodplain values. Chapter 3 of the main report and Appendix A (Plan Formulation) provide significant detail alternative identification, screening and the selection process. The “no action” alternative was included in the plan formulation phase.

Step 7: If the final determination is made that no practicable alternative exists to locating the action in the flood plain, advise the general public in the affected area of the findings.

> The Draft Integrated Feasibility Report and Environmental Impact Statement will be provided for public review and a public hearing will be scheduled during the public review period. Each comment received will be addressed and, if appropriate, incorporated into the Final Report. A record of all comments received will also be included in Appendix H (Public Involvement).

Step 8: Recommend the plan most responsive to the planning objectives established by the study and consistent with the requirements of the EO.

> The Recommended Plan is the most responsive to all of the study objectives and the most consistent with the EO.

5.15 Executive Order 11990, Protection of Wetlands

The purpose of EO 11990 is to “minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands.” To meet these objectives, this EO requires Federal agencies, in planning their actions, to consider alternatives to wetland sites and limit potential damage if an activity affecting a wetland cannot be avoided. The EO applies to:

- Acquisition, management, and disposition of Federal lands and facilities construction and improvement projects which are undertaken, financed or assisted by Federal agencies; and
- Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing activities.

EO 11990 applies to this study. All practicable measures have been taken to avoid and minimize the loss of wetlands and further enhance existing wetlands through the implementation of NNBFs. No work would be completed within any wetland area for the structural flood defenses. Construction of berms and seismic ground improvements would occur near but outside the wetlands. BMPs would be incorporated to prevent movement of sediment into the wetlands from the construction site and no surface waters would be diverted from or into wetlands that were not there prior to construction. Additionally, there would be stipulations that no staging areas, access roads, construction footprints would be sited in the wetlands. As a result, there would be no direct or indirect loss of wetlands.

Incorporation of NNBFs at Pier 94 during the second action would result in a net gain in overall quality and quantity of wetlands in the project area. The NNBF are primarily intended to restore open water to wetlands and improve degraded wetlands at that time. During construction, there may be some inadvertent direct or indirect impacts to existing wetlands. Vegetation may be trampled, smothered, or temporarily degraded due to turbidity as a result of placing material to achieve the target platform grade or from movement of equipment and personnel. It is expected that any wetlands present that could be impacted would be already significantly degraded due to SLR and natural conditions and may be temporarily lost until the restored vegetation reaches maturity and the wetland becomes fully functioning at which time the quality and quantity would be much higher than the pre-construction condition.

Additionally, fringe wetlands may be present along the EWN berm construction footprint and, similar to the NNBF wetlands, existing wetlands may be temporarily lost while the berm is constructed. Fringe wetlands would be replaced as part of the EWN berm design and the wetland loss would be considered temporary and the quality and quantity of fringe wetlands are expected to be much higher than the pre-construction conditions.

Based on current designs, there is no net loss of wetlands and therefore no compensatory mitigation is necessary. The TSP is compliant with EO 11990.

5.16 Executive Order 13112, Invasive Species

EO 13112 addresses the prevention of the introduction of invasive species and provides for their control and minimization of the economic, ecological, and human health impacts the invasive species causes. It establishes the Invasive Species Council, which is responsible for the preparation and issuance of the National Invasive Species Management Plan, which details and recommends performance-oriented goals and objectives and specific measures of success for Federal agencies. BMPs would be employed during construction activities to prevent the spread and introduction of invasive and non-native species. NNBF features of the TSP would help offset some habitat loss as a result of invasive species by restoring native habitats. The recommended plan is in compliance with EO 13112.

5.17 Executive Order 12898, Environmental Justice

Environmental justice requires agencies to incorporate into NEPA documents an analysis of the environmental effects of their proposed programs on minorities and low-income populations and communities. Environmental justice is defined by EPA as “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, local, and tribal programs and policies."

EO 12898 applies to the study. As part of the Port's commitment to equity, the Waterfront Resilience Program developed an internal equity evaluation tool in close collaboration with City and County staff through a series of equity working group meetings. The Equity Framework is a multi-step, iterative process meant to identify equity considerations and opportunities to maximize community benefits through the planning process. This tool was used during plan formulation and contributed to selection of alternatives that should be seriously considered as part of the EIS and that could be selected from for implementation. See Appendix E.2 (Flood Resiliency Study: Other Social Effects Report).

The potential impacts to minority and low-income groups are described in Appendix D-1-3 (Socioeconomics and Environmental Justice). A demographic analysis of the study area and an environmental justice review were completed for all alternatives. While the TNBP would generate an adverse effect, the distribution of these effects (displacement, flooding, and construction) would be dispersed throughout the study area. Therefore, the adverse effects generated under the TNBP would not be disproportionally felt by a minority or low-income population.

The EO also requires outreach to EJ communities. There has been extensive outreach to the local community related to sharing information about the multi-hazard earthquake and flood risks along the waterfront and the alternatives developed thus far. Public engagement helped shape the focused array of alternatives and identification of important features to retain or incorporate in the plan. Since 2017, the Port, through the Waterfront Resilience Program, has engaged with tens of thousands of people, including engaging community members at local events and Port-hosted meetings and walking tours, businesses and merchants, advisory committees, non-profit groups, youth, and others. Continued coordination will occur during the Draft IFR-EIS release and during PED. The USACE San Francisco District 20-Year Strategic Plan goals and plans would continue to be integrated into any outreach to environmental justice communities.

5.18 Executive Order 13045, Protection of Children

EO 13045 directs Federal agencies to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks. Examples of risks to children include increased traffic volumes and industrial or production-oriented activities that would generate substances or pollutants that children may come into contact with or ingest.

The project area is regularly visited by adults and children alike, particularly in reaches 1, 2 and 3; however, no children live in the project area. Construction activities would temporarily disrupt the area through the temporary loss of access and recreation and increased noise and traffic. This impact would be experienced equally by anyone who visits the area. Post-construction, access would be restored and pre-construction conditions would resume. Over the long-term, the flood defenses would minimize the risk of flooding and therefore also minimize the risk to anyone who visits the waterfront.

This report has evaluated the potential for the TSP to increase risks to children, and it has been determined that children visiting the project areas would not disproportionately experience any adverse effects from the proposed project.

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SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY, CA

DRAFT APPENDIX D-1-1
AIR QUALITY AND GREENHOUSE GAS ANALYSIS

JANUARY 2024

USACE TULSA DISTRICT | THE PORT OF SAN FRANCISCO

US Army Corps of Engineers

PORT OF SAN FRANCISCO

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Acronyms and Abbreviations

Acronym	Definition
ACMs	asbestos-containing materials
AMM	avoidance, minimization, and mitigation
BAAQMD	Bay Area Air Quality Management District
CAA	Clean Air Act
CAAQS	California ambient air quality standards
CARB	California Air Resources Board
CFR	Code of Federal Regulations
CH_4	methane
City	City and County of San Francisco
CO	carbon monoxide
CO_2	carbon dioxide
EIS	environmental impact statement
EO	executive order
EPA	U.S. Environmental Protection Agency
Foundation	Bay Area Clean Air Foundation
g/gal	grams per gallon
GCR	General Conformity Rule
GHG	greenhouse gas
HAP	hazardous air pollutant
HTRW	Hazardous, Toxic, and Radioactive Waste
I-280	Interstate 280
kg	kilograms
kg/gal	kilograms per gallon
mph	miles per hour
N_2O_2	nitrous oxide
NAAQS	national ambient air quality standards
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NO_2	nitrogen dioxide
NO_X	nitrogen oxides
O_3	ozone
Pb	lead
PM	particulate matter
PM10	particulates 10 microns in diameter or less
PM2.5	particulates 2.5 microns in diameter or less

Acronym	**Definition**
ppb	parts per billion
ppm	parts per million
ROG	reactive organic gas
SFBAAB	San Francisco Bay Area Air Basin
SIP	State Implementation Plan
SO_2	sulfur dioxide
State	State of California
TBP	Total Benefits Plan
$\mu g/m^3$	micrograms per cubic meter
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

1.0. Introduction

This section describes the affected environment for air quality and greenhouse gases (GHGs) and analyzes effects that could occur due to construction of the alternatives. The alternatives would result in temporary changes to air quality and GHG emissions through short-term construction activities. Although mitigation is available to avoid significant permanent impacts on global GHGs, implementation of the alternatives may result in significant and unavoidable impacts on localized air quality. Construction emissions and mitigation measures are discussed in Section 2.3.3 and Section 2.3.4.

2.0. Affected Environment

This section summarizes the federal, State of California (State), regional, and local regulations related to air quality and GHG emissions applicable to the alternatives. Relevant regulatory agencies include the U.S. Environmental Protection Agency (EPA), California Air Resources Board (CARB), and Bay Area Air Quality Management District (BAAQMD).

2.1 Regulatory Framework

2.1.1 Federal Regulations

2.1.1.1 Clean Air Act and General Conformity Rule

The EPA and CARB regulate and measure air quality through the Clean Air Act (CAA) and national ambient air quality standards (NAAQS), and California CAA and California ambient air quality standards (CAAQS), respectively. The NAAQS, presented in Table 2-1, serve as benchmarks for maintaining air quality. Under the CAA, State and local agencies in areas that exceed the NAAQS are required to develop State Implementation Plans (SIPs) to show how they will achieve the NAAQS for non-attainment criteria air pollutants by specific dates. SIPs are not single documents; rather, they are a compilation of new and previously submitted plans, programs (e.g., monitoring, modeling, permitting programs), district rules, State regulations, and federal controls.

To support compliance with the CAA and attainment of the NAAQS, the EPA established the General Conformity Rule (GCR) under CAA Section 176(c). The GCR is a critical tool that assess whether federal actions, including various alternatives, meet the requirements outlined in the CAA and SIP.

Table 2-1: National Ambient Air Quality Standards

Pollutant	Primary/ Secondary	Average Time	National Primary Standard	Violation Criteria National
CO	primary	8 hours	9 ppm	Not to be exceeded more than once per year
		1 hour	35 ppm	
Pb	primary and secondary	Rolling 3-month average	0.15 μg/m^3	Not to be exceeded
NO_2	primary	1 hour	100 ppb	The 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	primary and secondary	1 year	53 ppb	Annual mean
O_3	primary and secondary	8 hours	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
$PM_{2.5}$	primary	1 year	12.0 μg/m^3	Annual mean, averaged over 3 years
	secondary	1 year	15.0 μg/m^3	Annual mean, averaged over 3 years
	primary and secondary	24 hours	35 μg/m^3	The 98th percentile, averaged over 3 years
PM_{10}	primary and secondary	24 hours	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years
SO_2	primary	1 hour	75 ppb	The 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year

Source: U.S. Environmental Protection Agency 2016

CO= carbon monoxide; Pb = lead; NO_2 = nitrogen dioxide; O_3 = ozone; $PM_{2.5}$ = particulate matter 2.5 microns in diameter or less; PM_{10} = particulate matter 10 microns in diameter or less; SO_2 = sulfur dioxide; μg/m^3 = micrograms per cubic meter; ppb = parts per billion; ppm = parts per million

2.1.1.2 Federal Executive Action and Guidance on Greenhouse Gas Emissions

Several federal executive orders (EOs) have recently been signed by President Biden related to GHG emissions and climate resiliency. In particular, EO 13990 set a national goal to achieve a 50 to 52 percent reduction from 2005 levels in economy-wide net GHG pollution in 2030. In January 2023, the White House Council on Environmental Quality (CEQ) released interim guidance regarding the consideration of GHG in National Environmental Policy Act (NEPA) documents for federal actions.

2.1.2 State and Local Regulations

2.1.2.1 Local Air Quality Plans and Rules

The BAAQMD is responsible for developing the local elements of the SIP for the San

Francisco Bay Area Air Basin (SFBAAB), which includes San Francisco. The BAAQMD is also responsible for implementing federal and State regulations at the local level and establishing local air quality regulations and permit obligations.

2.1.2.2 State and Local Regulation of Greenhouse Gas Emissions

At the State level, California has adopted statewide legislation for addressing various aspects of climate change and GHG emissions mitigation. Notably, Assembly Bill 1279 outlines the State's GHG reduction goals for achieving a 40 percent reduction below 1990 emissions levels by 2030 and an 85 percent reduction in anthropogenic emissions below 1990 emissions levels, as well as net-zero GHG emissions, no later than 2045. The City and County of San Francisco (City) has also adopted a Climate Action Plan to achieve net-zero GHG emissions.

2.2 Existing Condition

Air quality and GHGs are important considerations for the alternatives because of current regional air quality conditions, which exceed certain federal and State ambient air quality standards, and because GHGs generated by the alternatives may contribute to global climate change.

The NAAQS and CAAQS were established by the EPA and CARB, respectively, to protect public health and welfare. Standards have been set for six criteria pollutants—ozone (O_3), carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO2), sulfur dioxide (SO_2), and particulate matter (PM), which consists of particulates 10 microns in diameter or less (PM10) and 2.5 microns in diameter or less (PM2.5). O_3 is considered a regional pollutant because its precursors affect air quality on a regional scale; nitrogen oxides (NOX) and reactive organic gases (ROGs) react photochemically to form O_3; this reaction occurs at some distance downwind of the emissions source. Pollutants such as CO, NO2, SO2, and Pb are considered local pollutants that tend to accumulate in the air locally. PM is both a local and regional pollutant. Fossil-fueled vehicles and equipment used to construct the alternatives would generate exhaust emissions with O_3 precursors (NO_X and ROGs), CO, NO_2 (as a component of NO_X), SO_2, and PM. Earthmoving activities would generate fugitive dust, which would contribute to the presence of PM in the air.

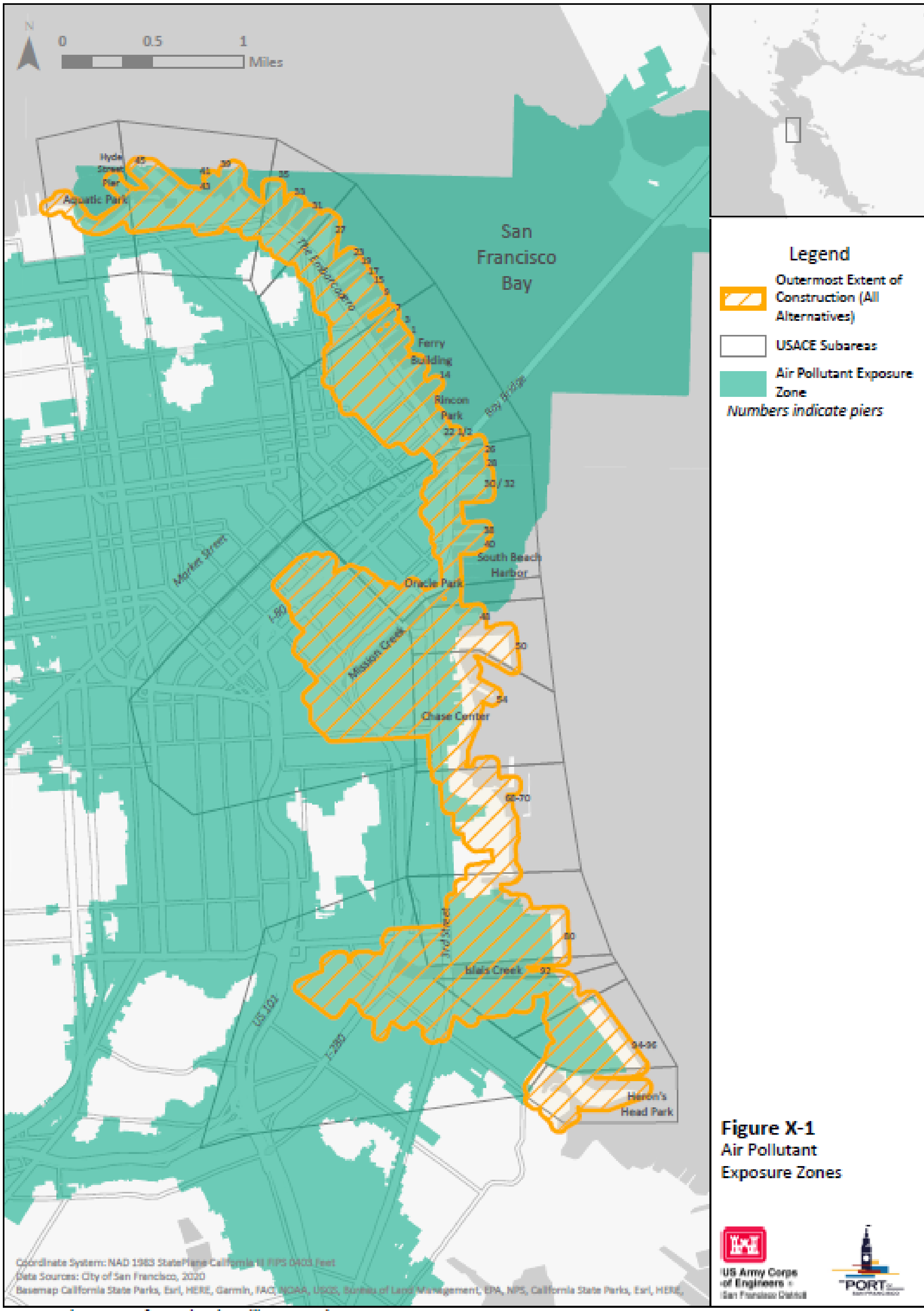
Criteria pollutant concentrations in the SFBAAB are measured at several monitoring stations. The nearest station to the study area is the San Francisco-Arkansas Street station, which is adjacent to the area of construction at 16th Street and Arkansas Street. Monitoring data for 2019 through 2021 show that the station experienced infrequent violations of the O_3 CAAQS and NAAQS, PM2.5 NAAQS, and PM10 CAAQS (CARB, 2023a). Data collected from monitoring stations throughout the SFBAAB are used to designate areas as non-attainment, maintenance, or attainment areas for the NAAQS and CAAQS. Nonattainment areas are regions where air quality does not meet the NAAQS, indicating higher levels of pollutants. Maintenance areas were previously nonattainment areas but have achieved and maintained compliance with the NAAQS. Attainment areas meet the air quality standards for all designated pollutants. According to the most recent local monitoring data, the area of construction is classified as being in non-attainment for O_3, attainment for CO, attainment/unclassified for PM10, and non-attainment for PM2.5 (CARB, 2023b; EPA, 2023).

Regulators have not established separate standards for GHGs or hazardous air pollutants (HAPs). Gases that trap heat in the atmosphere are known as GHGs. The primary GHGs generated by the alternatives would be carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O_2). The EPA defines HAPs as pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects (EPA, 2022). In Section 2.2.3 Effects, for each alternative, HAPs are evaluated as substantial pollutant concentrations potentially affecting sensitive receptors. The area of construction overlaps several areas that have been identified by the San Francisco Department of Public Health (2020) as having elevated health vulnerabilities from existing HAP concentrations, as shown in Figure 2-1. Sensitive land uses are particularly vulnerable to poor air quality because they are locations where human populations, especially children, seniors, and sick persons, are located and where there is a reasonable expectation of continuous exposure. Residences within or adjacent to the area of construction are found within the Aquatic Park, Northeast Waterfront, Ferry Building, South Beach, and Mission Bay subareas. Mixed-use buildings with housing units line Beach Street in Aquatic Park, and there are multi-family dwellings at the intersection of Chestnut Street and Sansome Street in the NE Waterfront. Farther south, the Rincon Hill and South Beach residential districts are adjacent to the area of construction in the South Beach subarea. Figure 1-1 in Appendix D-1-2: *Noise and Vibration*, shows the sensitive receptors both in and within 1,000 feet of the area of construction. These same receptors are also considered sensitive for air quality purposes and could be exposed to substantial pollutant concentrations.

2.3 Environmental Consequences

2.3.1 Assessment Method

The alternatives differ in their implementation timelines, which range from 30 to 100 years. The alternatives propose structural and non-structural interventions to reduce coastal flood risks from the various targeted sea-level-rise trajectories. Construction activities would depend on factors such as the degree of sea-level rise, local economic conditions, market demand, and other financing considerations. The specific size, location, construction techniques, and scheduling for each individual construction action have not yet been determined. Thus, in the absence of the detailed location-specific construction information required to provide an informative and meaningful analysis, the evaluation of potential construction-related effects resulting from implementation of the alternatives is conducted qualitatively for criteria pollutants. Specifically, emission-generating activities and the types of emission sources are described; additional details regarding anticipated cut-and-fill volumes, where available, are provided to help characterize the expected intensity of air quality effects.



San Francisco Waterfront Flood Resiliency Study
Integrated Feasibility Report / Environmental Impact Statement

Figure 2-1: Air Pollutant Exposure Zones

The GHG analysis, likewise, considers comparative construction data as well as quantitative metrics regarding construction costs and the change in land use. Specifically, fuel consumption is correlated to construction costs and converted to GHG emissions, based on the amount of CO_2 emitted per gallon of diesel consumed (EPA, 2005). To determine the number of gallons of fuel used to implement the project alternatives, it was assumed that 10 percent of the construction costs would be associated with fuel consumption and that the average cost of diesel would be $6 per gallon.

2.3.2 Basis of Significance

The context for air quality considers existing conditions within the SFBAAB, including regional attainment status, ambient air quality monitoring data, and applicable regulations, as established by the EPA and CARB. The air quality context also considers existing conditions along the alternatives' footprint and within 1,000 feet of construction work areas and permanent alternatives features, including the number and location of sensitive receptors. The context for GHG emissions includes the state and global atmosphere.

Impacts are determined by assessing the following conditions:

- Whether the alternative would conflict with implementation of applicable air quality plans or threaten to violate an ambient air quality standard (or additionally contribute to a non-attainment status),
- The degree to which the alternative would affect public health by exposing sensitive receptors to pollutant concentrations, and
- Whether the alternative would contribute cumulatively to GHG emissions and climate change.

The GCR, discussed in *Section D-2.1.3*, *Regulatory Background*, establishes emissions thresholds (known as *de minimis* levels) at 40 Code of Federal Regulations (CFR) 93.153(b) for use in evaluating the conformity of a project with applicable air quality plans. Given that the current evaluation is a planning study and that detailed emissions estimates will be prepared when the engineering design is further developed, the requirements of the GCR do not need to be met now, in accordance with 40 CFR 93.153(c), *Planning, Studies, and Provision of Technical Assistance.* GCR requirements would be met when the detailed emissions estimates can be prepared. However, for disclosure purposes only, a preliminary general conformity analysis has been completed for the preferred alternative and is included as *Sub-Appendix D-2-1: Draft General Conformity Determination* in *Appendix D-2: Clean Air Act Compliance*. This preliminary analysis is not based on detailed construction assumptions suitable for an actual conformity analysis; thus, subsequent phases under the project would require their own project-level conformity evaluation and determination at a future date.

2.3.3 Effects

This section describes the adverse and beneficial impacts on air quality and GHG emissions in the study area.

2.3.3.1 Construction Impact Summary

Construction activities would result in the generation of dust and emissions from heavy machinery, including the use of emergency generators and maintenance. The specific intensity of air quality impacts through 2040 and from 2070–2130 would depend on various factors, including the specific location of construction, the duration of construction or modification activities, and the type and number of pieces of equipment used. The intensity and magnitude of criteria pollutants from construction emission sources would be reduced during buildout by State and local regulations. Construction emissions generated may be offset, to some degree, by a reduced need for emergency action and response.

Given the information known at this time, the potential exists for construction emissions to conflict with implementation of air quality plans and violate ambient air quality standards. Implementation of avoidance and minimization measures and mitigation measures described in Section 2.3.4, *Mitigation*, would be required to reduce construction emissions from individual phases of construction.

While construction activities are generally not expected to be located near sensitive receptors, there may be instances of sensitive receptors within 1,000 feet of certain activities. Implementation of avoidance and minimization measures and mitigation measures described in Section 2.3.4, *Mitigation*, would be required; however, construction activities would still be expected to expose sensitive receptors to substantial pollutant concentrations.

Construction would also produce GHG emissions. GHG emissions, while not individually substantial, would contribute incrementally to global climate change. Implementation of avoidance and minimization measures described in Section 2.3.4, *Mitigation*, would be necessary to reduce construction exhaust emissions and GHGs.

2.3.3.2 Operations and Maintenance Impact Summary

Substantial operational emissions would not occur because the alternatives would consist primarily of the installation of fixed flood improvements, such as levees, seawalls, sheet pile walls, and related infrastructure. However, electric pumps would be used to pump inland water associated with operations. California regulations support increases in the renewable portfolio standards over time, with a goal of 100 percent renewable energy, and electric pumps would not be a significant source of criteria pollutant or GHG emissions over the long run. There would be no material change in long-term operational emissions, compared to those that would be generated under the FWOP. Consequently, operational air quality emissions would result in ***no impact***.

2.3.3.3 Total Benefits Plan

Table 2-2 shows a summary of the air quality impacts associated with the Total Benefits Plan (TBP).

Table 2-2: Summary of Air Quality Impacts Associated with the TBP

TBP Air Quality Impact Rating by Measure	**Bay Fill**	**Levee**	**Bulkhead wall/Seawall**	**Deployable Flood Gate**	**Roadway Impact**	**Sheetpile Wall**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint (1st Action)	4	4	5	4	4	4	4	4	5	3	3	3	3	1
Construction/Footprint (2nd Action)	5	4	5	1	4	1	4	1	5	3	3	3	3	3
O&M Assumptions	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mitigated Rating	4	3	4	3	3	3	3	3	4	2	2	2	2	2

* Denotes Engineering with Nature (EWN) measure.

2.3.3.3.1 Regional Air Quality Effects

Implementation of the TBP would require the use of diverse construction equipment and machinery across specific geographic areas, which would have an impact on air quality. In The Embarcadero (Reaches 1 and 2), key first actions include raising the shoreline, performing ground improvement for seismic performance, floodproofing buildings, and constructing concrete curbs around piers. First actions for Reach 2 and subsequent actions for Reach 1 continue raising the shoreline, considering building adaptations based on risk profiles, and addressing stormwater management. These activities could include use of excavators and backhoes for excavation and earthmoving, cranes for heavy lifting during the installation of floodwalls and bulkhead walls, concrete pumps for precise concrete placement, bulldozers for grading and leveling tasks, forklifts for efficient material handling, compactors to ensure soil stability, and drilling rigs for foundation work and ground improvement.

Similarly, in Mission Creek/Mission Bay (Reach 3), key first actions involve raising the shorelines, performing ground improvement, installing deployable closure structures, and enhancing wildlife habitat. Subsequent actions include further elevation, maintenance of roadway capacity, incorporation of engineering with nature features, and building adaptations. This could encompass excavators and backhoes for earthmoving and excavation, cranes for lifting and placing closure structures and bulkhead walls, concrete pumps for concrete placement, bulldozers for grading, forklifts for material handling, compactors for soil compaction, and drilling rigs for foundation work.

Lastly, in Islais Creek/Bayview (Reach 4), initial actions involve elevating the shorelines, installing concrete curbs, performing ground improvement, and incorporating engineering with nature features. Subsequent actions include additional shoreline elevation, construction of levees, building adaptations, and the consideration of additional infrastructure for stormwater management. This could include excavators, cranes, concrete pumps, bulldozers, forklifts, compactors, and drilling rigs, depending on the specific tasks required for shoreline elevation, concrete curb installation, and the deployment of closure structures.

Both the TBP and Alternative G would involve significant construction activities that would require heavy equipment and specialized materials. Overall, Alternative G and TBP would implement similar measures; however, the TBP plans to construct more measures than Alternative G, such as bay fill, a deployable flood gate, and a sheetpile wall.

Given the information known about the TBP, the potential exists for construction emissions to conflict with implementation of air quality plans and violate ambient air quality standards. The intensity and magnitude of criteria pollutant emissions and the potential for violations of ambient air quality standards would be reduced during buildout of the TBP by State and local regulations that result in changes in vehicle emissions—principally, the Advanced Clean Truck and Advanced Clean Cars II regulations, which ban the sale of fossil fuel–powered heavy vehicles, as well as passenger cars and trucks, beyond certain future dates. These and other future regulations adopted to support attainment of the State's air quality and GHG goals would reduce the emissions intensity of equipment and vehicles used to construct the TBP. Nevertheless, implementation of AMM-AQ-1 and AMM-AQ-2 would be required to reduce construction emissions from individual phases implemented under the TBP.

If construction emissions from future individual phases still exceed the GCR de minimis levels after implementation of AMM-AQ-1 and AMM-AQ-2, MM-AQ-1 would be required. With full implementation of AMM-AQ-1, AMM-AQ-2, and MM-AQ-1, this alternative would not conflict with air quality plans and would contribute to ambient air quality violations, and the impact would be ***less than significant with mitigation***.

2.3.3.3.2 Substantial Pollutant Concentrations

Similar to the activities under other action alternatives, construction activities under the TBP through 2040 and from 2070–2130 would generally not be located near sensitive receptors; however, there are housing units (e.g., apartment complexes, houseboats on

Mission Creek) that may be within 1,000 feet of construction activities. The potential for the TBP to expose sensitive receptors to substantial pollutant concentrations would be similar to the potential exposure for the other action alternatives but slightly decreased because the TBP would most likely incorporate more phasing and adaptability, potentially reducing its impact on sensitive receptors.

Compared to Alternative A, emissions generated by the TBP may be offset, to some degree, by a reduced need for emergency action and response. However, the specific nature of future emergency events cannot be predicted, nor can the location of activities relative to construction and receptors. Implementation of AMM-AQ-1 and AMM-AQ-2 would, therefore, be required to reduce the likelihood of receptors being exposed to substantial pollutant concentrations.

MM-AQ-2 would also be required for future construction located within 1,000 feet of sensitive receptors. Although the control strategies identified in AMM-AQ-1, AMM-AQ-2, and MM-AQ-2 would achieve considerable emission reductions, there may be instances in which project-specific conditions would preclude reductions in health risks to a level that would be below adopted thresholds. Consequently, this EIS takes the conservative approach in its post-mitigation significance conclusion and discloses, for NEPA compliance purposes, that the alternative would expose sensitive receptors to substantial pollutant concentrations. With implementation of AMM-AQ-1, AMM-AQ-2, and MM-AQ-2, this impact would be ***significant and unavoidable***.

2.3.3.3.3 Greenhouse Gas Emissions

The TBP would require specialized equipment that could contribute additional GHG emissions. Compared to the other alternatives, the TBP would likely have a greater GHG impact because it would implement the most measures.

The specific intensity of GHG emissions through 2040 and through 2070–2130 would depend on various factors, including the specific location of construction, the duration of construction or modification activities, and the type and number of pieces of equipment used. The intensity and magnitude of GHGs from construction emission sources would be reduced during buildout of the TBP by State and local regulations. Compared to Alternative A, GHG emissions generated by the TBP may be offset, to some degree, by a reduced need for emergency action and response.

CO_2 emissions are highly correlated to fuel use. Approximately 99 percent of the carbon in diesel fuel is emitted in the form of CO_2 (EPA, 2023). EPA published a CO_2 emission factor of 10,084 g/gal, or 10.1 kg/gal, which provides the CO_2e value. To determine the gallons of fuel used to implement the TBP, it was assumed that 10 percent of construction costs are associated with fuel consumption. Based on the 10-year average of data collected by the U.S. Army Corps of Engineers (USACE) Cost Center of Expertise, the average cost of diesel is $6 per gallon.

Using these assumptions, the TBP is expected to spend approximately $22.7 billion on construction in total, of which 10 percent ($2.27 billion) would be spent on fuel. This translates to 378,333,333 gallons of fuel used, 3,821,166,667 kg of CO_2e, and 3,821,167 $MTCO_2e$ (4,212,116 tons CO_2e) for the entire construction period (240 months). This translates into about 15,922 $MTCO_2e$ per month (17,550 tons per month) or 191,064 $MTCO_2e$ per year (210,600 tons per year CO_2e).

GHG emissions generated by the TBP would not, by themselves, lead to substantial climate effects but would contribute incrementally to global climate change. Implementation of AMM-AQ-1 through AMM-AQ-3 would be required to reduce GHGs. With implementation of AMM-AQ-1 through AMM-AQ-3, this impact would be ***less than significant***.

2.3.3.4 Alternative B: Nonstructural

2.3.3.4.1 Regional Air Quality Effects

Alternative B is nonstructural and includes floodproofing, modifying, or relocating buildings and infrastructure to reduce flood risks. As sea levels rise, areas with higher flood risks could be managed for responsible retreat, while areas with lower risks could be floodproofed or modified. Nature-based features would be added to retreat areas to reduce flood risks, while policy changes would be implemented to allow for increased housing density and business relocations in inland areas. Essential utilities and major transportation and transit corridors would be relocated or modified to continue providing service.

Some of the actions in Alternative B, such as relocating or modifying buildings and infrastructure, could have effects on air quality. For example, if new buildings are constructed in areas that were previously undeveloped, the construction of new buildings and demolition of old buildings would contribute to air pollution through the use of construction equipment and vehicles, such as haul trucks, excavators, cranes, and bulldozers. In addition, new buildings could lead to increased vehicular traffic and associated air pollution. Similarly, if utilities are relocated, this could require new construction or modifications to existing facilities, which would result in emissions from construction equipment and the transport of materials.

Construction emissions impacts associated with each individual intervention would be short term and limited to the period when construction would be taking place for a particular activity. Although these emissions may not individually exceed GCR de minimis levels, the concurrent construction of multiple interventions under Alternative B could generate combined criteria pollutant emissions in a single year that would have the potential to conflict with implementation of air quality plans and violate ambient air quality standards.

The intensity and magnitude of criteria pollutant emissions and the potential for violations of ambient air quality standards through 2040 and through 2090 would be reduced during buildout of Alternative B by State and local regulations that result in changes in vehicle emissions—principally, the Advanced Clean Truck and Advanced Clean Cars II regulations, which ban the sale of fossil fuel–powered heavy vehicles, as well as passenger cars and trucks, beyond certain future dates. These and other future regulations adopted to support attainment of the State's air quality and GHG goals would reduce the emissions intensity of equipment and vehicles used to construct Alternative B.

Implementation of Alternative B would provide more reliable flood protection, which would reduce the risk of emergency events and flooding. Compared to Alternative A, criteria pollutant emissions generated by Alternative B may be offset, to some degree, by reduced emergency action. Implementation of the BAAQMD's best management practices under AMM-AQ-1 would also be required to reduce criteria pollutant emissions. This avoidance, minimization, and mitigation (AMM) would be required for all future construction activity under Alternative B. Although this AMM would reduce the intensity of construction emissions, the potential to conflict with air quality plans and violate standards still exists, particularly for larger or concurrent construction activities. AMM-AQ-2 would be required for those activities in which a future detailed analysis identifies a significant impact. AMM-AQ-2 would further reduce construction emissions from individual phases implemented under Alternative B.

If construction emissions from future individual phases still exceed GCR de minimis levels after implementation of AMM-AQ-1 and AMM-AQ-2, MM AQ-1 would be required. Specifically, MM-AQ-1 would require USACE to make a good-faith effort to enter into a contractual agreement with the Bay Area Clean Air Foundation (Foundation), a public nonprofit and supporting organization for the BAAQMD. Under such an agreement, USACE would agree to mitigate the project's emissions by providing funds to the Foundation for grants that will go to projects that have been designed to achieve emission reductions, thereby offsetting project-related effects on air quality. Although the Foundation has successfully delivered emission reductions throughout the Bay Area for more than a decade, the precise quantity of emissions generated by Alternative B cannot currently be quantified, and thus, the amount of required grant funding, as well as the associated offset, is unknown.

Emissions generated by buildout of Alternative B would occur over several decades. The potential for cost escalations creates economic uncertainty that must be considered and disclosed. Ultimately, because of the plan-level nature of this analysis, coupled with the unknowns surrounding the future availability and affordability of funding for emission reduction projects, there is inherent uncertainty in the degree of mitigation that may ultimately be implemented to reduce potentially significant impacts.

With full implementation of AMM-AQ-1, AMM-AQ-2, and MM-AQ-1, this alternative would not conflict with air quality plans and contribute to ambient air quality violations and the impact would be ***less than significant with mitigation***.

2.3.3.4.2 Substantial Pollutant Concentrations

Alternative B construction activities through 2040 and through 2090 would occur mostly near commercial or industrial uses; however, there are housing units (e.g., apartment complexes, houseboats on Mission Creek) throughout the study area that may be within 1,000 feet of construction activities (Appendix D-1-2, *Noise and Vibrations*, Figure 1-1). In general, the construction of infrastructure would be a relatively short-term activity and spread out throughout the area of construction, as opposed to concentrated at a single location. However, the combustion of fossil fuel in diesel- and gasoline-powered equipment could expose receptors to increased pollutant concentrations. In addition, the demolition of structures may result in particulates that may disperse asbestos-containing materials (ACMs) to adjacent sensitive receptor locations; however, all demolition activities would be subject to EPA's National Emission Standards for Hazardous Air Pollutants (NESHAP) if asbestos is present at existing facilities.

As discussed above, compared to Alternative A, emissions generated by Alternative B may be offset, to some degree, by a reduced need for emergency action and response. However, the specific nature of future emergency events cannot be predicted, nor can the location of activities relative to alternative construction and receptors. Implementation of AMM-AQ-1 and AMM-AQ-2 would reduce construction exhaust emissions and, therefore, would be required to reduce the likelihood of receptors being exposed to substantial pollutant concentrations under Alternative B. MM-AQ-2 would also be required for future construction located within 1,000 feet of sensitive receptors and would require performing a health risk assessment and implement feasible control strategies to protect public health.

Although the control strategies identified in AMM-AQ-1, AMM-AQ-2, and MM-AQ-2 would achieve considerable emission reductions, there may be instances in which project-specific conditions would preclude reductions in health risks to a level that would be below adopted thresholds. Consequently, this EIS takes the conservative approach in its post-mitigation significance conclusion and discloses, for NEPA compliance purposes, that the alternative would expose sensitive receptors to substantial pollutant concentrations. With implementation of AMM-AQ-1, AMM-AQ-2, and MM-AQ-2, this impact would be ***significant and unavoidable***.

2.3.3.4.3 Greenhouse Gas Emissions

The same types of equipment and activities discussed for Alternative B would contribute to GHG emissions under Alternative B. Although the electricity needed to power equipment and vehicles would result in indirect GHG emissions prior to 2045, pursuant to State regulation, electricity generated and provided by local utilities would be carbon free by December 31, 2045. Material manufacturing, particularly cement, aggregate, and steel manufacturing, would also result in indirect GHG emissions upstream of construction activities.

The specific intensity of GHG emissions through 2040 and through 2090 would depend on various factors, including the specific location of construction, the duration of construction or modification activities, and the type and number of pieces of equipment used. Because these variables are not known at this time, the precise climate effects of construction activities associated with Alternative B, including social costs, cannot be accurately quantified. As discussed above for Alternative B, the intensity and magnitude of GHGs from construction emission sources would be reduced during buildout of Alternative B by State and local regulations. Compared to Alternative A, GHG emissions generated by Alternative B may be offset, to some degree, by a reduced need for emergency action and response.

CO_2 emissions are highly correlated to fuel use. Approximately 99 percent of the carbon in diesel fuel is emitted in the form of CO_2 (EPA, 2023). EPA published a CO_2 emission factor of 10,084 grams per gallon (g/gal), or 10.1 kilograms per gallon (kg/gal), which provides the CO_2e value. To determine the gallons of fuel used to implement Alternative B, it was assumed that 10 percent of construction costs are associated with fuel consumption. Based on the 10-year average of data collected by the USACE Cost Center of Expertise, the average cost of diesel is $6 per gallon. Using these assumptions, Alternative B is expected to spend approximately $7.2 billion on construction in total, of which 10 percent ($720 million) would be spent on fuel. This translates into 121,333,333 million gallons of fuel used, 1,212,000,000 kilograms (kg) of CO_2e, and 1,212,000 $MTCO_2e$ (1,336,001 tons CO_2e) for the entire construction period (600 months). This translates into about 2,020 $MTCO_2e$ per month (2,227 tons per month) or 24,240 $MTCO_2e$ per year (26,724 tons per year CO_2e).

GHG emissions generated by Alternative B would not, by themselves, lead to substantial climate effects but would contribute incrementally to global climate change. Implementation of AMM-AQ-1 and AMM-AQ-2 would reduce construction exhaust emissions and, therefore, would be required to reduce GHGs. Environmental review completed for future activities implemented under the project could identify additional project-specific mitigation, as informed by AMM-AQ-3. With implementation of AMM-AQ-1 through AMM-AQ-3, this impact would be ***less than significant***.

2.3.3.5 Alternative F: Manage the Water, Scaled for Higher Risk

Table 2-3 shows a summary of the air quality impacts associated with Alternative F**.**

Table 2-3: Summary of Air Quality Impacts Associated with Alternative F

Alternative F Air Quality Impact Rating by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	4	4	5	4	3	4	4	5	3	3	3
O&M Assumptions	1	1	1	1	1	1	1	1	1	1	1
Mitigated Rating	3	3	4	3	2	3	3	4	2	2	2

2.3.3.5.1 Regional Air Quality Effects

Alternative F proposes a coastal flood defense infrastructure that would rely on the construction of tide gates, shoreline extensions, levees, raised roads, and floodwalls along the current Bay shoreline, following the “manage the water” strategy. The shoreline would be extended into the Bay to make space for underground stormwater storage capacity. Inland drainage modifications would also be necessary. This may include measures that involve the consolidation of combined sewer discharge outfalls, new pumps, and green infrastructure. Floodproofing for maritime and industrial facilities would also be included. Residual coastal and inland flood risks could be addressed through floodproofing. More than 1,000,000 cubic yards of fill would be used during construction in 2040, with more than 113,000 cubic yards in 2090.

Constructing the infrastructure proposed in Alternative F would require a diverse range of equipment and machinery as well as specialized materials. Excavators and bulldozers would be required for significant earthmoving. Pile drivers would be used to install supports for structures. Pumps and mixers would be necessary for the construction of concrete infrastructure. Cranes, scaffolding, and other construction equipment would be used for floodproofing as well as raising or relocating structures.

Alternative F would most likely have substantial air quality emissions due to the need for more specialized equipment and the larger scale of the construction activities involved. Alternative F would also require cubic yards of fill in both 2040 and 2090 (total of 1.113 million cubic yards).

Although the precise magnitude of emissions generated by Alternative F cannot be quantified, given the information known about Alternative F, the potential exists for construction emissions to conflict with implementation of air quality plans and violate ambient air quality standards. The intensity and magnitude of criteria pollutant emissions and the potential for violations of ambient air quality standards would be reduced during buildout of Alternative F by State and local regulations that result in changes in vehicle emissions—principally, the Advanced Clean Truck and Advanced Clean Cars II regulations, which ban the sale of fossil fuel–powered heavy vehicles, as well as passenger cars and trucks, beyond certain future dates. These and other future regulations adopted to support attainment of the State's air quality and GHG goals would reduce the emissions intensity of equipment and vehicles used to construct Alternative F. Nevertheless, implementation of AMM-AQ-1 and AMM-AQ-2 would be required to reduce construction emissions from individual phases implemented under Alternative F. If construction emissions from future individual phases still exceed the GCR de minimis levels after implementation of AMM-AQ-1 and AMM-AQ-2, MM-AQ-1 would be required.

With full implementation of AMM-AQ-1, AMM-AQ-2, and MM-AQ-1, this alternative would not conflict with air quality plans and contribute to ambient air quality violations, and the impact would be ***less than significant with mitigation***.

2.3.3.5.2 Substantial Pollutant Concentrations

Similar to the other action alternatives, Alternative F construction activities through 2040 and through 2090 would generally not be located near sensitive receptors; however, there are housing units (e.g., apartment complexes, houseboats on Mission Creek) throughout the study area that may be within 1,000 feet of construction activities. The potential for Alternative F to expose sensitive receptors to substantial pollutant concentrations would be similar to the potential exposure described above for the other action alternatives but slightly increased because Alternative F would be likely to require more construction activity. Additionally, sensitive receptors may be exposed to temporary construction odors from diesel equipment; however, these odors would be short-term and would typically disperse once the construction activities are completed. Furthermore, certain measures, such as tide gates, may also expose sensitive receptors to odors due to the accumulation of organic matter and debris in the tidal channels. Over time, this organic matter can decompose, releasing unpleasant odors that may affect the surrounding environment and those close to the tide gates.

As discussed for Alternative F, compared to Alternative A, emissions generated by Alternative F may be offset to some degree by a reduced need for emergency action and response. However, the specific nature of future emergency events cannot be predicted, nor can the location of activities relative to construction and receptors. Implementation of AMM-AQ-1 and AMM-AQ-2 would, therefore, be required to reduce the likelihood of receptors being exposed to substantial pollutant concentrations under Alternative F. MM-AQ-2 would also be required for future construction located within 1,000 feet of sensitive receptors.

Although the control strategies identified in AMM-AQ-1, AMM-AQ-2, and MM-AQ-2 would achieve considerable emission reductions, there may be instances in which project-specific conditions would preclude reductions in health risks to a level that would be below adopted thresholds. Consequently, this EIS takes the conservative approach in its post-mitigation significance conclusion and discloses, for NEPA compliance purposes, that the alternative would expose sensitive receptors to substantial pollutant concentrations. With implementation of AMM-AQ-1, AMM-AQ-2, and MM-AQ-2, this impact would be ***significant and unavoidable***.

2.3.3.5.3 Greenhouse Gas Emissions

Alternative F would require specialized equipment that could contribute additional GHG emissions. Compared to Alternative B, Alternative F would be likely to have a greater GHG impact due to the need for more specialized equipment and the larger scale of the construction activities involved.

The specific intensity of GHG emissions through 2040 and through 2090 would depend on various factors, including the specific location of construction, the duration of construction or modification activities, and the type and number of pieces of equipment used. Because these variables are not known at this time, the precise climate effects of construction activities associated with Alternative F, including social costs, cannot be accurately quantified. As discussed for Alternative F, the intensity and magnitude of GHGs from construction emission sources would be reduced during buildout of Alternative F by State and local regulations. Compared to Alternative A, GHG emissions generated by Alternative F may be offset, to some degree, by a reduced need for emergency action and response.

CO_2 emissions are highly correlated to fuel use. Approximately 99 percent of the carbon in diesel fuel is emitted in the form of CO_2 (EPA, 2023). EPA published a CO_2 emission factor of 10,084 g/gal, or 10.1 kg/gal, which provides the CO_2e value. To determine the gallons of fuel used to implement Alternative F, it was assumed that 10 percent of construction costs are associated with fuel consumption. Based on the 10-year average of data collected by the USACE Cost Center of Expertise, the average cost of diesel is $6 per gallon. Using these assumptions, Alternative F is expected to spend approximately $17.4 billion on construction in total, of which 10 percent ($1.74 billion) would be spent on fuel. This translates to 283,333,333 gallons of fuel used, 2,861,666,667 kg of CO_2e, and 2,861,667 $MTCO_2e$ (3,154,448 tons CO_2e) for the entire construction period (240 months). This translates into about 11,924 $MTCO_2e$ per month (262,871 tons per month) or 143,088 $MTCO_2e$ per year (3,154,452 tons per year CO_2e).

GHG emissions generated by Alternative F would not, by themselves, lead to substantial climate effects but would contribute incrementally to global climate change. Implementation of AMM-AQ-1 through AMM-AQ-3 would be required to reduce GHGs. With implementation of AMM-AQ-1 through AMM-AQ-3, this impact would be ***less than significant***.

2.3.3.6 Alternative G: Partial Retreat, Scaled for Higher Risk

Table 2-4 shows a summary of the air quality impacts associated with Alternative G.

Table 2-4: Summary of Air Quality Impacts Associated with Alternative G

Alternative G Air Quality Impact Rating by Measure	**Levee**	**Bridge raise**	**Bulkhead wall/Seawall**	**Roadway Impact**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/ Footprint	4	5	5	4	4	4	5	3	3	3	3	3
O&M Assumptions	1	1	1	1	1	1	1	1	1	1	1	1
Mitigated Rating	3	4	4	3	3	3	4	2	2	2	2	2

2.3.3.6.1 Regional Air Quality Effects

Alternative G would construct flood defense structures and floodproof buildings in the Mission Bay and Islais Creek/Bayview area and along The Embarcadero. The alternative would involve building levees, floodwalls, seawalls, and closure structures, along with floodproofing and converting some areas to natural and nature-based features. In addition, extensive demolition and displacement of uses would occur throughout the Mission Bay area. By 2040, the alternative would aim to defend against 3.5 feet of sea-level rise. It would also require transportation and other infrastructure to be reconfigured. By 2090, the alternative would aim to construct new levees and walls to defend against up to 7 feet of sea-level rise and establish floodable open space zones. The alternative would also include modifying zoning, investing in public access improvements along the creek, and expanding bridges into causeways. In The Embarcadero area, the alternative would involve building an elevated shoreline with a new seawall and a short floodwall, reconstructing The Embarcadero roadway, and raising buildings to defend against sea-level rise. The shoreline would be elevated to defend against 7 feet of sea-level rise by 2090. In addition, more than 67,000 cubic yards of fill would be used during construction in 2040, with more than 63,000 cubic yards in 2090.

Generally, the equipment needed to complete Alternative G could include excavators, bulldozers, graders, cranes, pile drivers, concrete mixers, trucks, and other heavy machinery. Furthermore, the construction of flood defense structures such as levees, floodwalls, and seawalls would require excavation and earthmoving equipment as well as materials such as concrete, steel, and rock. Retrofitting buildings and raising the shoreline would require specialized construction equipment such as hydraulic jacks, scaffolding, and concrete pumps. The installation of new pump stations and drainage systems would require excavation and trenching equipment as well as electrical and plumbing systems.

Both Alternative F and Alternative G would involve significant construction activities that would require heavy equipment and specialized materials. Overall, Alternative G appears to focus more on demolition, relocation, and retreat strategies. However, Alternative G would use fewer cubic yards of fill in both 2040 and 2090 compared with Alternative F (total of 130,000 cubic yards vs 1,113,000 cubic yards), indicating that emissions from earthmoving activities would be less than the emissions discussed above for Alternative F.

Although the precise magnitude of emissions generated by Alternative G cannot be quantified, given the information known about Alternative G, the potential exists for construction emissions to conflict with implementation of air quality plans and violate ambient air quality standards. The intensity and magnitude of criteria pollutant emissions and the potential for violations of ambient air quality standards would be reduced during buildout of Alternative G by State and local regulations that result in changes in vehicle emissions—principally, the Advanced Clean Truck and Advanced Clean Cars II regulations, which ban the sale of fossil fuel–powered heavy vehicles, as well as passenger cars and trucks, beyond certain future dates. These and other future regulations adopted to support attainment of the State's air quality and GHG goals would reduce the emissions intensity of equipment and vehicles used to construct Alternative G. Nevertheless, implementation of AMM-AQ-1 and AMM-AQ-2 would be required to reduce construction emissions from individual phases implemented under Alternative G. If construction emissions from future individual phases still exceed the GCR de minimis levels after implementation of AMM-AQ-1 and AMM-AQ-2, MM-AQ-1 would be required.

With full implementation of AMM-AQ-1, AMM-AQ-2, and MM-AQ-1, this alternative would not conflict with air quality plans and contribute to ambient air quality violations, and the impact would be ***less than significant with mitigation***.

2.3.3.6.2 Substantial Pollutant Concentrations

Similar to the activities under other action alternatives, construction activities under Alternative G through 2040 and through 2090 would generally not be located near sensitive receptors; however, there are housing units (e.g., apartment complexes, houseboats on Mission Creek) that may be within 1,000 feet of construction activities. The potential for Alternative G to expose sensitive receptors to substantial pollutant concentrations would be similar to the potential exposure described above for the other action alternatives but slightly increased (with the exception of Alternative F) because Alternative G would most likely require more construction activity.

As discussed for Alternative G, compared to Alternative A, emissions generated by Alternative G may be offset, to some degree, by a reduced need for emergency action and response. However, the specific nature of future emergency events cannot be predicted, nor can the location of activities relative to construction and receptors. Implementation of AMM-AQ-1 and AMM-AQ-2 would therefore be required to reduce the likelihood of receptors being exposed to substantial pollutant concentrations under Alternative G. MM-AQ-2 would also be required for future construction within 1,000 feet of sensitive receptors.

Although the control strategies identified in AMM-AQ-1, AMM-AQ-2, and MM-AQ-2 would achieve considerable emission reductions, there may be instances in which project-specific conditions would preclude reductions in health risks to a level that would be below adopted thresholds. Consequently, this EIS takes the conservative approach in its post-mitigation significance conclusion and discloses, for NEPA compliance purposes, that the alternative would expose sensitive receptors to substantial pollutant concentrations. With implementation of AMM-AQ-1, AMM-AQ-2, and MM-AQ-2, this impact would be ***significant and unavoidable***.

2.3.3.6.3 Greenhouse Gas Emissions

Alternative G would require specialized equipment that could contribute additional GHG emissions. Compared to Alternative B, Alternative G would be likely to have a greater GHG impact due to the need for more specialized equipment and the larger scale of the construction activities involved.

The specific intensity of GHG emissions through 2040 and through 2090 would depend on various factors, including the specific location of construction, the duration of construction or modification activities, and the type and number of pieces of equipment used. Because these variables are not known at this time, the precise climate effects of construction activities associated with Alternative G, including social costs, cannot be accurately quantified. As discussed for Alternative G, the intensity and magnitude of GHGs from construction emission sources would be reduced during buildout of Alternative G by State and local regulations. Compared to Alternative A, GHG emissions generated by Alternative G may be offset, to some degree, by a reduced need for emergency action and response.

CO_2 emissions are highly correlated to fuel use. Approximately 99 percent of the carbon in diesel fuel is emitted in the form of CO_2 (EPA, 2023). EPA published a CO_2 emission factor of 10,084 g/gal, or 10.1 kg/gal, which provides the CO_2e value. To determine the gallons of fuel used to implement Alternative G, it was assumed that 10 percent of construction costs are associated with fuel consumption. Based on the 10-year average of data collected by the USACE Cost Center of Expertise, the average cost of diesel is $6 per gallon. Using these assumptions, Alternative G is expected to spend approximately $11.7 billion on construction in total, of which 10 percent ($1.17 billion) would be spent on fuel. This translates to 195,000,000 gallons of fuel used, 1,969,500,000 kg of CO_2e, and 1,969,500 $MTCO_2e$ (2,171,002 tons CO_2e) for the entire construction period (240 months). This translates into about 8,206 $MTCO_2e$ per month (9,046 tons per month) or 98,472 $MTCO_2e$ per year (108,552 tons per year CO_2e).

GHG emissions generated by Alternative G would not, by themselves, lead to substantial climate effects but would contribute incrementally to global climate change. Implementation of AMM-AQ-1 through AMM-AQ-3 would be required to reduce GHGs. With implementation of AMM-AQ-1 through AMM-AQ-3, this impact would be ***less than significant***.

2.3.3.7 Independent Measures for Consideration

Table 2-5 shows a summary of the air quality impacts associated with the independent measures.

Table 2-5: Summary of Air Quality Impacts Associated with the Independent Measures

Independent Measures Air Quality Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	3	3	4	3	3	3	3
O&M Assumptions	1	1	1	1	1	1	1
Mitigated Rating	2	2	3	2	2	2	2

2.3.3.7.1 Regional Air Quality Effects

2A - Robust Coastal Defense of Ferry Building and Agriculture Building

The construction of robust coastal defense structures would likely require a variety of heavy machinery. This could include excavators for site preparation and backfilling, pile-driving equipment if piles are to be installed, cranes for lifting and placing materials, and potentially barges for storage of equipment and materials. Concrete mixers and pumps may also be needed when raising structures.

2B - Coarse Beach at Rincon Park

The construction of a coarse beach at Rincon Park connecting to Pier 14 would likely require a variety of heavy machinery. This could include excavators for site preparation and backfilling, bulldozers for moving and spreading fill material, and potentially barges for storage of equipment and materials.

3A - Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves

The construction of a raised shoreline from Bay Bridge to South Beach Harbor with rebuilt wharves would likely require a variety of heavy machinery. This could include excavators for site preparation and backfilling, pile-driving equipment if piles are to be installed, cranes for lifting and placing materials, and potentially barges for storage of equipment and materials. If the current shoreline is to be raised, additional equipment such as bulldozers for moving and spreading fill material may be needed. The redesign of the northbound lanes of the Embarcadero roadway may require road construction equipment such as road graders, asphalt pavers, and rollers.

3B - McCovey Cove North Curb Extension

The construction of a raised shoreline along the north side of McCovey Cove would likely require a variety of heavy machinery. This could include excavators for site preparation and backfilling, pile-driving equipment if piles are to be installed, cranes for lifting and placing materials, and potentially barges for storage of equipment and materials. If the current shoreline is to be raised, additional equipment such as bulldozers for moving and spreading fill material may be needed.

3C - Planted Levee on Mission Bay

The construction of a planted levee along Mission Bay, south of Pier 50, would likely require the use of various construction equipment and machinery. Essential equipment would include excavators for digging and shaping the levee's foundation, bulldozers for grading and leveling the ground, front-end loaders for moving materials, and dump trucks for material transport. Compactors would be crucial to ensure the soil is adequately compacted for stability, while cranes might be required for positioning heavy rocks or materials. Backhoes could be used for trench digging, particularly for drainage systems. If paved pathways are part of the levee design, pavers would also be employed.

4A - Inland Coastal Flood Defense at Southwest Islais Creek

Constructing an inland coastal flood-defense project at Southwest Islais Creek, involving the conversion of industrial lands and public facilities for public water access, open space, and ecological benefits, would require a diverse array of construction equipment. Excavators would be instrumental for earthmoving and trenching to create space for flood defenses and amenities. Bulldozers would contribute to land grading and shaping, ensuring the desired topography for flood defenses and open spaces. Backhoes might be employed for trenching work, especially for drainage systems or utilities. When heavy lifting is necessary, cranes would come into play, aiding in the placement of substantial structures and materials. Dump trucks would facilitate material transport, while pavers could be used for creating pathways or paved surfaces. If concrete structures are part of the plan, concrete mixers would be essential.

Living Seawall (Vertical Shoreline)

The construction of a living seawall would involve a variety of equipment. Seawall construction can involve the use of excavators for site preparation and backfilling, pile-driving equipment if piles are to be installed, barges for storage of equipment and materials, cranes, tiebacks, anchors, welding equipment, and other specialized equipment.

Conclusion

Construction of the above independent measures could generate dust and emissions from the operation of construction machinery, as discussed above. These emissions could include PM, NOx, SOx, CO, and VOCs. The specific intensity of air quality impacts of each independent measure would depend on various factors, including the specific location of construction, the duration of construction or modification activities, and the type and number of pieces of equipment used. Because these variables are not known at this time, the precise air quality effects of construction activities associated with the independent measures cannot be accurately quantified. The intensity and magnitude of criteria pollutants from construction emission sources would be reduced during buildout by State and local regulations. Compared to Alternative A, emissions generated by the independent measures may be offset, to some degree, by a reduced need for emergency action and response.

Although the precise magnitude of emissions generated by the independent measures cannot be quantified, given the information known about the independent measures, the potential exists for construction emissions to conflict with implementation of air quality plans and violate ambient air quality standards. The intensity and magnitude of criteria pollutant emissions and the potential for violations of ambient air quality standards would be reduced during buildout of the independent measures by State and local regulations that result in changes in vehicle emissions—principally, the Advanced Clean Truck and Advanced Clean Cars II regulations, which ban the sale of fossil fuel–powered heavy vehicles, as well as passenger cars and trucks, beyond certain future dates. These and other future regulations adopted to support attainment of the State's air quality and GHG goals would reduce the emissions intensity of equipment and vehicles used to construct the independent measures. Nevertheless, implementation of AMM-AQ-1 and AMM-AQ-2 would be required to reduce construction emissions from individual phases implemented under the independent measures. If construction emissions from future individual phases still exceed the GCR de minimis levels after implementation of AMM-AQ-1 and AMM-AQ-2, MM-AQ-1 would be required.

With full implementation of AMM-AQ-1, AMM-AQ-2, and MM-AQ-1, these measures would not conflict with air quality plans or contribute to ambient air quality violations, and the impact would be ***less than significant with mitigation*** for the following independent measures:

- 2A. Robust Coastal Defense of Ferry Building and Agriculture Building
- 2B. Coarse Beach at Rincon Park

- 3A. Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves
- 3B. McCovey Cove North Curb Extension
- 3C. Planted Levee on Mission Bay
- 4A. Inland Coastal Flood Defense at Southwest Islais Creek
- Living Seawall (Vertical Shoreline)

2.3.3.7.2 Substantial Pollutant Concentrations

2A - Robust Coastal Defense of Ferry Building and Agriculture Building

The Robust Coastal Defense of Ferry Building and Agriculture Building independent measure would realign the coastal flood defense structure adjacent to the bayside edge of the Ferry Building and possibly the Agriculture Building along The Embarcadero.

Sensitive receptors that may be within 1,000 feet of construction activities include recreational areas (e.g., Sue Bierman and Parrot Park).

2B - Coarse Beach at Rincon Park

The Coarse Beach at Rincon Park independent measure would reduce wave hazards, support nearshore ecology, and provide public water access at Rincon Park along The Embarcadero.

Sensitive receptors that may be within 1,000 feet of construction activities include recreational areas (e.g., Sue Bierman and Parrot Park).

3A - Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves

The Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves independent measure aims to elevate the existing shoreline from the Bay Bridge to the entrance of Mission Creek. Instead of expanding the shoreline outward into the Bay, this project focuses on raising the existing shoreline. Additionally, it involves a redesign of the northbound lanes of The Embarcadero roadway.

Sensitive receptors that may be within 1,000 feet of construction activities include residential areas (e.g., apartment complexes).

3B - McCovey Cove North Curb Extension

The McCovey Cove North Curb Extension independent measure would raise the shoreline in line with the current shoreline edge on the north side of McCovey Cove, along Oracle Park.

Sensitive receptors that may be within 1,000 feet of construction activities include residential areas (e.g., apartment complexes).

3C - Planted Levee on Mission Bay

The Planted Levee on Mission Bay independent measure would occur south of Pier 50 and would be designed to reduce wave hazards, support nearshore ecology, and provide public water access.

Sensitive receptors that may be within 1,000 feet of construction activities include residential areas and parks (e.g., apartment complexes, condos, Bay Front Park).

4A - Inland Coastal Flood Defense at Southwest Islais Creek

The Inland Coastal Flood Defense at Southwest Islais Creek independent measure would include conversion of some industrial lands and public facilities to provide public water access, open space, and ecological benefits. The activities would occur east of 3rd Street, north of Evans Avenue, and west of Interstate 280 (I-280).

Sensitive receptors that may be within 1,000 feet of construction activities include residential areas and parks (e.g., apartment complexes, Tulare Park and Islais Creek Skate Park).

Living Seawall (vertical shoreline)

The Living Seawall independent measure would reduce wave hazards while supporting nearshore ecology wherever current maritime uses and pier configurations allow.

Because this independent measure would occur wherever current maritime uses and pier configurations are located, sensitive receptors that may be within 1,000 feet of construction activities could include various residential and recreational areas throughout the project site.

Conclusion

As discussed above, compared to Alternative A, emissions generated by the independent measures may be offset, to some degree, by a reduced need for emergency action and response. However, the specific nature of future emergency events cannot be predicted, nor can the location of activities relative to construction and receptors. Implementation of AMM-AQ-1 and AMM-AQ-2 would, therefore, be required to reduce the likelihood of receptors being exposed to substantial pollutant concentrations for each of the independent measures. MM-AQ-2 would also be required for future construction located within 1,000 feet of sensitive receptors.

Although the control strategies identified in AMM-AQ-1, AMM-AQ-2, and MM-AQ-2 would achieve considerable emission reductions, there may be instances in which project-specific conditions would preclude reductions in health risks to a level that would be below adopted thresholds. Consequently, this EIS takes the conservative approach in its post-mitigation significance conclusion and discloses, for NEPA compliance purposes, that the independent measures would expose sensitive receptors to substantial pollutant concentrations. With implementation of AMM-AQ-1, AMM-AQ-2, and MM-AQ-2, this impact would be ***significant and unavoidable*** for the following independent measures:

- 2A. Robust Coastal Defense of Ferry Building and Agriculture Building
- 2B. Coarse Beach at Rincon Park

- 3A. Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves
- 3B. McCovey Cove North Curb Extension
- 3C. Planted Levee on Mission Bay
- 4A. Inland Coastal Flood Defense at Southwest Islais Creek
- Living Seawall (Vertical Shoreline)

2.3.3.7.3 Greenhouse Gas Emissions

2A - Robust Coastal Defense of Ferry Building and Agriculture Building

The construction of robust coastal defense structures involves a range of heavy machinery and activities, as described above, that can result in significant GHG emissions. These emissions primarily arise from the operation of heavy construction equipment and the energy-intensive processes associated with construction materials. Excavators, used for site preparation and backfilling, as well as cranes for lifting and placing materials, are often powered by fossil fuels, such as diesel, releasing CO2 and other pollutants into the atmosphere. Pile-driving equipment, if used, also relies on fossil fuels and contributes to emissions. Moreover, the production of concrete involves processes that release CO_2, such as the production of cement and transportation of materials. Concrete mixers and pumps used for raising structures further add to emissions.

2B - Coarse Beach at Rincon Park

The construction of a coarse beach at Rincon Park connecting to Pier 14 involves the use of heavy machinery and construction activities, as described above, that can have GHG impacts. These emissions primarily come from the operation of heavy construction equipment and, if applicable, the processes associated with dredging and the transportation of materials. If new Bay fill is required, dredging equipment may be used, which also relies on fossil fuels and contributes to emissions. Additionally, barges utilized for equipment and material storage can result in emissions associated with their operation and maintenance.

3A - Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves

The construction of a raised shoreline from Bay Bridge to South Beach Harbor with rebuilt wharves involves a range of heavy machinery and construction activities, as described above, that can lead to significant GHG impacts. These emissions primarily arise from the operation of heavy construction equipment and processes associated with construction materials. The use of barges for equipment and material storage can also result in emissions related to their operation and maintenance. In the case of the redesign of the northbound lanes of The Embarcadero roadway, road construction equipment could lead to additional GHG emissions.

3B - McCovey Cove North Curb Extension

The construction of a raised shoreline along the north side of McCovey Cove involves the use of heavy machinery and construction activities, as described above, that can result in significant GHG impacts. These emissions primarily stem from the operation of heavy construction equipment and, if applicable, processes associated with dredging and the transportation of materials. The potential use of barges for equipment and material storage can also lead to emissions associated with their operation and maintenance. If the current shoreline is to be raised, additional equipment like bulldozers for moving and spreading fill material may be necessary, further contributing to emissions.

3C - Planted Levee on Mission Bay

The construction of a planted levee along Mission Bay, south of Pier 50, would involve using various construction equipment and machinery, as described above, resulting in GHG impacts. GHG emissions primarily arise from the operation of heavy construction equipment. Excavators, employed for digging and shaping the levee's foundation, along with bulldozers for grading and leveling the ground, front-end loaders for moving materials, and dump trucks for material transport, all contribute to emissions during their operation. Compactors used to compact the soil for stability also typically rely on fossil fuels. Cranes, if used to position heavy rocks or materials, and backhoes for trench digging can add to the emissions. If paved pathways are included in the levee design, the use of pavers would also result in emissions.

4A - Inland Coastal Flood Defense at Southwest Islais Creek

The construction of an inland coastal flood defense project at Southwest Islais Creek, involving a wide range of construction equipment, as described above, can contribute to GHGs. These emissions primarily result from the operation of heavy construction machinery. Equipment such as excavators, bulldozers, backhoes, cranes, and concrete mixers mentioned for various tasks like excavation, grading, trenching, lifting, and concrete work, are key sources of emissions. Dump trucks used for material transport and pavers for creating pathways or paved surfaces also typically run on fossil fuels, adding to emissions.

Living Seawall (Vertical Shoreline)

The construction of a living seawall, as described above, involves various equipment and activities that contribute to GHG emissions. Heavy construction equipment like excavators, cranes, and pile-driving equipment often rely on fossil fuels, emitting CO2, and other pollutants. GHGs are also released during the transportation of equipment and materials to the site, including trucks, barges, and other vehicles. Energy use, such as welding equipment and electricity, can further contribute to emissions. Additionally, the production of construction materials like concrete and steel involves energy-intensive processes that release GHGs. Construction site operations, including power generation and vehicle idling, also play a role in emissions.

Conclusion

The specific intensity of GHG emissions for these independent measures would depend on various factors, including the specific location of construction, the duration of construction or modification activities, and the type and number of pieces of equipment used. Because these variables are not known at this time, the precise climate effects of construction activities associated with these independent measures, including social costs, cannot be accurately quantified. As discussed above, the intensity and magnitude of GHGs from construction emission sources would be reduced by State and local regulations. Compared to Alternative A, GHG emissions generated by these independent measures may be offset, to some degree, by a reduced need for emergency action and response.

GHG emissions generated by these independent measures would not, by themselves, lead to substantial climate effects but would contribute incrementally to global climate change. Implementation of AMM-AQ-1 through AMM-AQ-3 would be required to reduce GHGs. With implementation of AMM-AQ-1 through AMM-AQ-3, this impact would be ***less than significant*** for the following independent measures.

- 2A. Robust Coastal Defense of Ferry Building and Agriculture Building
- 2B. Coarse Beach at Rincon Park
- 3A. Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves
- 3B. McCovey Cove North Curb Extension
- 3C. Planted Levee on Mission Bay
- 4A. Inland Coastal Flood Defense at Southwest Islais Creek
- Living Seawall (Vertical Shoreline)

2.3.4 Mitigation

While construction activities associated with Alternative A cannot be defined and air quality impacts are too speculative for meaningful evaluation, the measures below are available to reduce construction emissions under Alternative A, as necessary.

For Alternatives B, F, G, the TBP, and independent measures, the AMMs that follow would be necessary to reduce impacts.

AMM-AQ-1: Implement BAAQMD's Basic and Enhanced Best Management Practices for Construction

The following list of strategies is informed by measures recommended by the BAAQMD (2023) to reduce construction-generated criteria pollutant emissions:

- All exposed surfaces (e.g., unpaved parking and staging areas, soil piles, graded areas, and unpaved access roads) shall be watered two times per day, except during rainy days.
- All haul trucks transporting soil, sand, or other loose material off-site shall be covered.

- All visible mud or dirt track-out onto adjacent public roads shall be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited.
- All vehicle speeds on unpaved roads shall be limited to 15 miles per hour (mph).
- All roadways, driveways, and sidewalks to be paved shall be completed as soon as possible. Building pads shall be laid as soon as possible after grading unless seeding or soil binders are used.
- All excavation, grading, and/or demolition activities shall be suspended when average wind speeds exceed 20 mph.
- All trucks and equipment, including their tires, shall be washed off prior to leaving the active site.
- Unpaved roads providing access to sites located 100 feet or more from a paved road shall be treated with a 6- to 12-inch layer of compacted wood chips, mulch, or gravel.
- Publicly visible signs shall be posted with the telephone number and name of the person to contact at the lead agency regarding dust complaints. This person shall respond and take corrective action within 48 hours. The air district's general air pollution complaints number shall also be visible to ensure compliance with applicable regulations.
- Limit the simultaneous occurrence of excavation, grading, and ground-disturbing construction activities.
- Install wind breaks (e.g., trees, fences) on the windward side(s) of actively disturbed areas of construction. Wind breaks should have a maximum of 50 percent air porosity.
- Plant vegetative ground cover (e.g., fast-germinating native grass seed) in disturbed areas as soon as possible and water appropriately until the vegetation is established.
- Install sandbags or other erosion control measures to prevent silt runoff to public roadways from sites with a slope greater than 1 percent.
- Minimize the amount of excavated material or waste materials stored at the site.
- Hydroseed or apply non-toxic soil stabilizers to construction areas, including previously graded areas, that are inactive for at least 10 calendar days.

AMM-AQ-2: Implement Additional Control Strategies to Reduce Criteria Pollutant Emissions

As the design progresses, and after detailed construction assessments are conducted and project-specific impacts are identified, include measures, if necessary, to reduce criteria pollutant emissions to levels below de minimis thresholds. Reductions in emissions can be accomplished by the following measures, as feasible:

- Requiring that all construction equipment, diesel trucks, and generators be equipped with best available control technology for reductions in NO_X and PM emissions. Acceptable options for reducing emissions include the use of late-model engines,

low-emission diesel products, alternative fuels, engine retrofit technology, after-treatment products, add-on devices such as particulate filters, and/or other options as they become available.
- Use coatings that are low in volatile organic compounds (VOCs) or ROGs and go beyond local requirements (i.e., Regulation 8, Rule 3: Architectural Coatings)
- Modify the construction schedule to minimize simultaneous construction activity when possible.
- Use zero-emission and hybrid-powered equipment to the greatest extent possible.

AMM-AQ-3: Implement Control Strategies to Reduce Greenhouse Gas Emissions

After detailed construction assessments are conducted, and impacts are identified, if necessary, include measures to reduce GHG emissions. Reductions in emissions can be accomplished by the measures listed below, as feasible. The list of strategies is informed by measures recommended by the BAAQMD (2023) to reduce construction-generated GHG emissions; as such, these measures should be updated as project-specific analyses are conducted.

- Require all on-road heavy-duty trucks to be zero-emission vehicles or meet the most stringent emissions standard at the time of construction, such as a model-year (MY) standard, as a condition of contract.
- Minimize idling time, either by shutting equipment off when not in use or reducing the time of idling to no more than 2 minutes (a 5-minute limit is required by the State airborne toxics control measure [Title 13, Sections 2449(d)(3) and 2485 of the California Code of Regulations]). Provide clear signage that posts this requirement for workers at the entrances to the sites and develop an enforceable mechanism to monitor idling time and ensure compliance with this measure.
- Prohibit off-road diesel-powered equipment from being in the “on” position for more than 10 hours per day.
- Use CARB-approved renewable diesel fuel in off-road construction equipment and on-road trucks.
- Use EPA SmartWay-certified trucks for deliveries and equipment transport.
- Require all construction equipment to be maintained and properly tuned in accordance with manufacturer’s specifications. Equipment should be checked by a certified mechanic and determined to be running in proper condition prior to operation.
- Where grid power is available, prohibit portable diesel engines and provide electrical hook-ups for electric construction tools, such as saws, drills, and compressors; use electric tools whenever feasible.
- Encourage and provide carpools, shuttle vans, transit passes, and/or secure bicycle parking to construction workers and offer meal options on-site or shuttles to nearby meal destinations for construction employees.

- Reduce electricity use in construction offices by using LED bulbs, powering off computers every day, and replacing heating and cooling units with more efficient ones.
- Minimize energy used during site preparation by deconstructing existing structures to the greatest extent feasible instead of demolishing structures and discarding all materials.
- Recycle or salvage non-hazardous construction and demolition debris, with a goal of recycling at least 15 percent more by weight than the diversion requirement in Title 24.
- Use locally sourced or recycled materials for construction materials (goal of at least 20 percent, based on costs for building materials and volume for roadway, parking lot, sidewalks, and curb materials). Wood products used should be certified through a sustainable forestry program.
- Use low-carbon concrete, minimize the amount of concrete used, and produce concrete on-site if it is more efficient and lower emitting than transporting ready-mix.
- Develop a plan to efficiently use water for adequate dust control because substantial amounts of energy can be consumed during the pumping of water.
- Purchase carbon offsets.

For Alternatives B through G, the mitigation measures that follow would be necessary to reduce impacts.

MM-AQ-1: Offset Construction-Generated Criteria Pollutants in the San Francisco Bay Area Air Basin

Enter into a memorandum of understanding (MOU) with the Bay Area Clean Air Foundation (Foundation), a public nonprofit and supporting organization for the BAAQMD, to reduce emissions above the federal de minimis levels to net zero. The mitigation offset fee amount will be determined at the time of mitigation to fund one or more emissions reduction projects within the San Francisco Bay Area Air Basin (SFBAAB). The terms and conditions of the MOU will be negotiated prior to groundbreaking of each future construction phase. To qualify under this mitigation measure, the specific emissions reduction project(s) must result in emissions reductions in the SFBAAB that are real, surplus, quantifiable, and enforceable and will not otherwise be achieved through compliance with existing regulatory requirements or any other legal requirement. Funding will need to be received prior to contracting with participants and should allow enough time to receive and process applications to fund off-site reduction projects prior to commencement of the project activities that are being offset.

MM-AQ-2: Conduct Site-Specific Health Risk Assessments and Implement Measures to Reduce Public Exposure to Emissions

Require future construction located within 1,000 feet of sensitive receptors to perform a health risk assessment (HRA). If the HRA demonstrates health risks would be significant, additional feasible on- and off-site mitigation shall be analyzed to help reduce risks to the greatest extent practicable. Potential measures may include the following:

- Create buffers between residences and construction (e.g., vegetative barriers or other temporary buffers).
- Use construction equipment with the highest commercially available tier of emissions controls (in 2023, this is Tier 4).
- Use equipment during times when receptors are not present (e.g., when school is not in session or during non-school hours), as feasible.
- Establish staging areas for the construction equipment that are as distant as possible from off-site receptors, including existing residences.
- Where feasible, use haul trucks with on-road engines instead of off-road engines, even for on-site hauling.
- Provide financial assistance for high-efficiency air filtration systems to those affected for use in residences.
- Implement dust-suppression site controls to limit the exposure to potential contaminated soils, as necessary. Refer to the Hazardous, Toxic, and Radioactive Waste (HTRW)/soil quality section, as needed.

2.4 Cumulative and Other Impacts

The SFBAAB is the cumulative study area for air quality, while global atmosphere is the cumulative study area for GHGs. Consequently, there are numerous past, present and reasonably foreseeable projects within these study areas. Implementation of the three AMMs and two MMs would reduce criteria pollutant emissions generated by the alternatives but would not avoid the exposure of receptors to substantial pollutant concentrations in localized areas. Other projects in the cumulative impacts area may implement comparable mitigation measures, such as using water or dust control chemicals to reduce fugitive dust or complying with relevant air quality regulations. Other cumulative projects may also contribute pollutant concentrations in the same localized areas affected by project construction. Thus, construction of the project would cumulatively contribute to existing localized air quality impacts in the study area but would not cumulative contribute to regional air quality impacts. As a result, cumulative impacts relative to localized air quality would be ***significant and unavoidable***.

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SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY, CA

DRAFT APPENDIX D-1-2 NOISE AND VIBRATION

JANUARY 2024

USACE TULSA DISTRICT | THE PORT OF SAN FRANCISCO

US Army Corps of Engineers

PORT OF SAN FRANCISCO

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Acronyms and Abbreviations

Acronym	Definition
AMM	avoidance and minimization measure
dBA	A-weighted decibel
Caltrans	California Department of Transportation
City	City and County of San Francisco
Ldn	day-night sound level
dB	decibel
EWN	engineering with nature
Leq	equivalent sound level
FTA	Federal Transit Administration
FWOP	future without project conditions
Lmax	maximum sound levels
PPV	peak particle velocity
SCMs	standard construction measures
State	State of California
TNBP	Total Benefits Plan
VdB	vibration decibels

1.0. Affected Environment

This section describes the regulatory setting and existing conditions for noise and vibration in the area of construction, evaluates the significance of impacts on sensitive land uses that could result from construction of the alternatives, and provides avoidance and minimization measures to reduce the significance of noise or vibration impacts.

Definitions of the noise and vibration terms used in this analysis are provided below.

- **A-weighted decibels (dBA).** An overall frequency-weighted sound level in decibels that approximates the frequency response of the human ear for low- to mid-level sounds. The dBA scale is the most widely used for environmental noise assessment.
- **Day-night sound level (Ldn).** The energy average of A-weighted sound levels occurring over a 24-hour period, with a 10 dB penalty applied to A-weighted sound levels occurring during nighttime hours between 10:00 p.m. and 7:00 a.m.
- **Decibel (dB).** A unitless measure of sound. Decibels use a logarithmic scale that indicates the squared ratio of sound pressure amplitude to a reference sound pressure amplitude. The reference pressure for airborne sound is 20 micropascals.
- **Equivalent sound level (Leq).** Leq represents an average of the sound energy occurring over a specified period. In effect, Leq is the steady-state sound level containing the same acoustical energy as the time-varying sound that actually occurs during the same period. The one-hour A weighted equivalent sound level (Leq(h)) is the energy average of A-weighted sound levels occurring during a one-hour period.
- **Maximum sound levels (Lmax).** The highest instantaneous sound level measured during a specified period.
- **Peak particle velocity (PPV).** A measurement of ground vibration, defined as the maximum speed at which a particle in the ground is moving, expressed in inches per second (in/sec). This is used for analysis of building damage due to groundborne vibration and as a measure of potential annoyance to sensitive receptors due to vibration from construction activities.
- **Vibration decibels (VdB).** Vibration velocity decibel level, expressed as a maximum value for repeated events from the same source. This is commonly used to evaluate vibration annoyance potential from permanent operating sources but is also used for long-term construction.

1.1.1 Regulatory Framework

1.1.1.1 Noise

Noise and vibration from construction equipment is regulated at the local level. The City and County of San Francisco (City) has adopted policies related to noise limits on individual items of construction equipment in Article 29, Sections 2907 and 2908 of the San Francisco Police Code. Additional criteria for analysis of noise and vibration effects on sensitive receptors are obtained from federal and State of California (State) guidance, and the California Building Code. The regulatory framework for noise and vibration is discussed in the sections that follow.

1.1.1.1.1 Federal

Federal Transit Administration Standards for Construction Noise

Construction noise and vibration effects are assessed using analysis methods recommended by the U.S. Department of Transportation for construction of large public works infrastructure projects. The Federal Transit Administration (FTA) has developed methods for evaluating construction noise levels, as described in the *Transit Noise and Vibration Impact Assessment Manual* (2018). Although these methods are not standardized criteria, they are often applied as guidelines for noise limits at sensitive land uses and used to describe noise levels that could result in a negative community reaction.

FTA guidelines for construction noise level criteria are shown in Table 1-1. For residences, the recommended standard noise limits are 90 dBA, hourly equivalent noise level (Leq, 1 hour), during daytime hours (7:00 a.m. to 10:00 p.m.), and 80 dBA Leq, 1 hour during nighttime hours (10:00 p.m. to 7:00 a.m.)

Table 1-1: Federal Transit Administration Criteria for Construction Noise

	1-hour Leq (dBA)	
Land Use	**Day [a]**	**Night [a]**
Residential	90	80
Commercial	100	100
Industrial	100	100

Source: Federal Transit Administration, 2018.
[a] Daytime hours are 7:00 a.m. to 10:00 p.m.; nighttime hours are 10:00 p.m. to 7:00 a.m.
dBA = A-weighted decibel
Leq = equivalent sound level

1.1.1.1.2 State

California Building Code

California Building Code Title 24 establishes minimum noise insulation standards to protect persons within new hotels, motels, dormitories, long-term care facilities, apartment houses, and dwellings other than single-family residences. Under this regulation, interior noise levels attributable to exterior noise sources cannot exceed 45 dBA Ldn in any habitable room.

1.1.1.1.3 Local

San Francisco Noise Ordinance

Construction (Sections 2907 and 2908)

Article 29 of the San Francisco Police Code regulates noise and establishes policies to prohibit excessive or unnecessary noise. Section 2907(a) prohibits any powered construction equipment that exceeds a sound level of 80 dBA, when measured at a distance of 100 feet. Impact tools, such as jackhammers and pavement breakers, are exempt from this requirement, but Section 2907(b) requires that all such equipment be used with manufacturer-approved acoustic shields.

Section 2908 addresses construction work at night. This prohibits construction between 8:00 p.m. and 7:00 a.m. if the resulting noise level would exceed the ambient noise level by 5 dB or more. This restriction can be waived or modified only by special permit issued by the Director of San Francisco Public Works. The decision to approve a permit would consider the potential for disturbance at nearby receptors. Disturbance from nighttime noise is more likely to occur in a neighborhood where there are existing residential receptors because of the potential for sleep disturbance. An approved nighttime construction permit would include conditions regarding the types of equipment to be used, as well as the allowed durations for nighttime use to minimize disturbances in the community. Contractors of development projects would be required to comply with these permit conditions.

Public Works' Standard Construction Measures for Noise

San Francisco Public Works requires all construction contractors to include standard construction measures (SCMs) in bid packages for the purposes of environmental protection. The noise SCM requires all projects to use best available noise control technologies on noise-generating equipment, to locate stationary noise sources away from sensitive receptors, and erect temporary noise barriers where applicable. For nighttime construction activities, additional requirements of the SCM include intake exhaust mufflers or acoustic shields or shrouds for impact tools, avoiding the use of water blasters, and minimizing the use of backup warning alarms.

1.1.1.2 Vibration

Groundborne vibration produced by construction equipment is generally localized around the site of construction activity. Vibration produced at a level high enough to be perceptible inside buildings can result in annoyance and sleep disturbance for occupants of the buildings. Vibration can also result in building or property damage, depending on the level of vibration at the affected structures.

1.1.1.2.1 Federal

FTA criteria regarding vibration annoyance potential from repeated events by the same source of vibration are shown in Table 1-2. Vibration levels for FTA criteria are stated in terms of vibration velocity levels, or VdB. Generally, people are more sensitive to groundborne vibration during nighttime hours when sleeping than during daytime hours.

Table 1-2. Federal Transit Administration Criteria for Groundborne Vibration

	Impact Levels (VdB [a] relative to 1 micro-in/sec)		
Land Use Category	**Frequent Events [b]**	**Occasional Events [c]**	**Infrequent Events [d]**
Category 1: Buildings where vibration would interfere with interior operations	65 [e]	65 [e]	65 [e]
Category 2: Residences and buildings where people normally sleep	72	75	80
Category 3: Institutional land uses with primarily daytime uses	75	78	83

Source: Federal Transit Administration, 2018.
Notes:
[a] VdB, or vibration velocity decibel levels, expresses vibration annoyance potential.
[b] "Frequent events" is defined as more than 70 vibration events from the same source per day.
[c] "Occasional events" is defined as 30 to 70 vibration events from the same source per day.
[d.] "Infrequent events" is defined as fewer than 30 vibration events from the same source per day.
[e] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment, such as optical microscopes. Vibration-sensitive manufacturing or research would require detailed evaluation to define the acceptable vibration levels.
in/sec = inches per second

1.1.1.2.2 State

There are no state regulations related to construction-induced vibration. However, the California Department of Transportation (Caltrans) provides guidance regarding the evaluation of vibration impacts associated with construction activities in its *Transportation and Construction-Induced Vibration Guidance Manual* (Caltrans, 2020). The manual includes prediction methods, assessment procedures, and impact criteria regarding construction vibration. Table 1-3 contains guidelines developed by Caltrans regarding building damage from the transient and continuous vibration that is usually associated with construction activity. The activities that are typically associated with single-impact (transient) or infrequent vibration include blasting and the use of drop balls or dropped metal plates. Impact pile drivers, "pogo stick" compactors (small handheld soil compactors), crack-and-seat equipment (equipment that breaks and re-seats pavement), excavation equipment, static compaction equipment, tracked vehicles, vehicles on highways, vibratory pile drivers, pile extraction equipment, and vibratory compaction equipment are typically associated with continuous vibration.

Table 1-3: Vibration Guidelines for Potential Damage to Structures

	Maximum PPV (in/sec)	
Structure Type and Condition	**Transient Sources**	**Continuous/Frequent Intermittent Sources**
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.2	0.1
Historic and some old buildings	0.5	0.25
Older residential structures	0.5	0.3
New residential structures	1.0	0.5
Modern industrial/commercial buildings	2.0	0.5

Source: California Department of Transportation, 2020.
Notes: Transient sources create a single, isolated vibration event (e.g., from blasting or the use of drop balls). Continuous/frequent intermittent sources include impact pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.
PPV = peak particle velocity; in/sec = inches per second

1.1.2 Existing Condition

1.1.2.1 Existing Noise and Vibration Sources

Noise levels in the area of construction and adjacent areas in all reaches are influenced by traffic, transit vehicles, construction, aircraft, watercraft, industrial, commercial, and other sources associated with a densely populated urban environment. The influence of each of these sources of noise on ambient levels depends on the proximity of receivers to transportation corridors and developed areas.

Ambient noise levels have been measured for previous environmental studies of projects along the Port waterfront. A noise measurement of 75 Ldn was taken in 2018 for the Better Market Street project, located in Reach 2 (San Francisco Planning Department, 2019). For the Pier 70 project, located in Reach 3 (Mission Creek/Mission Bay Reach), noise measurements taken in 2012 and 2015 were in the range of 58 to 68 Ldn, with an average value of 64 Ldn, influenced primarily by traffic, heavy equipment, and ship repair activities (San Francisco Planning Department, 2016). For the Warrior Arena (now known as the Chase Center) environmental study, located in Reach 3 (Mission Creek/Mission Bay Reach), ambient noise levels taken in 2014 were measured at a consistent value of 75 Ldn, due primarily to local traffic (San Francisco Planning Department 2015). Noise measurements were also taken for the Mission Rock development project in 2015, located in Reach 3 (Mission Creek/Mission Bay Reach), where ambient levels around the site were in the range of 64 to 83 Ldn, with an average value of 71 Ldn (San Francisco Planning Department, 2017). Noise levels in this area were influenced by traffic, light rail, construction noise, and noise from baseball games at Oracle Park (formerly AT&T Park). These levels are typical of an urban or a dense urban environment, based on historical measured levels taken in these settings (U.S. Environmental Protection Agency, 1971).

Sources of vibration include heavy trucks and transit vehicles producing vibration from contact between the moving wheel and the surface of the traveled way (rail or road). The levels of vibration associated with these sources are generally perceptible only within short distances, generally less than 100 feet from the source. Pile driving can produce vibration at distances of greater than 100 feet from the source, depending on the method of installation and the size of pile used.

1.1.2.2 Noise- and Vibration-Sensitive Land Uses

Noise- and vibration-sensitive land uses are generally defined as locations where people reside or where the presence of elevated noise could significantly affect use of the land. Typical sensitive land uses include residences, schools, hospitals, places of worship, and hotels. In general, in all reaches, the area surrounding the zones of construction consists of a mix of residential, recreational, commercial, and industrial uses. The area is generally densely populated with multi-family, condominium, and transient lodging uses that face the Port waterfront areas. Outdoor noise-sensitive receptors in the area also include parks, recreational uses, and outdoor dining areas. Outdoor areas are generally not considered to be sensitive to vibration. Figure 1-1 shows the sensitive receptors within and up to 1,000 feet from the zones of construction.

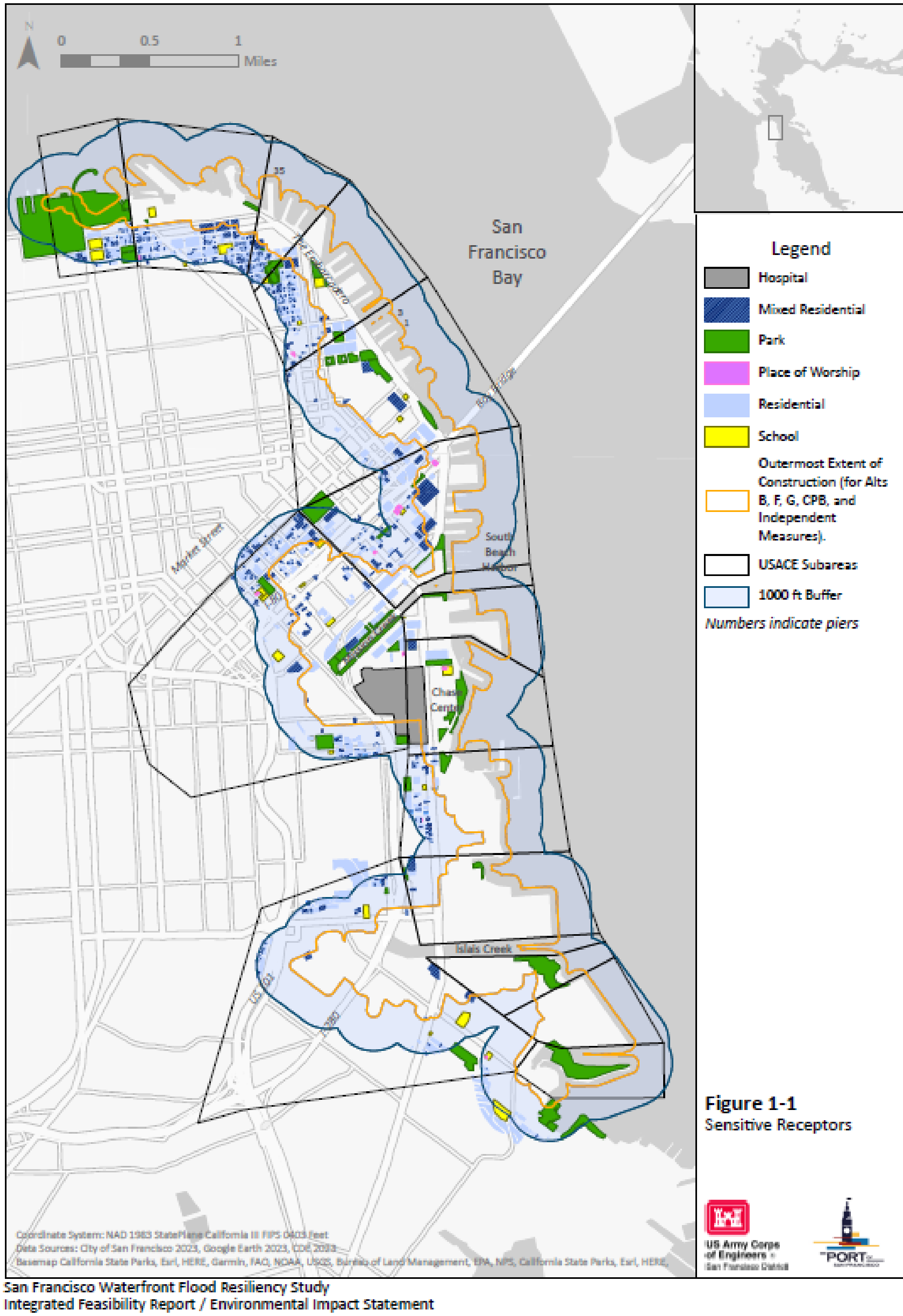

Figure 1-1: Sensitive Receptors within and 1,000 Feet from the Zones of Construction

2.0. Environmental Consequences

2.1 Assessment Method

This section describes the methods used to analyze potential sound levels from heavy equipment during construction of adaptation measures and associated activities. Operation of the project would include the ongoing use of equipment to manage inland flooding and changes and redistribution of traffic on the city road network along the waterfront compared to Future without Project Conditions (FWOP). A doubling of traffic volume would cause the sound level from traffic to increase by 3 dB, which is a perceptible increase in sound level. No impact from traffic is anticipated because none of the alternatives are expected to induce a doubling of traffic volume compared to FWOP. Operation of Alternative F would require pumps for managing water from flooding events, which would be a source of operational noise on a permanent intermittent basis. Pump facilities would be required to be designed to comply with the City noise ordinance and are not a significant source of vibration.

2.1.1 Construction Equipment Noise

The assessment of potential construction noise levels was based on methodology developed by the FTA (2018) and construction noise criteria from applicable local guidance (such as local general plan documents or noise ordinances). Noise levels produced by commonly used construction equipment are shown in Table 2-1. Pile drivers can be expected to generate maximum noise levels of 96 to 117 dBA, depending on the driving method and size of pile. Other types of heavy construction equipment generate maximum noise levels ranging from 80 to 90 dBA at a distance of 50 feet. The construction noise level at a given receiver location depends on the type of construction activity and the distance and shielding between the activity and noise-sensitive receivers.

Table 2-1. Construction Equipment Noise Emission Levels

Equipment	Noise Level (dBA) at 50 Feet	Noise Level (dBA) at 100 Feet
Pile-driver (impact)	101 to 117	95 to 111
Pile-driver (sonic)	96	90
Impact Hammer (Hoe Ram)	90	84
Auger Drill Rig (for drilled piles)	85	79
Heavy Truck	84	78
Excavator	85	79
Bulldozer	85	79
Pump	81	75
Generator	81	75
Mixer	80	74

Equipment	Noise Level (dBA) at 50 Feet	Noise Level (dBA) at 100 Feet
Grader	85	79
Compactor	82	76

Source: Federal Transit Administration, 2018.
dBA = A-weighted decibel.

Construction equipment used would vary by component or construction phase of the alternatives and would involve the use of impact pile drivers (or possibly vibratory pile drivers or drills), excavators, bulldozers, heavy trucks, pumps, generators, graders, compactors, impact hammers, and other heavy equipment. To provide a conservative assessment, this construction noise analysis assumes that piles would be driven using impact methods. However, other methods may be used, such as vibratory or drilling methods, which would result in lower levels of noise levels relative to impact pile-driving. The source levels used to calculate noise exposure are based on the Lmax of equipment emission levels developed by FTA. The Leq value accounts for the energy-average of noise over a specified interval (usually 1 hour). For this analysis it is assumed a given piece of equipment may operate 100 percent of the time.

The analysis assumes that roads along waterfront areas of adaptation would be closed. In general, night work would not be required except for limited cases, such as for continuous concrete pours and ground improvements, which would progress in a linear fashion along the waterfront and are not high-impact activities.

Potential noise levels resulting from construction of the alternatives were evaluated by combining the noise levels of the three loudest pieces of equipment that would most likely operate at the same time (for example, an excavator, a bulldozer, and a truck being operated simultaneously during the site preparation phase) and applying the appropriate usage factor (percent of time equipment is in operation) to each piece of equipment. Sound levels from construction activities are calculated as a function of distance from the source(s), based on point-source attenuation over hard (i.e., acoustically reflective) ground, noting that 6 dB of reduction per doubling of distance can be assumed over hard ground.

2.1.1.1 Construction Equipment Vibration

With regard to potential vibration impacts during construction, such effects were evaluated using the construction vibration modeling methods from guidance by FTA. Worst-case construction vibration levels are provided and compared to FTA criteria for groundborne vibration and Caltrans vibration guidelines for building damage.

To provide a conservative assessment, this construction vibration analysis assumes that piles would be driven using impact methods. However, other methods may be used, such as vibratory or drilling methods, which would result in lower levels of noise levels relative to impact pile driving.

Source vibration levels for different types of construction equipment are shown in Table 2-2.

Table 2-2: Construction Equipment Vibration Levels

Equipment		Peak Particle Velocity (in/sec)			
		25 Feet	50 Feet	75 Feet	100 Feet
Pile Driver (impact)	Upper range	1.518	0.537	0.292	0.190
	Typical	0.644	0.228	0.124	0.081
Pile Driver (vibratory)	Upper range	0.734	0.260	0.141	0.092
	Typical	0.170	0.060	0.033	0.021
Clam Shovel Drop (slurry wall)		0.202	0.071	0.039	0.025
Vibratory Roller		0.210	0.074	0.040	0.026
Hoe Ram		0.089	0.031	0.017	0.011
Bulldozer		0.089	0.031	0.017	0.011
Caisson Drilling		0.089	0.031	0.017	0.011
Drill Rig (excavator mounted)		0.003	0.001	0.001	0.000
Loaded Trucks		0.076	0.027	0.015	0.010
Jackhammer		0.035	0.012	0.007	0.004

Source: Federal Transit Administration, 2018.
in/sec = inches per second.

2.1.2 Basis of Significance

The alternatives would have a significant impact if it would:

- Generate a substantial temporary increase in ambient noise levels in the vicinity of the alternatives in excess of applicable federal, state or local criteria.
- Generate excessive groundborne vibration or groundborne noise levels.

The analysis evaluates noise levels from heavy equipment likely to be used for construction under each of the alternatives. Overall equipment noise levels were calculated for each phase of construction for each alternative. In accordance with FTA construction noise guidance, the noise levels assume simultaneous operation of the three loudest pieces of equipment for a given construction phase relative to receptors at specified distances from the noise source.

The following criteria will be evaluated to determine whether the alternatives would result in a substantial temporary increase in ambient noise.

- Compliance with San Francisco Police Code Section 2907(a), which limits noise from construction equipment to 80 dBA at 100 feet. Impact tools that exceed the limit are required to be fitted with mufflers, acoustical shields, or enclosures. As shown in Table 2-1, except for pile drivers and hoe rams, construction of shoreline adaptation measures would meet the requirements of the city noise ordinance for individual pieces of equipment. The use of multiple pieces of equipment simultaneously on a construction site is evaluated separately, as discussed below.

- Construction phase inventory, schedule and duration for the alternatives are still in development at the time of this analysis. As such the evaluation considers the potential maximum construction noise exposures relative to the extent of construction. If any of the following three criteria are met, the heavy equipment noise from construction of the project would result in a significant impact:
  - Construction noise levels from the simultaneous use of the two loudest pieces of equipment would equal or exceed 90 dBA 1-hour Leq at the nearest sensitive receptor.
  - The simultaneous use of the two loudest pieces of equipment would result in a noise level that would exceed existing ambient levels by more than 10 dBA.
  - Construction during nighttime hours would result in noise levels that would equal or exceed 45 dBA at the interior of the nearest residence, motel, hotel, hospital, or convalescent home. An interior noise level of 45 dBA correlates to an exterior level of 70 dBA, assuming an indoor-to-outdoor noise reduction of at least 25 dBA. Interior noise levels of 45 dBA or lower are generally necessary to prevent sleep disturbance.
- Traffic generated by construction would result in a 3 dBA increase relative to No Action conditions.

Vibration from construction equipment is evaluated using the following criteria:

- Potential for construction-generated vibration to damage nearby buildings according to Caltrans vibration criteria for building damage in Table 1-3.
- Construction-generated vibration could result in sleep disturbance to occupants of nearby buildings. This analysis assumes no high-impact activity, such as pile driving and demolition work would occur during nighttime hours. Concrete pours are generally not a significant source of vibration. As such, sleep disturbance due to vibration is not anticipated under the alternatives, and this effect is not discussed further in the section.
- Construction-generated vibration could result in interference or damage to equipment that is highly sensitive to vibration, such as medical or scientific instruments, according to FTA criteria for Category 1 vibration-sensitive use in Table 1-2. This effect could occur where impact hammer pile driving is performed near buildings containing sensitive equipment but is unlikely to occur during the use of other types of heavy equipment.

2.2 Effects

Construction equipment noise and vibration levels are evaluated in this section for each of the alternatives. Noise impacts can result when people are exposed to noise from construction and demolition equipment, traffic, or operations as related to implementation of the alternatives, where these are perceptible and sufficiently elevated over background or existing noise levels. Vibration can also result from construction equipment and traffic, particularly related to activities such as pile driving, and can cause damage to buildings and disturbance to residents, visitors, and workers.

2.2.1 Construction Impact Summary

Project noise impacts will consist mostly of noise related to construction machinery and construction-related traffic. This section describes the methods used to analyze potential sound levels from heavy equipment during construction of adaptation measures and associated activities.

The construction noise level at a given receiver location depends on the type of construction activity and the distance and shielding between the activity and noise-sensitive receivers, such as residences and schools.

The assessment of potential construction noise levels was based on methodology developed by the FTA (2018) and construction noise criteria from applicable local guidance (such as local general plan documents or noise ordinances). Noise levels produced by commonly used construction equipment are discussed in the previous section 2.1, Assessment Methods.

Construction activities would produce a variety of noise and vibration levels depending on the type of equipment used and distance to sensitive receptors. Impact pile drivers would produce the highest levels of construction noise and vibration and thus would be the most impactful piece of construction equipment. Pile drivers can be expected to generate maximum noise levels of 96 to 117 dBA, depending on the driving method and size of pile. Other types of heavy construction equipment generate maximum noise levels ranging from 80 to 90 dBA at a distance of 50 feet. It is assumed that piles would be installed with use of an impact hammer, though a vibratory hammer may be used where feasible. Pile driving and related equipment would likely be operated from a barge when installing cofferdams or sheetpile and bulkhead walls along the waterfront. Work in locations such as along edges of Mission or Islais Creek could also take place from land. No pile driving would be performed at night. Daytime pile driving would be installed along a linear path, and noise from pile driving would only exceed daytime noise level criterion for intermittent periods for up to a week for a given receptor. Temporary construction vibration from impact pile driving could also result in damage to more fragile historic buildings, according to Caltrans Building Damage Criteria in Table 1-3.

Temporary construction noise and vibration impacts would be minimized by implementing avoidance and minimization measures, such as those described in the mitigation section below. Following construction activities, construction noise and vibration impacts would cease and return to baseline conditions.

2.2.2 Operations and Maintenance Impact Summary

Operations and maintenance includes the ongoing use of equipment to manage inland flooding and changes and redistribution of traffic on the city road network along the waterfront compared to the FWOP. A doubling of traffic volume would cause the sound level from traffic to increase by 3 dB, which is a perceptible increase in sound level. No impact from traffic is anticipated because a doubling of traffic volume compared to the FWOP would not be expected occur.

Operational noise could include noise from operating tidal gates where used, and noise from pump stations that will be established to pump stormwater or combined sewer outflow to the Bay from inland areas. Operation of Alternative F, and depending on flood events, other alternatives as well, would require pumps for managing water from flooding events, which would be a source of operational noise on a permanent intermittent basis. However, pump facilities would be required to be designed to comply with the City noise ordinance and are not a significant source of vibration. Operation impacts would be ***less than significant*** for all alternatives.

2.2.3 Total Benefits Plan

The Total Benefits Plan (TNBP) includes many of the same structural flood defense measures as Alternative G, with the addition of building deployable closure structures along the Mission Creek and Islais Creek bridges (instead of replacing bridges, as under Alternative G), structural raising of existing wharf buildings, demolishing or relocating buildings bayward of the proposed floodwalls, and reconstructing buildings removed from bayward locations. Ground improvements to mitigate seismic risks would be included in both first actions and subsequent actions.

Table 2-3 shows a summary of the noise impacts associated with the TNBP.

Table 2-3: Summary of Noise Impacts Associated with the TNBP

TNBP Noise Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*

Construction/ Footprint (1st Action)	3	3	1	3	3	4	3	3	4	3	3	3	3	1
Construction/Footprint (2nd Action)	3	3	4	1	1	1	3	1	4	3	3	3	3	3
O&M Assumptions	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mitigated Rating	2	2	3	2	2	3	2	2	3	2	2	2	2	2

* Denotes EWN measure.

2.2.3.1 Construction Noise

Sheet-pile wall construction proposed for areas near Pier 80 and Pier 96 would produce the highest noise levels among the types of construction equipment, at a level of 101 dBA for an impact pile driver at a distance of 50 feet, as shown in Table 2-4. A noise level of this magnitude would exceed FTA construction noise criterion of 90 dBA 1-hour Leq at a distance of 175 feet from the pile-driver location. Wharf buildings at South Beach and Fisherman's Wharf would be raised in place and installed on new foundations. Pile drivers and heavy construction equipment would be used to build the new wharf support structures. Pile driving would be performed on an intermittent basis during the day, and, considering that piles would be installed along a linear path, few piles would be within 175 feet of any given receiver, noise from pile driving would only exceed daytime noise level criterion for up to a week.

The reconstruction of The Embarcadero roadway would use trucks, graders, bulldozers, and equipment similar to the types used for other adaptation measures. Equipment noise levels from demolition and construction of adaptation measures would be similar to Alternative G.

Subsequent adaptations would use similar equipment for raising walls and levees and additional ground improvements.

Noise levels anticipated from temporary construction activities under the TNBP are shown in Table 2-4.

Table 2-4: Construction Equipment Noise Levels, TNBP

Construction Activity	Equipment Used [a]	Overall Combined Source Level, dBA 1-hour Leq [b] 50 feet	100 feet	200 feet	400 feet
Demolition	Hoe Ram, Excavator, Heavy Truck	92	86	80	74
Sheet-Pile Wall Construction	Impact Pile Driver, Heavy Truck	101	95	89	83
Levee, Bridge and Wall Construction, Relocated buildings, Ground improvements, Roadway Reconstruction	Heavy Truck, Bulldozer, Grader	89	83	77	71

[a] The two or three loudest items of equipment that may operate in one location simultaneously.
[b] Distance calculations do not include the effects, if any, of local shielding from walls, topography or other barriers, which may further reduce sound levels.
Leq = equivalent sound level; dBA = A-weighted decibel.

As shown in Figure 1-1, the construction extent overlaps and adjoins several areas of residential, mixed-residential, school, and park use. Construction of sheet-pile walls and demolition activities under the TNBP could produce noise 10 dBA or greater above ambient levels, while also exceeding FTA criterion of 90 dBA 1-hour Leq at the nearest noise-sensitive receptors, which would be up to 175 feet away from the extent of construction. With implementation of AMM-NOI-1, temporary noise impacts under the TNBP would be ***less than significant***.

2.2.3.2 Construction Vibration

Construction of the TNBP would involve impact pile drivers, but the intensity of sound levels during periods of pile driving would be less under the TNBP compared to Alternative F which has a greater amount of pile driving. Structures within 100 feet of pile-driving activity could be exposed to vibration levels of 0.19 inch per second PPV or greater, as shown in Table 2-2. Temporary construction vibration of this magnitude could result in damage to more fragile historic buildings, according to Caltrans Building Damage Criteria in Table 1-3. Vibration levels may exceed the FTA criterion of 65 VdB for vibration sensitive use up to 500 feet away from pile-driving sites.

Heavy equipment types, such as jackhammers or hoe rams, used for demolition under the TNBP would create a perceptible level of vibration, but only in the immediate vicinity of the equipment. Generally, vibration from these types of equipment is not perceptible more than 50 feet from the source. Therefore, sheet-pile wall construction and demolition activities under the TNBP could exceed Caltrans vibration criteria for building damage, and/or FTA criteria for construction vibration for any buildings containing sensitive equipment located within 500 feet of pile driving. With implementation of AMM-

NOI-2, temporary construction vibration impacts under the TNBP would be ***less than significant***.

2.2.4 Alternative A: No Action

Under Alternative A, no actions would be taken to reduce flood risks beyond projects already approved along the San Francisco waterfront. The increased risk of coastal flooding increases the potential for damage to public and private properties, disruptions to utilities, interruptions to transportation services, and road closures.

2.2.4.1 Construction Noise

A flooding event would require the use of a considerable amount of heavy equipment for emergency flood-fighting and cleanup actions, commensurate with the size of the flood. The presence of heavy equipment and associated transportation would generate noise in the areas they are protecting. Buildings and infrastructure damaged by flooding would need to be demolished and the services provided would need to be relocated to other areas of the city, requiring new construction. Demolition would require the use of heavy equipment such as wrecking balls, jackhammers, hoe rams, heavy trucks, excavators, and bulldozers.

Alternative A could involve use of a considerable amount of heavy trucks and earthmoving equipment to respond to flooding events. These activities would be reactive to flooding events as they occur. Construction of new buildings and infrastructure would increase within inland areas of the City to replace assets and property lost to flooding events. The frequency and duration of these activities would be commensurate with flooding events; however, the use of heavy equipment for flood fighting on an emergency basis would very likely be substantial and could be any hour of the day or night. As such, there is a high potential for sleep interference due to emergency flood-fighting activities.

The relocation and redevelopment of residences, businesses, and other uses in other areas of the city with unrecoverable flood damage would involve all phases of building construction, including demolition, grading, building construction, and paving. Equipment noise from redevelopment could occur at any scale or location within the city and, as such, impacts of construction noise would be expected, but effects on specific receptors are too speculative at this time. Accordingly, the intensity of construction noise generated under Alternative A cannot be predicted or quantified without speculating on future events. Therefore, the impact would be ***too speculative for meaningful consideration***.

2.2.4.2 Construction Vibration

Heavy equipment types used for responses to substantial flooding and demolition under Alternative A would create a perceptible level of vibration in the immediate vicinity of the equipment. It is unlikely that high-impact equipment, such as pile drivers, would be used for these types of activities, although jackhammers and hoe rams may be used for demolition. The relocation of services and properties to as yet unknown areas would use heavy equipment that may potentially produce vibration near sensitive receptors and historic buildings that are more susceptible to building damage. The frequency and duration of these activities would be commensurate with flooding events, which could occur on an emergency basis within residential areas with a high risk or flooding.

Relocation of buildings to other areas of the city would involve the use of heavy equipment for site preparation, grading, building construction and paving. In situations where deep support systems are needed for building foundations, vibratory or impact pile driving may be used. Because potential sites for future development are not known, effects on specific receptors are too speculative at this time.

Demolition and reconstruction activities under Alternative A could potentially exceed Caltrans vibration criteria for building damage listed in Table 1-3, and/or FTA criteria for construction vibration in listed Table 1-2, in situations where heavy equipment is operated within 50 feet of existing buildings. The intensity of construction vibration generated under Alternative A cannot be predicted or quantified without speculating on future events. Therefore, the impact would be ***too speculative for meaningful consideration*****.**

2.2.5 Alternative B: Nonstructural

Alternative B involves a combination of dry floodproofing of certain buildings, relocation of buildings and assets, and a planned retreat from areas susceptible to frequent flood events. There would be no structural changes to the shoreline for the purpose of managing flooding events, apart from currently approved projects.

2.2.5.1 Construction Noise

Land uses in areas where there is a higher risk of flooding would be managed for retreat and relocation to inland areas of the city or region. The managed retreat would require demolition of some buildings and infrastructure in areas where natural flooding would be allowed under Alternative B. Demolition would require the use of heavy equipment, such as wrecking balls, jackhammers, hoe rams, heavy trucks, excavators, and bulldozers. The buildings and infrastructure in areas of retreat would be relocated inland or be modified. Building of transportation and transit causeways may be done for some transportation systems to raise the elevation of highways or railways above flooding levels.

Policy changes would be required to allow for redevelopment at higher densities in other areas of the City. Redevelopment would involve all phases of building construction, including demolition, grading, building construction, and paving. Depending on policy choices, equipment noise from redevelopment could theoretically occur at any scale or location within the city and, as such, the effects of noise and vibration would be expected, but effects on specific receptors are too speculative at this time.

Dry floodproofing of individual buildings would involve material delivery and use of light-duty construction equipment. These activities would generally be short term (i.e., less than a month for an individual building) and would require little or no use of heavy-duty equipment.

Noise levels from construction activities under Alternative B are shown in Table 2-5.

Table 2-5: Construction Equipment Noise Levels, Alternative B

		Overall Combined Source Level, dBA 1-hour Leq [b]			
Construction Activity	**Equipment Used [a]**	**50 feet**	**100 feet**	**200 feet**	**400 feet**
Demolition	Hoe Ram, Excavator, Heavy Truck	92	86	80	74
Site Preparation (for redevelopment projects)	Heavy Truck, Bulldozer, Grader	89	83	77	71
Building Construction (for redevelopment projects)	Crane, Loader	85	79	73	67
Paving (for redevelopment projects)	Roller, Loader	86	80	74	68

Note: Distance calculation do not include the effects, if any, of local shielding from walls, topography or other barriers which may further reduce sound levels.
[a] The two or three loudest items of equipment that may operate in one location simultaneously.
[b] Distance calculations do not include the effects, if any, of local shielding from walls, topography or other barriers, which may further reduce sound levels.
Leq = equivalent sound level; dBA = A-weighted decibel.

Demolition and reconstruction activities under Alternative B could exceed FTA criteria (i.e., 90 dBA 1-hour Leq) at the nearest noise-sensitive receptor or result in an increase of 10 dBA or more above the ambient noise level at receptors up to 60 feet away from construction areas. With implementation of AMM NOI-1, noise impacts under Alternative B would be ***less than significant***.

2.2.5.2 Construction Vibration

Heavy equipment types, such as jackhammers or hoe rams, used for demolition under Alternative B would create a perceptible level of vibration in the immediate vicinity of the equipment. Because the retreat would be managed and would involve groups of buildings within areas of flooding, vibration effects would generally only be a concern where there are historic buildings directly adjacent to areas of demolition.

Demolition and reconstruction activities under Alternative B could exceed Caltrans vibration criteria for building damage listed in Table 1-3, and/or FTA criteria for construction vibration listed in Table 1-2. With implementation of AMM-NOI-2, vibration impacts under Alternative B would be ***less than significant***.

2.2.6 Alternative F: Manage the Water, Scaled for Higher Risk

Flood-protection measures under Alternative F include tide gates in Mission Creek and Islais Creek to manage sea-level rise and seawalls and bay fill along the northern waterfront, levees, and walls. Measures would be adaptable to additional sea-level rise in 2090.

Table 2-6 shows a summary of the noise impacts associated with Alternative F.

Table 2-6: Summary of Noise Impacts Associated with Alternative F

Alternative F Noise Impact Rating by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	3	3	4	3	4	3	3	3	3	3	3
O&M Assumptions	1	1	1	1	1	1	1	1	1	1	1
Mitigated Rating	2	2	3	2	3	2	2	2	2	2	2

* Denotes EWN measure.

2.2.6.1 Construction Noise

For this alternative, fill would be placed in the Bay and extensive seawalls would be constructed along the northern waterfront for approximately 2.5 miles. Piles would be 66 inches in diameter, with 18-inch closure piles. The impact hammer force required to drive piles of this size would be substantial, and as such, noise levels from pile driving could be as high as 117 dBA at residential receptors 50 feet from the pile hammer equipment. A noise level of this magnitude would exceed FTA construction noise criterion of 90 dBA 1-hour Leq at a distance of 1,100 feet from the pile driver location.

The building of tide gates would require pile driving for installation of temporary cofferdams for in-water work. The gate structures would be built using cast-in-place methods.

Flood protection would be provided by cast-in-place walls and levees. The construction of levees and walls would require demolition of pavement and parking areas. Heavy trucks would deliver fill and material, and mixer trucks would be used to pour concrete for walls and fill areas. The levees would be paved once constructed. Alternative F would also include engineering with nature (EWN) features along the shoreline to provide ecological armoring. These measures would primarily use light-duty construction equipment, with occasional use of heavy trucks for deliveries. A crane operated from a barge may be used for placement of riprap and other materials along the shoreline.

Flood control measures would be designed to be adaptable to future sea level change events. Subsequent adaptations would use similar equipment for raising walls and levees and additional ground improvements.

Noise levels from construction activities under Alternative F are shown in Table 2-7.

Table 2-7: Construction Equipment Noise Levels, Alternative F

		Overall Combined Source Level, dBA 1-hour Leq [b]			
Construction Activity	**Equipment Used [a]**	**50 feet**	**100 feet**	**200 feet**	**400 feet**
Demolition	Hoe Ram, Excavator, Heavy Truck	92	86	80	74
Pile Driving for Seawall and bulkheads	Impact Pile Driver (66-inch piles), Heavy Trucks	117	111	105	99
Pile Driving for tide gate cofferdams	Impact Pile Driver	101	95	89	83
Levee, Shoreline extension, Ground Improvement, Bridge and Wall Construction, EWN features	Heavy Truck, Bulldozer, Grader	89	83	77	71

[a] The two or three loudest items of equipment that may operate in one location simultaneously.
[b] Distance calculations do not include the effects, if any, of local shielding from walls, topography or other barriers, which may further reduce sound levels.
Leq = equivalent sound level; dBA = A-weighted decibel.

As shown in Figure 1-1, the construction extent overlaps and adjoins several areas of residential, mixed-residential, school, and park use. Demolition activities under Alternative F could produce noise 10 dBA or greater above ambient levels while also exceeding FTA criterion of 90 dBA 1-hour Leq at the nearest noise-sensitive receptors, which would be up to 60 feet away from the extent of construction. Impact pile driving may exceed these levels up to 1,100 feet away from pile-driving sites. Implementation of AMM-NOI-1 would reduce noise levels from construction, but the magnitude of pile driving noise during construction of the seawall would be difficult to mitigate and would likely be disruptive to daytime activities in the area. As such, noise impacts under Alternative F would be ***significant and unavoidable***.

2.2.6.2 Construction Vibration

Construction of Alternative F would require impact pile drivers for construction of the seawall along the northern waterfront. Due to the size of the piles and the force required for driving, structures within 100 feet of pile-driving activity could be exposed to vibration levels higher than the upper range of values shown in Table 2-2. Due to the proximity of existing structures, vibration during pile driving of the seawall could result in damage to buildings along the waterfront, according to Caltrans Building Damage Criteria listed in Table 1-3. Vibration levels may exceed the FTA criterion of 65 VdB for vibration sensitive use up to 1,000 feet away from pile-driving sites.

Heavy equipment types, such as jackhammers or hoe rams, used for demolition under Alternative F would create a perceptible level of vibration, but only in the immediate vicinity of the equipment. Generally, vibration from these types of equipment is not perceptible more than 50 feet from the source.

Therefore, pile-driving and demolition activities under Alternative F could exceed Caltrans vibration criteria for building damage, and/or FTA criteria for construction vibration for any buildings containing sensitive equipment located within 1,000 feet of pile driving. Because of the size of piles that would be used, the potential effects on historic buildings and vibration sensitive uses would be greater than the other alternatives and would require a great high degree of site-specific planning to mitigate vibration effects. Implementation of AMM-NOI-2 may not be sufficient to mitigate effects of vibration. Due to uncertainty of vibration effects from piles along the northern waterfront, vibration impacts under Alternative F would be ***significant and unavoidable***.

2.2.7 Alternative G: Partial Retreat, Scaled for Higher Risk

Alternative G includes structural floodproofing measures that would adapt the shoreline to natural flooding in the city. This would include building levees or walls in some areas and demolishing or relocating buildings, transportation systems, and assets that lie within areas of natural flooding.

Table 2-8 shows a summary of the anticipated noise impacts associated with Alternative G.

Table 2-8. Summary of Noise Impacts Associated with Alternative G

Alternative G Noise Impact Rating by Measure	Levee	Bridge raise	Bulkhead wall/Seawall	Roadway Impact	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint	3	3	3	3	3	3	3	3	3	3	3	3
O&M Assumptions	1	1	1	1	1	1	1	1	1	1	1	1
Mitigated Rating	2	2	2	2	2	2	2	2	2	2	2	2

* Denotes EWN measure.

2.2.7.1 Construction Noise

Under Alternative G, levees would be constructed for fortification against flooding risk. This would require demolition of pavement and parking areas. Trucks would deliver fill and concrete; once constructed, the levee would be paved. Bridges over Islais Creek would be raised, which would require demolition of existing bridges and building of truss bridges at a higher elevation to adapt to sea level change. Additional walls and T-walls would be built using cast-in-place techniques. Heavy trucks would deliver fill and material, and mixer trucks would be used to pour concrete for walls and fill areas. Roadways would be reconstructed to conform to revised elevation changes landward of new walls. Concrete work and ground improvements would need to be done continuously for some features; therefore, the need for night work is likely.

The building of EWN shoreline adaptation measures would be similar to Alternative F.

Land uses in areas where there is a higher risk of flooding would be managed for retreat and relocation to inland areas of the city. The managed retreat would require demolition or relocation of existing buildings and infrastructure in areas where natural flooding would be allowed under Alternative G. Demolition would require the use of heavy equipment, such as wrecking balls, jackhammers, hoe rams, heavy trucks, excavators, and bulldozers. Buildings demolished within areas of flooding would be reconstructed in new inland locations. Building of transportation and transit causeways may be done for some transportation systems to raise the elevation of highways or railways above flooding levels.

Policy changes would be required to allow for redevelopment at higher densities in other areas of the city. Redevelopment would involve all phases of building construction, including demolition, grading, building construction, and paving. Depending on policy choices, equipment noise from redevelopment could occur at any scale or location within the city, and as such, the effects of noise and vibration would be expected, but effects on specific receptors are too speculative at this time.

Noise levels from construction activities under Alternative G are shown in Table 2-9.

Table 2-9: Construction Equipment Noise Levels, Alternative G

Construction Activity	Equipment Used [a]	Overall Combined Source Level, dBA 1-hour Leq [b] 50 feet	100 feet	200 feet	400 feet
Demolition	Hoe Ram, Excavator, Heavy Truck	92	86	80	74
Levee, Bridge and Wall Construction, Ground Improvement	Heavy Truck, Bulldozer, Grader	89	83	77	71
Site Preparation (for redevelopment projects)	Heavy Truck, Bulldozer, Grader	89	83	77	71
Building Construction (for redevelopment projects)	Crane, Loader	85	79	73	67
Paving (for redevelopment projects)	Roller, Loader	86	80	74	68

[a] The two or three loudest items of equipment that may operate in one location simultaneously.
[b] Distance calculations do not include the effects, if any, of local shielding from walls, topography or other barriers, which may further reduce sound levels.
Leq = equivalent sound level; dBA = A-weighted decibel.

As shown in Figure 1-1, the construction extent overlaps and adjoins several areas of residential, mixed-residential, school, and park use. Construction and demolition activities under Alternative G could produce noise 10 dBA or greater above ambient levels while also exceeding FTA criterion of 90 dBA 1-hour Leq at the nearest noise-sensitive receptors, which would be up to 60 feet away from the extent of construction.

With implementation of AMM-NOI-1, noise impacts under Alternative G would be ***less than significant***.

2.2.7.2 Construction Vibration

Heavy equipment types, such as jackhammers or hoe rams, used for demolition under Alternative G would create a perceptible level of vibration in the immediate vicinity of the equipment. Because the retreat would be managed and would involve groups of buildings in areas of flooding, vibration effects would generally only be a concern where there are historic buildings directly adjacent to areas of demolition.

Reconstruction of the buildings that were demolished within areas of flooding would involve the use of heavy equipment for site preparation, grading, building construction, and paving. In situations where deep support systems are needed for building foundations, vibratory or impact pile driving may be used. Because potential sites for future development are not known, effects on specific receptors are too speculative at this time, but considering the high densities of existing development throughout the City, vibration from construction equipment in areas of reconstruction could result in building damage based on Caltrans criteria listed in Table 1-3: Vibration Guidelines for Potential Damage to Structures.

Demolition and reconstruction activities under Alternative G could exceed Caltrans vibration criteria for building damage listed in Table 1-3: Vibration Guidelines for Potential Damage to Structures, and/or FTA criteria for construction vibration listed in Table 1-2. Federal Transit Administration Criteria for Groundborne Vibration, in situations where heavy equipment is operated within 50 feet of existing buildings. With implementation of AMM-NOI-2, vibration impacts under Alternative G would be ***less than significant***.

2.2.8 Independent Measures for Consideration

Table 2-10 shows a summary of the anticipated noise impacts associated with the independent measures.

Table 2-10: Summary of Noise Impacts Associated with the Independent Measures

Independent Measures Noise Impact Rating	2A	2B	3A	3B	3C	4A	Vertical Shoreline*
Construction/Footprint	3	3	4	3	3	3	3
O&M Assumptions	1	1	1	1	1	1	1
Mitigated Rating	2	2	3	2	2	2	2

* Denotes EWN measure.

2.2.8.1 Construction Noise

2.2.8.1.1 2A. Robust Coastal Defense of Ferry Building and Agriculture Building

This measure would use equipment similar to construction of levees and ground improvement measures under Alternative G. Construction could produce noise 10 dBA or greater above ambient levels while also exceeding FTA criterion of 90 dBA 1-hour

Leq up to 60 feet away from the extent of construction. With implementation of AMM-NOI-1, noise impacts from this activity would be ***less than significant***.

2.2.8.1.2 2B. Coarse Beach at Rincon Park

Noise levels from equipment would be similar to the Living Seawall. With implementation of AMM-NOI-1, noise impacts from this activity would be ***less than significant***.

2.2.8.1.3 3A. Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves

Rebuilt wharves may require pile driving as described for the TNBP. Pile driving could produce noise 10 dBA or greater above ambient levels while also exceeding FTA criterion of 90 dBA 1-hour Leq at the nearest noise-sensitive receptors up to 175 feet away from the extent of construction. Noise levels from equipment for other features would be similar to road reconstruction under Alternative G. With implementation of AMM-NOI-1, noise impacts from this activity would be ***less than significant***.

2.2.8.1.4 3B. McCovey Cove North Curb Extension

This measure would use equipment similar to construction of levees and ground improvement measures for Robust Coastal Defense of Ferry Building and Agriculture Building. With implementation of AMM-NOI-1, noise impacts from this activity would be ***less than significant***.

2.2.8.1.5 3C. Planted Levee on Mission Bay

This measure would use equipment similar to the Living Seawall. With implementation of AMM-NOI-1, noise impacts from this activity would be ***less than significant***.

2.2.8.1.6 4A. Inland Coastal Flood Defense at Southwest Islais Creek

This measure would involve demolishing buildings in order to adapt areas of surrender to inland flooding, similar to Alternative G. Demolition could produce noise 10 dBA or greater above ambient levels while also exceeding FTA criterion of 90 dBA 1-hour Leq up to 60 feet away from the extent of construction. With implementation of AMM-NOI-1, noise impacts from this activity would be ***less than significant***.

2.2.8.1.7 Living Seawall

Construction equipment would be similar to EWN measures described under Alternative F and would primarily use light-duty construction equipment, with occasional use of heavy trucks for deliveries, and pile driving for the cofferdams assumed needed to construct the walls. A crane operated from a barge may be used for placement of building materials along the shoreline. Construction could produce noise 10 dBA or greater above ambient levels while also exceeding FTA criterion of 90 dBA 1-hour Leq up to 60 feet away from the extent of construction. With implementation of AMM-NOI-1, noise impacts from this activity would be ***less than significant.***

2.2.8.2 Construction Vibration

2.2.8.2.1 2A. Robust Coastal Defense of Ferry Building and Agriculture Building

Construction of this measure would be similar to the levees and ground improvement measures under Alternative G. Vibration effects from the demolition and reconstruction activities under Alternative G could exceed Caltrans vibration criteria for building damage listed in Table 1-3, and/or FTA criteria for construction vibration listed in Table 1-2, in situations where heavy equipment is operated within 50 feet of existing buildings. With implementation of AMM-NOI-2, vibration impacts would be ***less than significant***.

2.2.8.2.2 2B. Coarse Beach at Rincon Park

Vibration under this measure would be similar to Living Seawall. With implementation of AMM-NOI-2, vibration impacts would be ***less than significant***.

2.2.8.2.3 3A. Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves

Rebuilt wharves under this measure may require pile driving as described for the TNBP. Structures within 100 feet of pile-driving activity could be exposed to vibration levels of 0.2 inch per second PPV or greater, as shown in Table 2-2. Vibration of this magnitude could result in damage to more fragile historic buildings, according to Caltrans Building Damage Criteria in Table 1-3. Vibration levels may exceed the FTA criterion of 65 VdB for vibration sensitive use up to 500 feet away from pile-driving sites. However, with implementation of AMM-NOI-2, vibration impacts would be ***less than significant***.

2.2.8.2.4 3B. McCovey Cove North Curb Extension

Construction of this measure would be similar to the levees and ground improvement measures under Robust Coastal Defense of Ferry Building and Agriculture Building. With implementation of AMM-NOI-2, vibration impacts would be ***less than significant***.

2.2.8.2.5 3C. Planted Levee on Mission Bay

Vibration under this measure would be similar to Living Seawall. With implementation of AMM-NOI-2, vibration impacts would be ***less than significant***.

2.2.8.2.6 4A. Inland Coastal Flood Defense at Southwest Islais Creek

This measure would involve needed demolition of buildings in order to adapt to inland flooding. Demolition could exceed Caltrans vibration criteria for building damage listed in Table 1-3, and/or FTA criteria for construction vibration listed in Table 1-2, in situations where heavy equipment is operated within 50 feet of existing buildings. With implementation of AMM-NOI-2, vibration impacts would be ***less than significant***.

2.2.8.2.7 Living Seawall

Construction of this measure would be similar to EWN features described under Alternative F and could include pile-driving for installation of cofferdams. Vibration effects from demolition and reconstruction activities could exceed Caltrans vibration criteria for building damage listed in Table 1-3, and/or FTA criteria for construction vibration listed in Table 1-2, in situations where heavy equipment is operated within 50 feet of existing buildings. With implementation of AMM-NOI-2, vibration impacts would be ***less than significant***.

2.3 Mitigation

While construction activities associated with Alternative A cannot be defined and noise and vibration impacts are too speculative for meaningful evaluation, the following measures are available to reduce noise and vibration under Alternative A, as necessary.

For the rest of the alternatives and independent measures, the following AMMs can be implemented to reduce impacts due to construction noise and vibration.

AMM-NOI-1 Use Best Noise Control Practices during Construction.

The U.S. Army Corps of Engineers will prepare a noise control plan that will specify methods the contractor will implement to minimize construction equipment noise levels at sensitive receivers. Additional analysis on construction phasing, duration, and the location of measures will inform a site-specific evaluation of the noise control measures most appropriate for implementation.

Best practices to minimize construction noise include the following.

- Limiting heavy equipment use to daytime hours not regulated by the City, between 7:00 a.m. and 8:00 p.m.
  - Limiting pile driving to times of day that would be least disruptive to residences, hotels, motels, hospitals, or convalescent homes.
- Locating stationary equipment (e.g., generators, pumps, cement mixers, idling trucks) as far as possible from noise-sensitive land uses.
- Requiring that all construction equipment powered by gasoline or diesel engines have sound-control devices, such as exhaust mufflers, that are at least as effective

as those originally provided by the manufacturer and that all equipment be operated and maintained to minimize noise generation.

- Using equipment powered by electric motors instead of gasoline- or diesel-powered engines.
- Preventing excessive noise by shutting down idle vehicles or equipment.
- Using noise-reducing enclosures around noise-generating equipment.
- Using noise-reducing shrouds for impact pile drivers, where feasible.
- Selecting haul routes that affect the fewest number of people.
- Constructing barriers between noise sources and noise-sensitive land uses or taking advantage of existing barrier features (e.g., terrain, structures) to block sound transmission to noise-sensitive land uses. The barriers should be designed to obstruct the line of sight between the noise-sensitive land use and on-site construction equipment.
- Notifying adjacent residents in advance of construction work.

AMM-NOI-2 Vibration Control

Prior to construction, the construction contractor will designate a community liaison to respond to complaints about vibration caused by construction of adaptation measures. Through the community liaison, the contractor will provide notification to all property owners and occupants of buildings within 200 feet of pile-driving locations at least 10 days prior to the start of construction informing them of the estimated start date and duration of vibration-generating construction activities. These notifications will also be provided to buildings containing vibration sensitive equipment within 800 feet of pile-driving locations.

Measures to reduce groundborne vibration from pile driving include:

- Using smaller, lower vibration generating equipment within 100 feet of potentially affected buildings.
- Using alternative pile-driving methods such as vibratory hammers, hydraulic press-in driving, or use of predrilled pile holes.
- Preparing a pile driving schedule that includes driving method(s), locations, pile types, sizes, number of blows and times of day that driving would be done.
- Conducting vibration monitoring at potentially affected buildings to measure levels from vibration-producing activities.
    - Prepare a building conditions report prior to and after construction for potentially affected buildings. If new cracks or damages are found, the construction contractor will remediate building damages found to occur during construction.

- Coordinating with managers of buildings containing sensitive equipment to determine actions for avoiding impacts on vibration-sensitive equipment, based on specifications of equipment and hourly/daily schedule of use.

2.4 Cumulative and Other Impacts

2.4.1 Noise

Construction activities under the alternatives could coincide with construction activities associated with cumulative projects, resulting in a combined increase in construction noise. In general, the potential for projects to overlap, resulting in combined or prolonged increases in ambient noise, is more likely when the construction noise influence areas of two or more projects overlap. As such, the cumulative noise from simultaneous construction activity in proximity to one another could result in higher noise levels than would otherwise occur with one project under construction. Construction of multiple projects consecutively could increase the duration of construction noise levels that would be 10 dBA above the ambient noise level or 90 dBA at sensitive receptors. Given that the adaptations constructed under the alternatives would occur along the shoreline in the vicinity of Embarcadero Early Projects and other ongoing construction, the alternatives would make a considerable contribution to the significant cumulative construction noise impact. Implementation of AMM-NOI-1 would reduce this impact to a ***less-than-significant*** level.

2.4.2 Vibration

Because of the highly localized nature of vibration from heavy equipment, vibration from two projects near one another would generally not combine to further increase vibration levels. Therefore, vibration from the alternatives would not combine with vibration from cumulative projects. This cumulative impact would be ***less than significant***.

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SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY, CA

DRAFT APPENDIX D-1-3 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

JANUARY 2024

USACE TULSA DISTRICT | THE PORT OF SAN FRANCISCO

US Army Corps of Engineers

PORT OF SAN FRANCISCO

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Acronyms and Abbreviations

Acronym	Definition
ADA	Americans with Disabilities Act
AMM	avoidance and minimization measures
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
City	City and County of San Francisco
EIS	Environmental Impact Statement
EO	Executive Order
EWN	Engineering With Nature
FWOP	Future without Project Conditions
GIS	geographic information system
LOD	line of defense
NEPA	National Environmental Policy Act
OSE Report	Other Social Effects Report
Port	Port of San Francisco
Public Works	City and San Francisco Public Works
SFMTA	San Francisco Municipal Transportation Agency
SoMa	South of Market
TPB	Total Benefits Plan
U.S.C.	United States Code
Uniform Act	Uniform Relocation Assistance and Real Property Acquisition Policies Act
USACE	U.S. Army Corps of Engineers

1.0 Affected Environment

1.1 Regulatory Framework

- Title VI of the Civil Rights Act - Title VI of the Civil Rights Act of 1964 (42 United States Code [U.S.C.] § 2000(d) et seq.) prohibits discrimination on the basis of race, color, and national origin in programs and activities receiving federal financial assistance. Under Title VI, each federal agency is required to make sure that no person, on the grounds of race, color, or national origin, is excluded from participation in, denied the benefits of, or subjected to discrimination under any program or activity receiving federal financial assistance.
- Executive Order 12898 - Signed by President Clinton in 1994, Executive Order (EO) 12898 established a directive for addressing the environmental justice impacts of federal actions. Environmental justice refers to the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. In addition, EO 12898 directs federal agencies (or their designees) to take the appropriate and necessary steps to identify and address disproportionately high and adverse effects of federal projects on the health or environment of minority and low-income populations to the greatest extent practicable and permitted by law.
- Biden-Harris Administration Executive Orders:
    - The current administration signed the following EOs that strengthen EO 12898.
    - EO 13985, January 20, 2021, (Advancing Racial Equity and Support for Underserved Communities Through the Federal Government. On his first day in office, President Biden signed EO 13985 that emphasized the human costs of systemic racism and persistent poverty and provided a mandate for all federal agencies to launch a whole-of-government approach to equity (White House, 2023).
    - EO 13990, January 20, 2021, Protecting Public Health and the Environment and Restoring Science To Tackle the Climate Crisis. This order declared the Administration’s policy to listen to the science; to improve public health and protect the environment; to ensure access to clean air and water; to reduce greenhouse gas emissions; to bolster resilience to the impacts of climate change; and to prioritize both environmental justice and the creation of well-paying union jobs. It directed Federal agencies to immediately review and take action to

address the promulgation of Federal regulations and other actions during the last 4 years that conflict with these national objectives and to immediately commence work to confront the climate crisis.

- EO 14008, January 27, 2021, Tackling the Climate Crisis at Home and Abroad, declares the Administration’s policy to move quickly to build resilience, both at home and abroad, against the impacts of climate change.
- EO 14052, November 15, 2021, Implementation of the Infrastructure Investment and Jobs Act, includes a task force structure to support the implementation of the Infrastructure Investment and Jobs Act (White House 2021a).[1]
- EO 14057, December 8, 2021,Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability, sets out a range of goals to deliver a federal emissions reduction pathway consistent with President Biden's goal of reducing U.S. greenhouse gas emission by 50–52 percent from 2005 levels by 2030 and limiting global warming to 1.5 degrees Celsius (White House, 2021b).
- EO 14082, September 12, 2022, Implementation of the Energy and Infrastructure Provisions of the Inflation Reduction Act of 2022, expanded the task force identified in EO 14052 (White House, 2022).
- EO 14091 of February 16, 2023, Further Advancing Racial Equity and Support for Underserved Communities Through the Federal Government, reaffirms the Administration’s commitment to deliver equity (White House, 2022). In doing so it also calls annual public Equity Action Plans to assess and include actions to address the barriers in underserved communities within each agency (White House, 2023).
- EO 14096, April 21, 2023, Revitalizing Our Nation’s Commitment to Environmental Justice for All. This order establishes a new Office of Environmental Justice within the White House to coordinate efforts across the government and requires federal agencies to notify communities if toxic substances are released from a federal facility. The newest EO lays out further requirements surrounding an environmental justice analysis, which should be pre-released in the Council on Environmental Quality (CEQ) Phase 2 National Environmental Policy Act (NEPA) regulations expected to be released soon.

[1] Note that as of 2022 the CEQ has developed their Climate and Economic Justice Screening Tool, as part of EO 14008, which identifies communities that are disadvantaged because they are overburdened and underserved (EPA, 2023a).

- Americans with Disabilities Act of 1990 - The Americans with Disabilities Act of 1990 extends the protection of the Civil Rights Act of 1964 to the disabled, prohibiting discrimination in public accommodations, transportation, or other services.
- Improving Access to Services for Persons with Limited English Proficiency (EO 13166) - EO 13166 requires each federal agency to ensure that recipients of federal financial assistance provide meaningful access to their programs and activities by limited English proficiency applicants and beneficiaries. Meaningful access can include availability of vital documents, printed and internet-based information in one or more languages, depending on the location of the project, and translation services during public meetings.
- Protection of Children from Environmental Health Risks and Safety Risks (EO 13045) - EO 13045 requires federal agencies to minimize environmental health and safety risks to children and to prioritize the identification and assessment of environmental health and safety risks that may have a disproportionate impact on children.
- Americans with Disabilities Act (42 U.S.C. §§ 12101–12213) - The Americans with Disabilities Act (ADA) (42 U.S.C. §§ 12101–12213) prohibits discrimination against persons with disability and requires equal opportunity in employment, state and local government services, public accommodations, commercial facilities, and transportation.
- Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 U.S.C. § 61) - The Uniform Relocation Assistance and Real Property Acquisition Policies Act (Uniform Act) requires that persons displaced as a result of a federal action or undertaking involving federal funds must be treated fairly, consistently, and equitably. The Uniform Act outlines a process to provide displaced persons fair and just compensation for any acquisition of property taken for the project. The Uniform Act also requires relocation assistance and benefits to displaced persons.

1.2 Existing Condition

1.2.1 Study Area

The reference community is the area that represents the general population that could be affected adversely or beneficially by the alternatives. For this study, the reference community is the City and County of San Francisco (City). Information for the City is presented throughout this analysis to provide context and allow for comparison and contrast among census blocks within the study area.

The study area for direct and indirect effects for socioeconomics and for minority populations and low-income populations encompasses the census blocks within the maximum project alternative area footprint plus a 200-foot buffer, and that would experience flooding under the 2090-sea-level rise plus 100-year storm event as addressed in Section 3, *Existing and Future Without Project Conditions.* This is the area in which direct impacts on communities associated with construction and property displacement are most likely to occur related to Alternatives B, F, and G and the Total Benefits Plan (TNBP) along with adjoining areas that might be indirectly affected. Refer to Figure 1-1, for a visual of the study area including the census blocks, the outermost extent of construction for all alternatives, U.S. Army Corps of Engineers (USACE) reaches, and inundation area. Table 1-1through Table 1-3 also indicate which census blocks within the study area also fall within the project footprint for the maximum construction area under Alternatives B, F, and G and the TNBP.

For this section, the most recent and comprehensive U.S. Census Bureau data are considered. This data, the 2017–2021 American Community Survey data are used to describe existing (2020) population, housing, employment, and income in the reference community and study area.[2] The analysis presented in this appendix relies on this data over the recently developed Climate and Economic Justice Screening Tool by the CEQ, because the CEQ datasets considered in that tool heavily rely on older, 2010, census data and only provide detail at the Census Tract level (Council on Environmental Quality, 2023a). Furthermore, because this CEQ tool considers a broad range of criteria for environmental, climate, socioeconomic, or other burdens, specifically, by only flagging census blocks that are at or above the 50 percent percentile for low income, it omits some of the nuances of the study area; that is, it is in a city with a high diversity in both income and ethnic diversity (Council on Environmental Quality, 2023b and 2023c). Therefore, the 2017–2021 American Community Survey data were used in this analysis.

[2] The 5-year estimates are published for areas with populations of all sizes and are the most reliable and precise of the ACS period estimates, as well as the most comprehensive. Over the 1- and 3-year estimates it provides detail for very small populations, geographies down to census tracts and block groups. The population controls for the 2017–2021 American Community Survey data products are the average of the population estimates across the 5-year period.

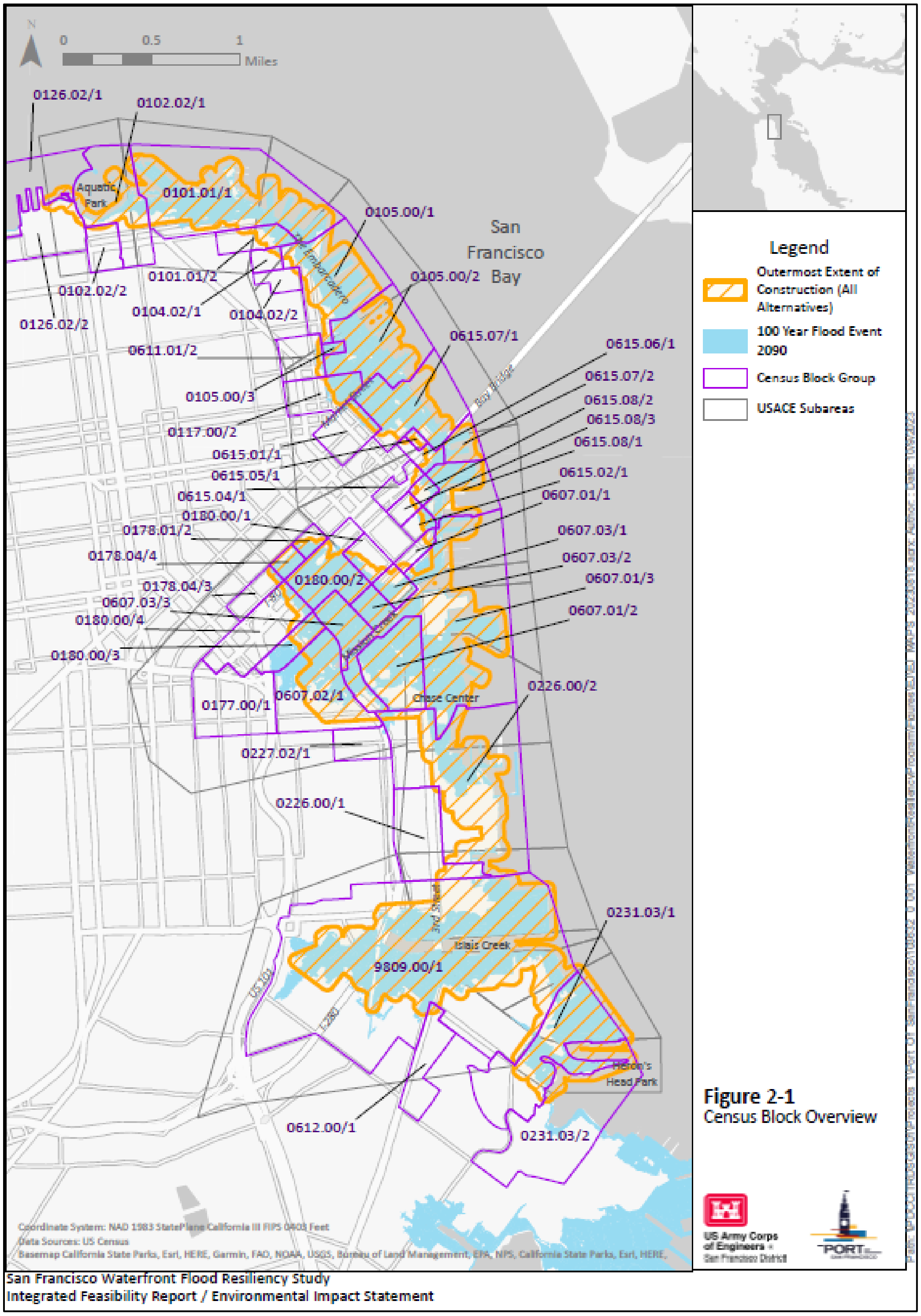


Figure 1-1. Study Area and Census Block Overview

1.2.1.1 Neighborhoods/Communities/Community Character

The study area is highly developed and characterized by multiple land uses. It encompasses several neighborhoods, including North Beach/Fisherman's Wharf, the Financial District, South of Market (SoMa)/Mission Bay, Potrero Hill/Central Waterfront, and Bayview North/Islais Creek. These are described below, starting with the northernmost portion of construction under Alternatives B, F, and G and the TNBP and proceeding to the southernmost portion (City and County of San Francisco, 2020).

The North Beach and Fisherman's Wharf neighborhoods are located along the northeast edge of the City's waterfront. These neighborhoods include mainly commercial land uses, with some residential buildings, as well as large City tourist attractions. The Financial District is the Bay Area's largest and densest job center, comprising large areas of high-density housing, commercial, and mixed-use space near The Embarcadero and Market Street.

Next, the SoMa and Mission Bay neighborhoods comprise developing mixed-use neighborhoods as well as large commercial buildings on both sides of Mission Creek; Mission Bay includes health industry sues, as well as residential and other commercial uses. The Potrero Hill and Central Waterfront neighborhoods include residential areas along the hillside as well as mixed industrial and residential uses along the shoreline in an area known as Dogpatch. This neighborhood is located along the east edge of the City, between the SoMa and Bayview neighborhoods.

Finally, the Bayview North/Islais Creek neighborhood, located along the southeast edge of the City, includes the industrial areas surrounding Islais Creek, as well as residential areas and developments.

The occupied housing units in the city and the study area are occupied primarily by renters, approximately 61.8 percent and 67.3 percent, respectively, which may suggest that these are desirable places to live (U.S. Census Bureau, 2021a). However, areas with higher levels of renter-occupied housing could indicate that people do not stay in these locations for extended periods of time and move to different neighborhoods frequently, suggesting weaker community cohesion (Rohe et al., 2013).

Community resources and services within the study area, more specifically, the construction area related to Alternatives B, F, and G, the TNBP, and the independent measures, include the emergency water system for firefighting (e.g., the Auxiliary Water Supply System, fireboat pump stations, hydrants, valves, cisterns, pipes); San Francisco Fire Department stations 4, 8, 9, 13, 25, and 35; San Francisco Police Department headquarters and county jail; open space, trails, and parks (e.g., Aquatic Park, Shoreline Park, China Basin Park, Pier 52 Bay Front Park, Agua Vista Park, Crane Cove Park, Warm Water Cove Park, and Heron's Head); and Port of San Francisco (Port) facilities and several piers and ferry terminals (e.g., WETA Pier 39, Ferry Building, and China Basin ferry terminals; South Beach Harbor and Park, McCovey Cove, and India Basin Marina).

Additional community resources and services include regional and local transportation infrastructure (e.g., the Bay Bridge, Bay Area Rapid Transit [BART], San Francisco Municipal Railway [Muni], Caltrain); wastewater infrastructure (e.g., pump stations, the Southeast Wastewater Treatment Plant, the North Point Wet-Weather Treatment Plant); the Recology Recycle Center; University of California, San Francisco Medical Center at Mission Bay; Oracle Park and Chase Center; and tourist attractions (e.g., the Ferry Building, The Embarcadero Promenade, Fisherman's Wharf, the Exploratorium, historic buildings and piers, restaurants, hotels).

1.2.1.2 Population Characteristics

As shown in Table 1-1, racial and ethnic data were collected for 873,965 persons in the City (U.S. Census Bureau, 2020). Of these, 341,306 (39.1 percent) identified themselves as White; 294,220 (33.7 percent) Asian; 136,761 (15.6 percent) as Hispanic or Latino; 45,071 (5.2 percent) Black or African American; 1,570 (0.2 percent) American Indian and Alaska Native; 3,244 (0.4 percent) Native Hawaiian and Other Pacific Islanders; 6,347 (0.7 percent) Some Other Race; and 45,446 (5.2 percent) Two or More Races. Depending on how persons of two or more races are considered, the City population is 61 percent minority (including two or more races).

In comparison, the study area has a total population of 63,483 within 45 census tract blocks and a lower percentage of White (38.6 percent), Hispanic or Latino (11.8 percent), and Asian Alone (33.4 percent). The study area has a higher percentage Black or African American (8.8 percent), Some Other Race (0.9 percent), and Native Hawaiian and Other Pacific Islanders (1.1 percent) compared to the City. The study area and the City have the same percentage of Two or More Races Alone (5.2 percent) and American Indian and Alaskan Native (0.2 percent). The study area population is 61 percent minority (including two or more races), which is higher than in the City as a whole.

1.2.1.3 Housing

As shown in Table 1-2, according to the U.S. Census Bureau, there are 404,720 housing units in the City, of which 361,222 (89.3 percent) are occupied and 43,498 (10.7 percent) are vacant (U.S. Census Bureau, 2021b). The average household size within the occupied housing units is 2.3 persons (U.S. Census Bureau, 2021c); 138,048 (38.2 percent) of the housing units are owner occupied, and 223,174 (61.8 percent) are renter occupied (U.S. Census Bureau, 2021d).

Overall, the study area has a slightly lower percentage of occupied units (84.1percent) compared to the City (89.3 percent). Of the occupied units, the study area has a lower percentage of owner-occupied housing units (32.7 percent) compared to the City (38.2 percent) and a greater proportion (67.3 percent) of renter-occupied housing units compared to the City at large (61.8 percent). In addition, the average household size within the study area (2.0 persons) was slightly smaller than that of the City (2.3 persons).

The Bay Area faces many challenges related to housing, which have a disproportionate impact on the region's low-income population. These challenges include (among others) rising housing costs and decreasing affordability and a spatial mismatch between the location of jobs and housing. The housing costs in Bay Area metro centers (San Francisco, Oakland, and San Jose) are extremely high, with most affordable Bay Area homes located in inland communities.

1.2.1.4 Employment and Income

As shown in Table 1-3, according to the U.S. Census Bureau, per capita income in the City is $77,267, and the median household income is $126,187 (U.S. Census Bureau, 2021d and 2021e). As of 2021, 9.8 percent of the residents within the City were living below the poverty level, which equates to 82,356 residents (U.S. Census Bureau, 2021g). Low-income limits in San Francisco are defined as $82,200 for an individual and $117,400 for a family of four in 2018, based on 80 percent of the area's median income (City and County of San Francisco 2020).

The per capita income for the study area ($110,299) is higher than that of the City, as is the median household income for the study area ($157,093) (U.S. Census Bureau, 2021d and 2021e). The number of citizens within the study area living below the poverty level is 6,157 (11.2 percent), which is slightly higher than the number in the City (9.8 percent) (U.S. Census Bureau, 2021f).

1.2.1.5 Environmental Justice

To evaluate potential environmental justice issues within the study area, a demographic profile of the relevant census blocks was developed to identify the low-income and minority populations present per EO 12898 (U.S. Environmental Protection Agency, 2016). For the purposes of this analysis, a census block included a population to be evaluated for environmental justice issues if:

- The total minority population of the census block was more than 50 percent of the total population or substantially higher (i.e., more than 15 percent) than that of the city or county (reference area) where it is located, or
- The proportion of the census block population that was below the poverty level was substantially higher (i.e., more than 15 percent greater) than the proportion of the City/county of San Francisco (reference area) population below the poverty level.

Because the city has a minority population that totals more than 50 percent, at 61 percent, the "substantially higher" criterion (i.e., more than 15 percent) was used in this analysis (i.e., more than 61 percent + 15 percent = 76 percent).

The census blocks shown on Figure 1-1, as well as in Table 1-1 and Table 1-3, present ethnicity and income data for the study area.

As described above, minorities represent approximately 61 percent of the total population of the City and approximately 61 percent of that of the study area. As shown in Table 1-1, the 2017–2021 American Community Survey 5-year estimates indicate that the proportion of the population within the study area composed of minority populations ranges from 23 percent (census track block 0126.02/1) to 98 percent (census tract block 0231.03/1). Using the “substantially higher” criterion, census tract, 0231.03/1, 231.03/02, and 0612.00/1 in the Bayview Neighborhood, and 0611.01/2 in the Financial District each meet the minority criteria for environmental justice in the study area, because the percentage of minority populations is more than 15 percent greater than the proportion of minority populations in the City (61 percent), that is, more than 76 percent meeting the minority criteria. Of these minority-population-identified census blocks, only blocks, 0231.03/2, and 0612.00/1 are located within the footprints of Alternatives B, F, and G, the TNBP, and Independent Measure 4A. See Figure 1-2 for an overview of the footprint and the minority-population-identified census blocks.

As described above, the study area has a median household income of $157,093, which is higher than the median household income in the City, $126,187. In contrast, the total percentage of individuals living below the poverty threshold is higher in the study area (11.2 percent) compared to the City as a whole (9.8 percent). However, using the “substantially higher than the city” criterion for population below the poverty level (9.8 percent + 15 percent = 24.8 percent), only the following census blocks meet the low-income criteria for environmental justice (again at or above 24.8 percent): census tract blocks 0105.00/1 in the Northern Waterfront, 0611.01/2, 0117.00/2, and 0615.01/1 in the Financial District, and 0231.03/2 in the Bayview Neighborhood. Of these low-income-population-identified census blocks, only blocks 0105.00/1 and 0231.03/2 are located within the maximum construction footprints of Alternatives B, F, G, and the TNBP. See Figure 1-3 for an overview of the footprint and the low-income-population-identified census blocks.

Table 1-1. Race and Ethnicity for the City and County of San Francisco and the Study Area

Region (a)	Total Population for Whom Data Were Compiled	White Alone		Black or African American Alone		American Indian and Alaskan Native Alone		Asian Alone		Native Hawaiian and Other Pacific Islanders Alone		Some Other Race Alone		Two or More Races Alone		Hispanic or Latino Ethnicity		Percent Minority
	No.	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	%
San Francisco	873,965	341,306	39.1%	45,071	5.2%	1,570	0.2%	294,220	33.7%	3,244	0.4%	6,347	0.7%	45,446	5.2%	136,761	15.6%	61%
Study Area Total	63,483	24,477	38.6%	5,564	8.8%	128	0.2%	21,227	33.4%	715	1.1%	588	0.9%	3,294	5.2%	7,490	11.8%	61%
0101.01/1[a]	838	423	50.5%	38	4.5%	0	0.0%	199	23.7%	4	0.5%	5	0.6%	58	6.9%	111	13.2%	50%
0101.01/2 [a*]	1,188	540	45.5%	31	2.6%	3	0.3%	467	39.3%	1	0.1%	5	0.4%	55	4.6%	86	7.2%	55%
0102.02/1 [a]	1,017	705	69.3%	15	1.5%	0	0.0%	155	15.2%	2	0.2%	14	1.4%	56	5.5%	70	6.9%	31%
0102.02/2	1,057	730	69.1%	11	1.0%	0	0.0%	196	18.5%	1	0.1%	5	0.5%	49	4.6%	65	6.1%	31%
0104.02/1	780	481	61.7%	9	1.2%	2	0.3%	172	22.1%	1	0.1%	6	0.8%	51	6.5%	58	7.4%	38%
0104.02/2	699	490	70.1%	2	0.3%	1	0.1%	112	16.0%	0	0.0%	7	1.0%	32	4.6%	55	7.9%	30%
0105.00/1 [a]	1,265	564	44.6%	32	2.5%	2	0.2%	493	39.0%	6	0.5%	15	1.2%	62	4.9%	91	7.2%	55%
0105.00/2 [a]	865	452	52.3%	36	4.2%	3	0.3%	260	30.1%	3	0.3%	3	0.3%	39	4.5%	69	8.0%	48%
0105.00/3	1,104	513	46.5%	25	2.3%	0	0.0%	449	40.7%	0	0.0%	13	1.2%	27	2.4%	77	7.0%	54%
0117.00/2	442	114	25.8%	14	3.2%	2	0.5%	229	51.8%	0	0.0%	2	0.5%	32	7.2%	49	11.1%	74%
0126.02/1	1,595	1,221	76.6%	11	0.7%	1	0.1%	135	8.5%	0	0.0%	4	0.3%	106	6.6%	117	7.3%	23%
0126.02/2 [a]	1,463	1,085	74.2%	14	1.0%	1	0.1%	166	11.3%	3	0.2%	14	1.0%	54	3.7%	126	8.6%	26%
0177.00/1	1,041	410	39.4%	139	13.4%	2	0.2%	233	22.4%	7	0.7%	15	1.4%	62	6.0%	173	16.6%	61%
0178.01/2	1,161	349	30.1%	13	1.1%	0	0.0%	689	59.3%	0	0.0%	2	0.2%	56	4.8%	52	4.5%	70%
0178.04/3	687	231	33.6%	63	9.2%	3	0.4%	215	31.3%	3	0.4%	8	1.2%	51	7.4%	113	16.4%	66%
0178.04/4	680	265	39.0%	31	4.6%	2	0.3%	233	34.3%	2	0.3%	5	0.7%	25	3.7%	117	17.2%	61%
0180.00/1	880	324	36.8%	12	1.4%	0	0.0%	378	43.0%	0	0.0%	9	1.0%	43	4.9%	114	13.0%	63%
0180.00/2	1,063	431	40.5%	106	10.0%	0	0.0%	304	28.6%	10	0.9%	13	1.2%	77	7.2%	122	11.5%	59%
0180.00/3	1,088	409	37.6%	72	6.6%	2	0.2%	465	42.7%	12	1.1%	2	0.2%	52	4.8%	74	6.8%	62%
0180.00/4	1,727	503	29.1%	472	27.3%	13	0.8%	247	14.3%	18	1.0%	8	0.5%	116	6.7%	350	20.3%	71%

Region (a)	Total Population for Whom Data Were Compiled	White Alone		Black or African American Alone		American Indian and Alaskan Native Alone		Asian Alone		Native Hawaiian and Other Pacific Islanders Alone		Some Other Race Alone		Two or More Races Alone		Hispanic or Latino Ethnicity		Percent Minority
	No.	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	%
0226.00/1 [a]	2,390	1,150	48.1%	66	2.8%	3	0.1%	813	34.0%	2	0.1%	5	0.2%	143	6.0%	208	8.7%	52%
0226.00/2 [a]	2,611	1,253	48.0%	125	4.8%	6	0.2%	646	24.7%	3	0.1%	54	2.1%	194	7.4%	330	12.6%	52%
0227.02/1	1,128	672	59.6%	17	1.5%	2	0.2%	226	20.0%	0	0.0%	6	0.5%	73	6.5%	132	11.7%	40%
0231.03/1	**2,246**	**50**	**2.2%**	**1,230**	**54.8%**	**8**	**0.4%**	**273**	**12.2%**	**284**	**12.6%**	**22**	**1.0%**	**121**	**5.4%**	**258**	**11.5%**	**98%**
0231.03/2 [a]	**2,655**	**107**	**4.0%**	**1,201**	**45.2%**	**16**	**0.6%**	**188**	**7.1%**	**252**	**9.5%**	**48**	**1.8%**	**161**	**6.1%**	**682**	**25.7%**	**96%**
0607.01/1 [a]	1,043	496	47.6%	23	2.2%	0	0.0%	382	36.6%	3	0.3%	15	1.4%	52	5.0%	72	6.9%	52%
0607.01/2 [a]	6,050	2,045	33.8%	417	6.9%	21	0.3%	2,187	36.1%	50	0.8%	76	1.3%	290	4.8%	964	15.9%	66%
0607.01/3 [a]	1,517	558	36.8%	19	1.3%	2	0.1%	697	45.9%	2	0.1%	16	1.1%	101	6.7%	122	8.0%	63%
0607.02/1 [a]	3,142	933	29.7%	154	4.9%	5	0.2%	1,518	48.3%	6	0.2%	18	0.6%	185	5.9%	323	10.3%	70%
0607.03/1 [a]	1,804	569	31.5%	70	3.9%	0	0.0%	827	45.8%	0	0.0%	13	0.7%	85	4.7%	240	13.3%	68%
0607.03/2 [a]	1,788	539	30.1%	109	6.1%	1	0.1%	887	49.6%	3	0.2%	18	1.0%	81	4.5%	150	8.4%	70%
0607.03/3 [a]	2,088	634	30.4%	65	3.1%	1	0.0%	1,063	50.9%	4	0.2%	12	0.6%	114	5.5%	195	9.3%	70%
0611.01/2	**871**	**125**	**14.4%**	**18**	**2.1%**	**0**	**0.0%**	**679**	**78.0%**	**7**	**0.8%**	**0**	**0.0%**	**18**	**2.1%**	**24**	**2.8%**	**86%**
0612.00/1 [a]	**1,428**	**148**	**10.4%**	**286**	**20.0%**	**1**	**0.1%**	**409**	**28.6%**	**4**	**0.3%**	**6**	**0.4%**	**52**	**3.6%**	**522**	**36.6%**	**90%**
0615.01/1	809	486	60.1%	37	4.6%	0	0.0%	203	25.1%	0	0.0%	0	0.0%	39	4.8%	44	5.4%	40%
0615.02/1 [a]	1,452	784	54.0%	13	0.9%	0	0.0%	515	35.5%	0	0.0%	26	1.8%	48	3.3%	66	4.5%	46%
0615.04/1	1,294	468	36.2%	62	4.8%	2	0.2%	599	46.3%	1	0.1%	7	0.5%	54	4.2%	101	7.8%	64%
0615.05/1	1,051	393	37.4%	20	1.9%	0	0.0%	546	52.0%	0	0.0%	9	0.9%	34	3.2%	49	4.7%	63%
0615.06/1 [a]	1,983	742	37.4%	32	1.6%	1	0.1%	956	48.2%	0	0.0%	19	1.0%	87	4.4%	146	7.4%	63%
0615.07/1 [a]	1,738	595	34.2%	161	9.3%	2	0.1%	637	36.7%	2	0.1%	23	1.3%	70	4.0%	248	14.3%	66%
0615.07/2 [a]	0	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	0	NA	NA
0615.08/1 [a]	521	264	50.7%	34	6.5%	3	0.6%	129	24.8%	3	0.6%	2	0.4%	30	5.8%	56	10.7%	49%
0615.08/2 [a]	1,396	537	38.5%	22	1.6%	3	0.2%	673	48.2%	1	0.1%	22	1.6%	47	3.4%	91	6.5%	62%
0615.08/3	590	268	45.4%	12	2.0%	0	0.0%	209	35.4%	0	0.0%	8	1.4%	53	9.0%	40	6.8%	55%

Region (a)	Total Population for Whom Data Were Compiled	White Alone		Black or African American Alone		American Indian and Alaskan Native Alone		Asian Alone		Native Hawaiian and Other Pacific Islanders Alone		Some Other Race Alone		Two or More Races Alone		Hispanic or Latino Ethnicity		Percent Minority
	No.	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	%
9809.00/1 [a]	1,248	421	33.7%	225	18.0%	14	1.1%	168	13.5%	15	1.2%	8	0.6%	59	4.7%	338	27.1%	66%

Source: U.S. Census Bureau, 2020.

[a] Indicates the block is located within the maximum construction area related to the other alternatives. Study area includes 45 census block groups, listed as “census tract ID/block number”.

Bolded census blocks are identified as minority environmental justice populations.

Table 1-2. Housing Characteristics for the City of San Francisco and the Study Area

			Housing Units [c]					Occupied Housing Units [d]			
	Total Households	Average Household Size [b]	Total	Occupied	Percent Occupied	Vacant	Percent Vacant	Owner Occupied	Percent Owner Occupied	Renter Occupied	Percent Renter Occupied
San Francisco	361,222	2.3	404,720	361,222	89.3%	43,498	10.7%	138,048	38.2%	223,174	61.8%
Study Area Total [e]	26,213	2.0	31,158	26,211	84.1%	4,945	15.9%	8,565	32.7%	17,648	67.3%
0101.01/1 [a]	448	1.7	515	448	87.0%	67	13.0%	15	3.3%	433	96.7%
0101.01/2 [a]	784	1.7	883	784	88.8%	99	11.2%	158	20.2%	626	79.8%
0102.02/1 [a]	446	2.0	700	446	63.7%	254	36.3%	117	26.2%	329	73.8%
102.02/2	584	1.7	719	582	80.9%	135	18.8%	202	34.6%	382	65.4%
0104.02/1	336	2.0	451	336	74.5%	115	25.5%	167	49.7%	169	50.3%
0104.02/2	562	2.0	620	562	90.6%	58	9.4%	154	27.4%	408	72.6%
0105.00/1 [a]	625	2.3	764	625	81.8%	139	18.2%	327	52.3%	298	47.7%
0105.00/2 [a]	517	2.0	568	517	91.0%	51	9.0%	76	14.7%	441	85.3%
0105.00/3	668	1.4	719	668	92.9%	51	7.1%	0	0.0%	668	100.0%
0117.00/2	152	2.5	198	152	76.8%	46	23.2%	0	0.0%	152	100.0%
0126.02/1	684	2.1	839	684	81.5%	155	18.5%	244	35.7%	440	64.3%
0126.02/2 [a]	720	2.2	818	720	88.0%	98	12.0%	211	29.3%	509	70.7%
0177.00/1	194	1.9	241	194	80.5%	47	19.5%	81	41.8%	113	58.2%
0178.01/2	872	1.7	959	872	90.9%	87	9.1%	416	47.7%	456	52.3%
0178.04/3	276	2.3	318	276	86.8%	42	13.2%	114	41.3%	162	58.7%
0178.04/4	371	1.7	478	371	77.6%	107	22.4%	169	45.6%	202	54.4%
0180.00/1	541	1.7	634	541	85.3%	93	14.7%	147	27.2%	394	72.8%
0180.00/2	369	2.0	491	369	75.2%	122	24.8%	97	26.3%	272	73.7%
0180.00/3	413	1.8	491	413	84.1%	78	15.9%	61	14.8%	352	85.2%
0180.00/4	256	2.2	278	256	92.1%	22	7.9%	154	60.2%	102	39.8%
0226.00/1 [a]	1,188	1.8	1,329	1,188	89.4%	141	10.6%	335	28.2%	853	71.8%
0226.00/2 [a]	712	2.0	844	712	84.4%	132	15.6%	168	23.6%	544	76.4%
0227.02/1	586	2.1	597	586	98.2%	11	1.8%	202	34.5%	384	65.5%
0231.03/1 [a]	613	2.7	706	613	86.8%	93	13.2%	0	0.0%	613	100.0%

	Total Households	Average Household Size [b]	Housing Units [c]					Occupied Housing Units [d]			
			Total	Occupied	Percent Occupied	Vacant	Percent Vacant	Owner Occupied	Percent Owner Occupied	Renter Occupied	Percent Renter Occupied
0231.03/2 [a]	695	3.5	785	695	88.5%	90	11.5%	36	5.2%	659	94.8%
0607.01/1 [a]	275	2.2	321	275	85.7%	46	14.3%	58	21.1%	217	78.9%
0607.01/2 [a]	2,236	2.4	2,521	2,236	88.7%	285	11.3%	200	8.9%	2,036	91.1%
0607.01/3 [a]	606	2.6	606	606	100.0%	0	0.0%	435	71.8%	171	28.2%
0607.02/1 [a]	895	1.7	1,096	895	81.7%	201	18.3%	198	22.1%	697	77.9%
0607.03/1 [a]	828	2.2	894	828	92.6%	66	7.4%	287	34.7%	541	65.3%
0607.03/2 [a]	775	1.7	866	775	89.5%	91	10.5%	262	33.8%	513	66.2%
0607.03/3 [a]	1,039	2.3	1,039	1,039	100.0%	0	0.0%	650	62.6%	389	37.4%
0611.01/2	510	2.1	560	510	91.1%	50	8.9%	80	15.7%	430	84.3%
0612.00/1 [a]	404	2.9	432	404	93.5%	28	6.5%	177	43.8%	227	56.2%
0615.01/1	620	1.5	810	620	76.5%	190	23.5%	620	100.0%	0	0.0%
0615.02/1*	601	1.6	1,018	601	59.0%	417	41.0%	117	19.5%	484	80.5%
0615.04/1	491	1.5	642	491	76.5%	151	23.5%	0	0.0%	491	100.0%
0615.05/1	407	1.9	674	407	60.4%	267	39.6%	382	93.9%	25	6.1%
0615.06/1 [a]	1,156	2.0	1,350	1,156	85.6%	194	14.4%	842	72.8%	314	27.2%
0615.07/1 [a]	684	2.8	728	684	94.0%	44	6.0%	54	7.9%	630	92.1%
0615.07/2 [a]	0	-	0	0	NA	0	NA	0	NA	0	NA
0615.08/1 [a]	353	1.6	632	353	55.9%	279	44.1%	299	84.7%	54	15.3%
0615.08/2 [a]	367	2.1	513	367	71.5%	146	28.5%	0	0.0%	367	100.0%
0615.08/3	227	1.9	334	227	68.0%	107	32.0%	227	100.0%	0	0.0%
9809.00/1 [a]	127	2.3	177	127	71.8%	50	28.2%	26	20.5%	101	79.5%

Source: U.S. Census Bureau, 2021b, 2021c, and 2021d.

[a] Indicates the block is located within the maximum construction area related to the alternatives.

[b] Household Size pulled from Table B25010 (U.S. Census Bureau, 2021c).

[c] Housing Units pulled from Table 25002 (U.S. Census Bureau, 2021b).

[d] Occupied Housing Units/or tenure pulled from Table 25003 (U.S. Census Bureau, 2021d).

[e] Resource study area includes 45 census block groups, listed as “census tract ID/block number”.

Table 1-3. Economic Data for the City of San Francisco and the Study Area

Region	Per Capita Income [b]	Median Household Income [c]	Population for Whom Poverty Status Is Determined: Total	People Below the Poverty Level [d]	
San Francisco	**77,267**	**126,187 (d)**	**844,284**	**82,356**	**9.8%**
Study Area Total [e]	**110,299**	**157,093**	**54,748**	**6,157**	**11.2%**
0101.01/1 [a]	55,910	88,790	781	59	7.6%
0101.01/2 [a]	67,741	56,050	1,337	198	14.8%
0102.02/1 [a]	105,638	205,341	911	0	0.0%
0102.02/2	205,605	174,464	975	101	10.4%
0104.02/1	86,671	127,778	662	76	11.5%
0104.02/2	188,901	177,267	1,100	0	0.0%
0105.00/1 [a]	**92,010**	**156,490**	**1,465**	**397**	**27.1%**
0105.00/2 [a]	115,128	209,871	1,055	44	4.2%
0105.00/3	123,196	116,923	910	51	5.6%
0117.00/2	**30,425**	**44,000**	**386**	**96**	**24.9%**
0126.02/1	152,562	217,407	1,404	114	8.1%
0126.02/2 [a]	124,670	157,695	1,573	83	5.3%
0177.00/1	129,549	165,789	364	6	1.6%
0178.01/2	82,938	133,780	1,479	61	4.1%
0178.04/3	69,757	163,000	645	15	2.3%
0178.04/4	154,216	-[f]	631	56	8.9%
0180.00/1	104,207	136,719	942	22	2.3%
0180.00/2	74,037	162,708	733	71	9.7%
0180.00/3	108,425	158,558	748	91	12.2%
0180.00/4	101,028	250,000+	569	28	4.9%
0226.00/1 [a]	161,271	229,713	2,173	34	1.6%
0226.00/2 [a]	126,609	194,444	1,397	0	0.0%
0227.02/1	113,507	216,875	1,228	105	8.6%
0231.03/1 [a]	12,730	27,075	1,627	294	18.1%
0231.03/2 [a]	**12,860**	**29,511**	**2,437**	**1,111**	**45.6%**
0607.01/1 [a]	102,345	99,030	597	18	3.0%
0607.01/2 [a]	81,646	149,483	5,348	733	13.7%
0607.01/3 [a]	160,652	250,000+	1,560	0	0.0%
0607.02/1 [a]	86,830	-	1,488	162	10.9%
0607.03/1 [a]	71,994	169,000	1,858	0	0.0%
0607.03/2 [a]	107,222	213,146	1,297	205	15.8%
0607.03/3 [a]	94,222	211,307	2,378	23	1.0%
0611.01/2	**50,640**	**14,943**	**1,045**	**395**	**37.8%**
0612.00/1 [a]	32,096	66,774	1,163	266	22.9%
0615.01/1	**307,554**	**250,000+**	**903**	**251**	**27.8%**
0615.02/1 [a]	141,398	-	982	70	7.1%
0615.04/1	106,761	-	719	0	0.0%

Region	Per Capita Income [b]	Median Household Income [c]	Population for Whom Poverty Status Is Determined: Total	People Below the Poverty Level [d]	
0615.05/1	147,287	249,901	776	0	0.0%
0615.06/1 [a]	201,507	250,000+	2,251	141	6.3%
0615.07/1 [a]	57,782	93,466	1,940	332	17.1%
0615.07/2 [a]	-	-	-	-	NA
0615.08/1 [a]	178,001	250,000+	553	0	0.0%
0615.08/2 [a]	94,960	102,485	765	74	9.7%
0615.08/3	160,894	-	425	0	NA
9809.00/1 [a]	69,757	137,750	296	63	21.3%

Source: U.S. Census Bureau, 2021h.
[a] Indicates the block is located within the maximum construction area related to Project Alternatives.
[b] Per Capita Income pulled from Table B25010. City and County of San Francisco Median Income pulled from Table S1903.
[c] Median Household Income pulled from Table B19013.
[d] Population and People below the poverty level pulled from Table B17101.
[e] Resource Study Area includes 45 census block groups/0listed as "census tract ID/block number".
[f] Data were not available.
Bolded census blocks are identified as low-income environmental justice populations.

1.2.1.6 Environmental Justice Outreach

To satisfy various federal communication and environmental justice requirements, as well as state and local guidance, there has been extensive outreach to the local community related to the alternatives. Since 2017, the Port, through the Waterfront Resilience Program, has engaged with tens of thousands of people, including engaging community members at local events and Port-hosted meetings and walking tours, businesses and merchants, advisory committees, non-profit groups, youth, and others. The San Francisco District Office of USACE is committed to integrating environmental justice and equity principles into all aspects of their mission; as part of their 20-Year Strategic Plan, specifically, Strategic Goal 1: Build Trust, Talent, and Capability, and Strategic Goal 6: Deliver Value and Benefits Equitably, USACE maintains a regularly updated roadmap for complying with their equity goals and policies (USACE 2023).[3]

[3] These goals and policies are documented in the following material:
Memorandum, Assistant Secretary of the Army for Civil Works, Memorandum for Commanding General, U.S. Army Corps of Engineers (USACE), subject: Implementation of Environmental Justice and the Justice40 Initiative, 15 March 2022.
Memorandum, Deputy Commanding General for Civil and Emergency Operations Memorandum for USACE, subject: Implementation of the Interim Environmental Justice Strategic Plan, 16 December 2022.USACE.
Interim Environmental Justice Strategic Plan: Community Outreach & Engagement. 19 December 2022
Memorandum, Directorate of Civil Works Memorandum for USACE, subject: Interim Environmental Justice Guidance for Civil Works Planning Studies, 13 January 2023.
USACE Collaboration and Public Participation Center of Expertise (CPCX). Guide for Preparing District Environmental Justice Strategic Plan, Version 1. January 2023

See also the March 15, 2022, USACE Memo for Implementation of Environmental Justice and the Justice40 Initiative for additional outreach content.

Engagement has focused on sharing information about the multi-hazard earthquake and flood risks facing San Francisco's waterfront and gaining feedback about community priorities and concerns. It also has reflected and reported back to the public how their input has shaped the resilience work led by the Port, including affirming the Waterfront Resilience Program's focus on life safety and emergency response. The Port has conducted outreach and engagement to communities within the project area starting in 2017. Some of the outreach conducted was intercept, where people were stopped on the street and asked questions relevant to the Program at the time. Some outreach was done via community events, where the Port had a table and engaged people via activities at the table. In 2018, we conducted tenant outreach to connect with workers along the waterfront. At all outreach opportunities, we ask people to sign up for the WRP newsletter and stay connected with our work. (Port of San Francisco, 2023a) Regular updates and notifications about upcoming outreach events are shared via a subscription list of over 4,500 recipients and the sfport.com/wrp website, which averages more than 1,200 views a month.

As part of the Port's commitment to equity, the Waterfront Resilience Program has developed an internal equity evaluation tool in close collaboration with City and County staff through a series of equity working group meetings. The Equity Framework is a multi-step, iterative process meant to identify equity considerations and opportunities to maximize community benefits through the planning process. This tool was also reviewed through a series of three focus groups with community-based organization leaders for their feedback on how the equity evaluation tool could be improved or applied differently to facilitate equitable outcomes through the planning process. The community engagement and outreach strategies are intended to respond to the needs and priorities of San Francisco's waterfront communities and targeted community groups, including youth, seniors, and communities historically excluded from planning processes.

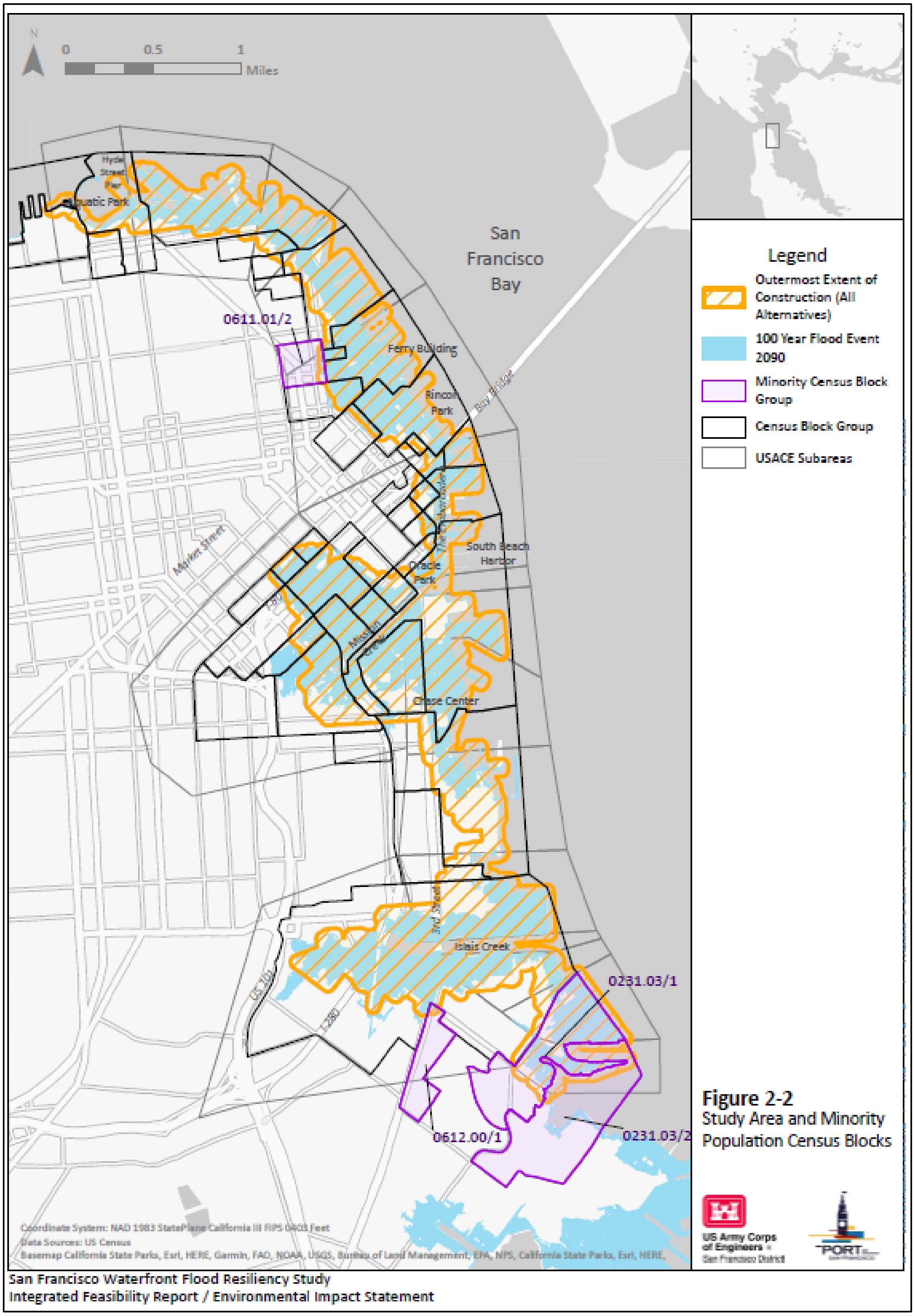


Figure 1-2. Study Area and Minority Population Census Block

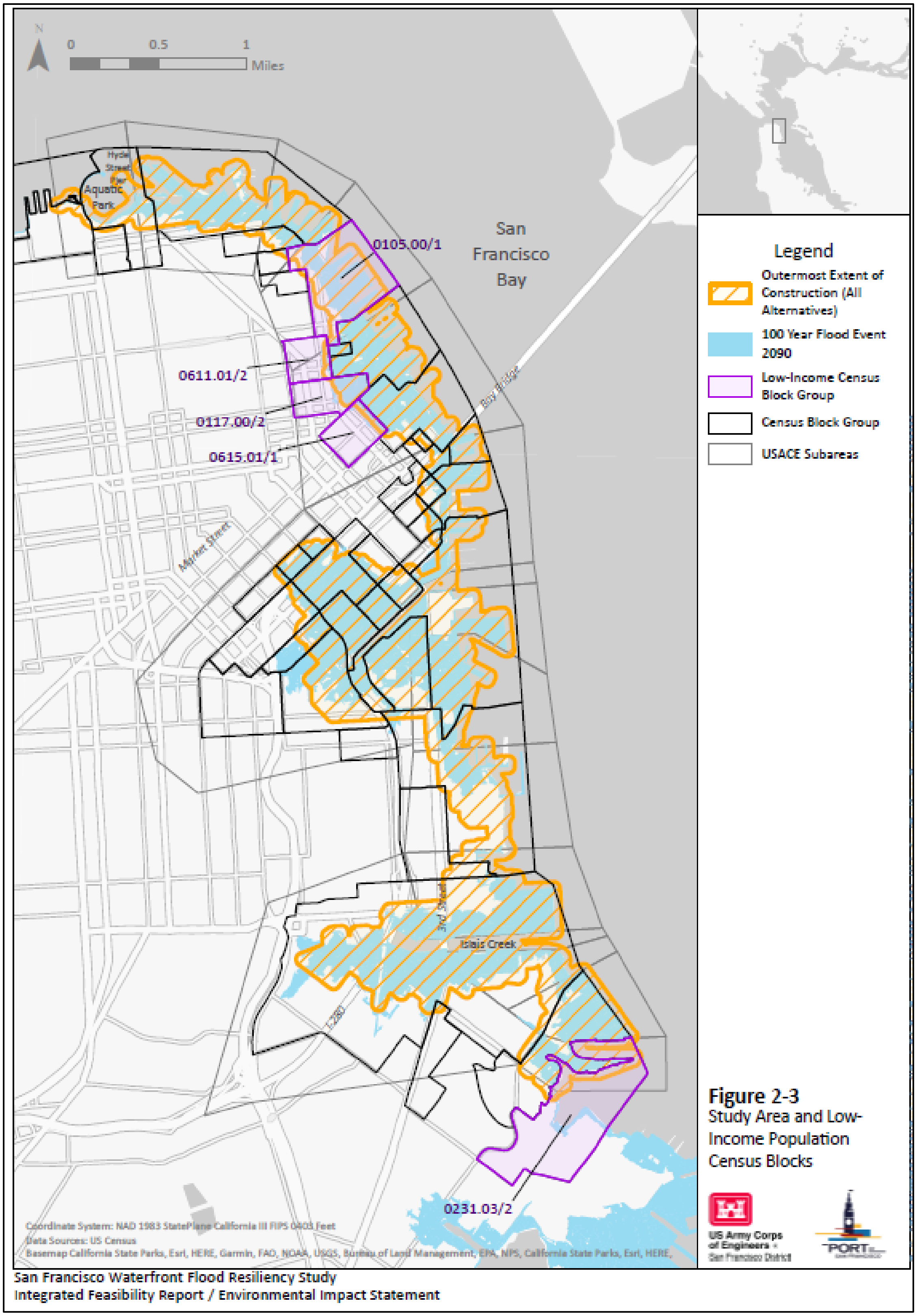


Figure 1-3. Study Area and Low-Income Population Census Block

Engagement strategies are inclusive, culturally nuanced, and available in multiple languages, allowing communities, especially those who do not or have never participated in the public process, to participate and provide their input.

2.0 Environmental Consequences

2.1 Assessment Method

The context for socioeconomic and environmental justice includes existing conditions within the worst-case future (2090) sea-level-rise inundation area, as well as existing conditions along the project footprint and within 1,000 feet of construction work areas and permanent project features**.** The results of future sea-level inundation are characterized in detail Section 3, *Existing and Future Without Project Conditions*, and incorporated by reference to address potential flood impacts under each alternative.

The CEQ regulations implementing NEPA state that when economic or social effects and natural or physical environmental effects are interrelated, the Environmental Impact Statement (EIS) will discuss these effects on the human environment (40 Code of Federal Regulations [CFR] 1508.1(m)). The CEQ regulations further state that the "human environment shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." From these CEQ regulations, the socioeconomic analysis evaluates how elements of the human environment such as population, employment, education, and housing might be affected by the alternatives.

For socioeconomic impacts, effects are considered in terms of the qualitative scales of displacement, demolition, and inundation experienced under each alternative relative to the division of a community, displacement of persons and structures/resources, and adverse economic impacts caused by either the project construction footprint or the future sea-level-rise flood inundation area. To substantiate these findings, findings identified in Chapter 3, *Future Project without Project Conditions,* the San Francisco Waterfront Flood Resiliency Study, Other Social Effects Report (OSE Report), prepared for the Port (Port of San Francisco, 2023b) and the Future without Project Conditions (FWOP) Regional Economic Development and OSE Analysis Results presentation (Port of San Francisco 2023c) are incorporated by reference.

For environmental justice impacts per EO 12898, the analysis considers the significant construction and operations effects identified in each resource section of this EIS, the magnitude of the effect, whether effects are adverse, the duration of effects (temporary or permanent), and the geographic location of the effects under each alternative relative to the identified environmental justice population within the specified boundary. It also considers the location of the future sea-level-rise flood inundation area relative to each alternative. Where the alternatives would result in no effect on environmental justice populations or would result in an effect that does not warrant mitigation, the effect would be negligible, and no further analysis would be conducted (U.S. Environmental Protection Agency, 2016).

Adverse effects in the environmental justice analysis are based on the following considerations.

- Effects that are minimized through mitigation will be evaluated to determine whether the avoidance and minimization measures (AMMs) are (1) equally applied to environmental justice populations and non-environmental justice populations, and (2) if they address the concerns of the environmental justice populations. If the AMMs are not successful in addressing (1) and (2), effects will be considered adverse.
- Effects that are not substantially reduced through mitigation will be considered adverse.

To determine whether the effect would have a disproportionate effect, the second part of the assessment evaluates whether effects that would adversely affect an environmental justice population would have disproportionately high and adverse effects on these populations. A disproportionately high and adverse effect on an environmental justice population is defined as an effect that:

- Would be predominantly borne by environmental justice populations, or
- Would be suffered by environmental justice populations and would be appreciably more severe or greater in magnitude than the adverse effect suffered by the non-environmental justice populations in the affected area and the reference community.

The identification of an environmental justice population, as addressed under Section 1.2.1.5, Environmental Justice, is focused on census block data for race and income from U.S. Census Bureau 2017–2021 American Community Survey 5-Year Estimates, as well as from their Decennial Census Redistricting data. To address all alternatives the study area spans 45 census blocks with a total area of approximately 4,580 acres.

Where actions would be moderate in the near-term and localized, and the effects would be within or below regulatory standards, as applicable, and the use of mitigation measures would manage potential adverse impacts, the rating was determined to be a 3; in nearly all cases where there would be construction or demolition activities, mitigation (AMMs) are required, and as such a 3 was selected. Where an action, or their operation and maintenance, does not involve displacement or construction, a rating of 1, which indicates there would be no impacts to the resource because the resource is unaffected, was selected. Overall, where ratings of 3 applied, the mitigated rating was reduced to a 2, which indicates effects to the resource would either be negligible or, if detectable, have minor temporary impacts locally to the resource. The impacts would be below regulatory standards, as applicable, and mitigation measures may be implemented to sustain low to no impact to the resource. This impact rating applies to all alternatives.

2.2 Basis of Significance

Effects are determined by assessing the following conditions:

- Would an adverse socioeconomic effect be generated related to:
  - *Communities and Neighborhood*: The potential for construction or operation to disrupt community interactions or physically divide established communities.
  - *Displacement:* The potential for construction and operation to require substantial displacement of residences, commercial and industrial businesses, and community and public facilities.
  - *Economics*: The potential for construction and operation to cause substantial adverse effects on employment, school district funding, or county and City property and sales tax revenues.
- Would an adverse environmental effect be generated that would be disproportionally felt by a minority or low-income population.

2.3 Effects

2.3.1 Construction Impact Summary

Construction activities have the potential to result in socioeconomic effects related to community and neighborhood interactions and connectivity; to the displacement of residences, commercial and industrial businesses, and community and public facilities; but generally, minimize negative economic effects. For actions that require acquisition and demolition of buildings, there would be a direct displacement effect and for all construction activity there would be temporary interruption related to site access, or road closures, vehicle access, etc. Construction would also result in a demand for construction jobs. Additionally, by preserving businesses and planning for the incremental removal of some existing land uses, the overall population and tax revenues within the City would likely only experience a slight reduction, if at all, but would also shift in location. Any such impacts would be minimized by using AMMs, such as those described Section 3.0, *Mitigation*. Following construction activities, communities and neighborhoods would be expected to return to baseline conditions.

Based on the conclusions of other sections in Appendix D, construction activities would also have the potential to result in adverse environmental effects that could be disproportionally felt by a minority or low-income population; specifically, for the topics of transportation, aesthetics, air quality, noise, and socioeconomics. However, based on the location of construction activity including demolition, pile driving, and other actions, and with the application of identified AMMs described in Section 3.0, *Mitigation*, there would not be disproportionate effect on a minority or low-income population of the proposed actions.

2.3.2 Operations and Maintenance Impact Summary

The operation and maintenance effects are limited to inundation adaptation and operation and maintenance activities. Long term, the protection measures would avoid the worse effects of the FWOP on communities and neighborhoods, displacements, and economics and would avoid long-term effects on environmental justice communities. Therefore, ***beneficial effects*** related to flood inundation would occur, in contrast to the FWOP.

2.3.3 Total Benefits Plan

Table 2-1 shows a summary of the socioeconomics and environmental justice impacts associated with the TNBP. The TNBP would result in fewer socioeconomic and environmental justice impacts than Alternatives B and G, and a similar level of impact to Alternative F, as described in detail below.

Table 2-1. Summary of Socioeconomic and Environmental Justice Impacts Associated with the TNBP

TNBP Socioeconomic and Environmental Justice Impact Rating by Measure	Bay Fill	Levee	Bulkhead wall/Seawall	Deployable Flood Gate	Roadway Impact	Sheetpile Wall	T-wall	Vertical Wall/Curb Extension	Wharf	Ecological Armoring*	Ecotone Levee*	Embankment Shoreline*	Naturalized Shoreline*	Marsh Enhancement*
Construction/Footprint (1st Action)	2	3	3	1	3	1	3	1	3	3	3	3	3	1
Construction/Footprint (2nd Action)	3	3	3	1	3	1	3	1	3	3	3	3	3	3
O&M Assumptions	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Mitigated Rating	2	2	2	1	2	1	2	1	2	2	2	2	2	2

* Denotes engineering with nature (EWN) measure.

2.3.3.1 Socioeconomics

The TNBP involves initial first actions (implemented in the year 2040) and subsequent actions to add height or adapt measures as risks increase (implemented in 2070–2130). In The Embarcadero area (Reaches 1 and 2), first action items include raising the shoreline, performing ground improvement for seismic performance, floodproofing buildings, and constructing concrete curbs around piers. Reach 2 and subsequent actions in Reach 1 continue raising the shoreline, considering building adaptations based on risk profiles, and addressing stormwater management. In Mission Creek/Mission Bay (Reach 3), key first actions involve raising the shorelines, performing ground improvement, installing deployable closure structures, and enhancing wildlife habitat. Subsequent actions include further elevation, maintenance of roadway capacity, incorporation of engineering with nature features, and building adaptations. Lastly, in Islais Creek/Bayview (Reach 4), initial actions involve elevating the shorelines, installing concrete curbs, performing ground improvement, and incorporating engineering with nature features. Subsequent actions include additional shoreline elevation, construction of levees, building adaptations, and the consideration of additional infrastructure for stormwater management.

Compared to future inundation conditions addressed in Section 3*, Existing and Future Without Project Conditions*, the TNBP provides extensive features to reduce flooding through 2090. Under FWOP conditions, there would be no reduction of the risks of coastal flooding, resulting in lower quality of life, lowered property values, and the displacement of businesses, jobs, and homes. Future flooding under the FWOP conditions would also require emergency response and recovery activities, which would also result in effects on socioeconomics**.** FWOP inundation area is shown in Figure 2-1. For comparison purposes, the area of inundation and construction under the TNBP is shown in Figure 2-2, showing a substantial reduction in inundation area.

To support these sea-level-rise protection measures under the TNBP, an overall estimate of 988,902 square feet of building footprints would be demolished. Direct construction effects related to 2090 sea-level rise would be less than Alternatives B, F, or G. Based on geographic information system (GIS) data approximately 957 acres of land would experience construction activity, either directly or indirectly within the 200-foot buffer identified in Figure 2-2.

2.3.3.1.1 Communities and Neighborhoods

Residual future flooding under the TNBP would be more limited than all of the alternatives and would cover roughly 250 acres of land, compared to 1,337 acres of land under the FWOP.

Under FWOP conditions, inundation by 2090 (with the 100 year storm) would expose 134 acres of parks, 22 miles of MUNI transit routes and 42 miles of streets throughout the four reaches. By contrast, under the TNBP, transportation and circulation would relatedly be minimally affected by both the proposed improvements and the limited flooding (See Figure 2-1 and Figure 2-2).

Floodproofing structures and transit systems and construction of an elevated LOD would have beneficial effects on communities and neighborhoods within the study area by preserving community features during the worst-case scenario flooding through 2090.

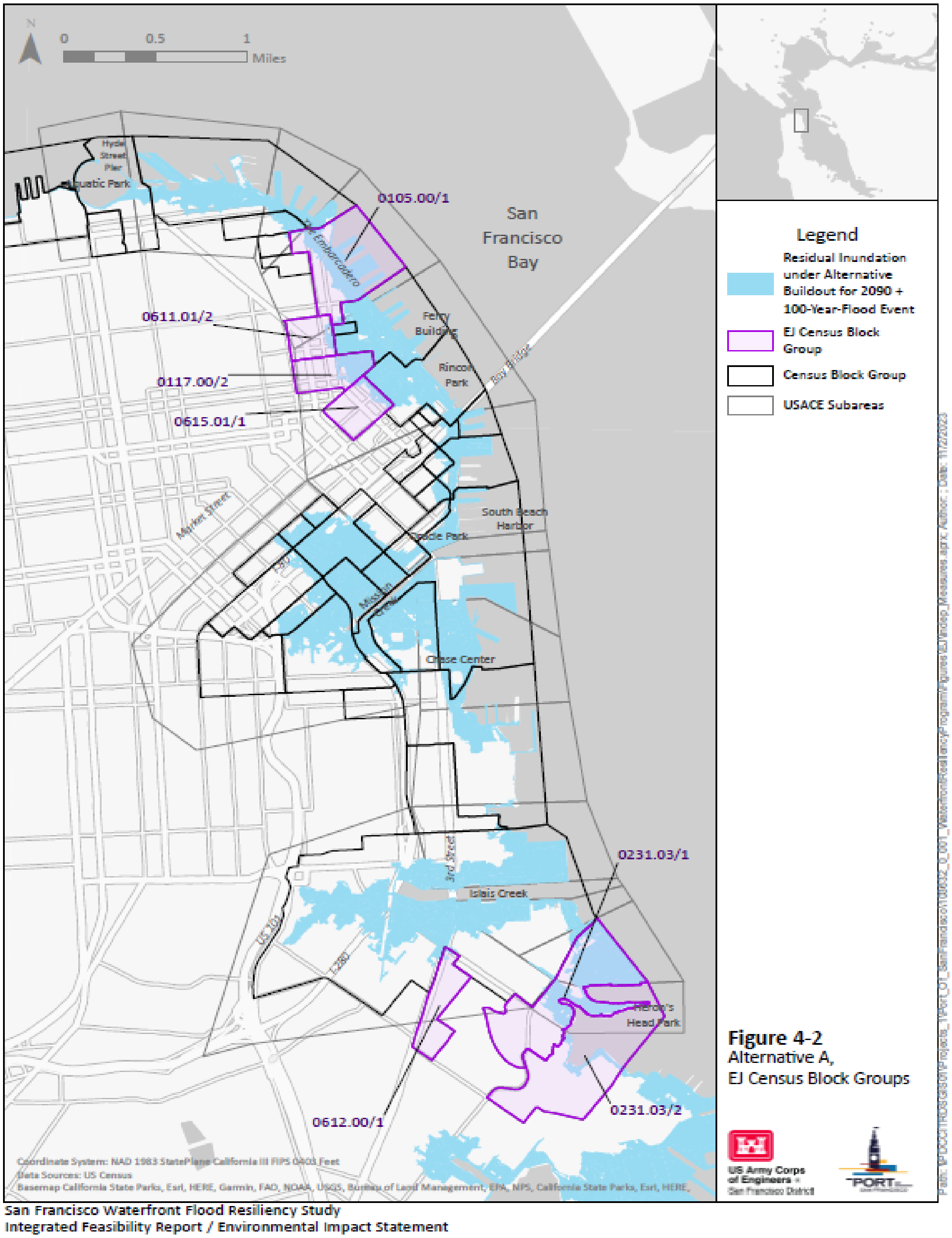


Figure 2-1. Alternative A (FWOP) Inundation.

Note: figure included her for comparative purposes, Alternative A (FWOP) not included in the appendix discussion but in the No Action separate discussion)

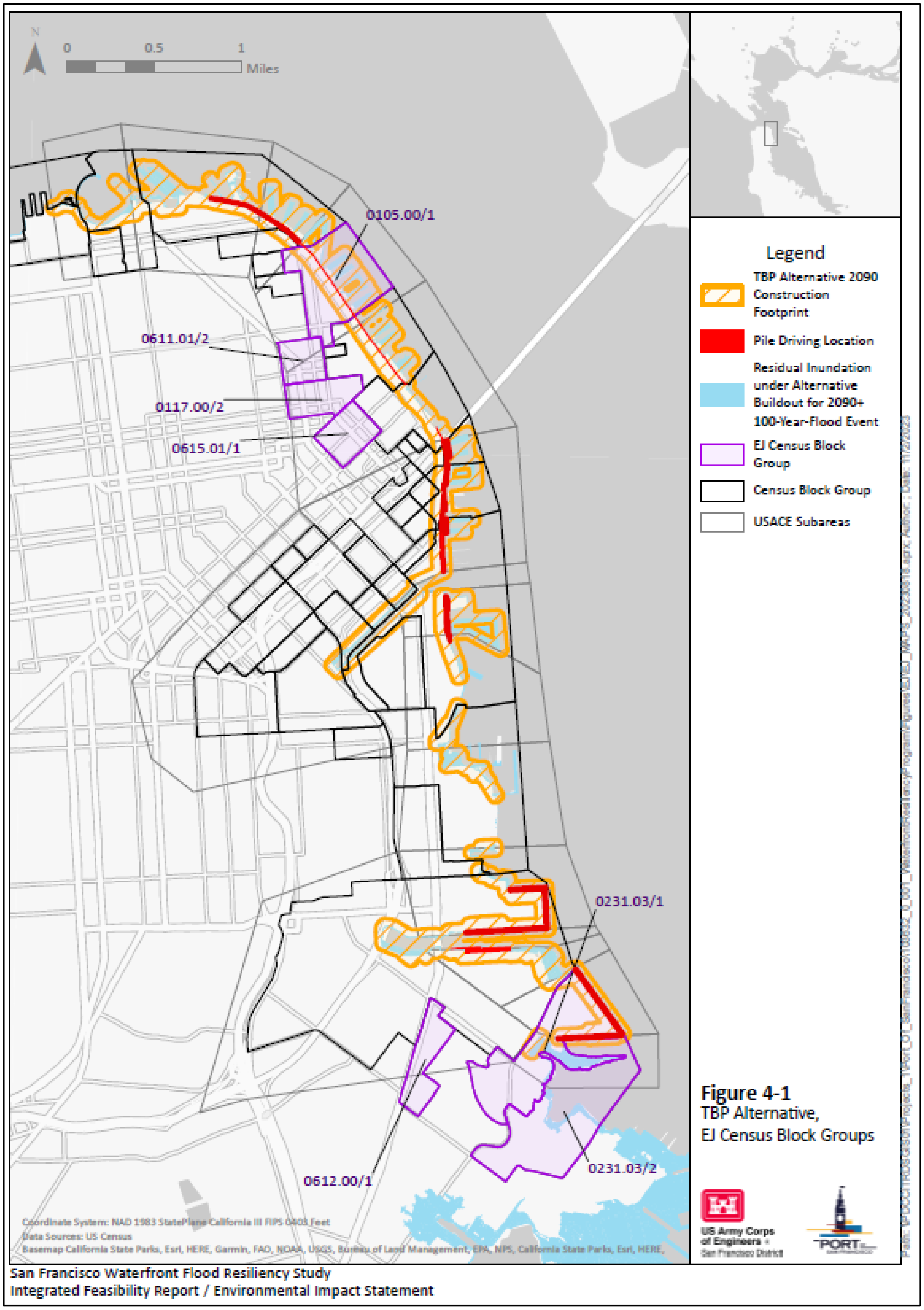


Figure 2-2. Alternative TNBP Inundation

Construction related to dry-floodproofing would be limited to short construction periods per project site and would not divide communities. The construction of the TNBP LOD features would have limited shoreline effects and would not divide a community given their coastal boundary location (Figure 2-2). In addition, use of AMMs would serve to minimize construction disturbance for all construction activities.

2.3.3.1.2 Displacement

With respect to inundation, by 2090 (with a 100-year storm), the TNBP would experience residual inundation which would affect 250 acres compared to 1,337 acres under FWOP conditions. However, due to acquisition and demolition under this alternative many of the uses in this area would already be removed.

Under FWOP conditions, in 2090 (with a 100-year storm), flooding would affect residences, commercial and industrial businesses, and community and public facilities in each reach including 11,204 households, 32 affordable housing sites, 127 disadvantaged businesses, 134 acres of open space and 237 public facilities (including Port facilities, community centers, fire and police facilities, libraries, health centers, clinics, and other City department buildings).

With the TNBP, in 2090 (with a 100-year storm), flooding would affect a smaller set of residences, business, and community facilities including 1,333 households, no affordable housing sites, no disadvantaged businesses, no open space and 50 public facilities.

The TNBP does not propose any relocation of residences or community and public facilities, but would require alterations to commercial and industrial businesses, including the demolition of 988,902 square feet of building footprints. By providing an aggressive LOD elevation and retaining much of the existing shoreline, the TNBP requires minimal displacement of existing uses. Additionally, implementation of project construction- and displacement-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-9 would be required to reduce socioeconomic effects related to the TNBP. These AMMs would be required for all future construction activity under the TNBP.

Overall, displacement from the TNBP would be less than that experienced under FWOP conditions, as the TNBP would protect numerous resources that would otherwise suffer from increasing flood frequencies and depths.

2.3.3.1.3 Economics

Overall, the impacts from construction of the TNBP would be less severe than these economic impacts under the FWOP. Under the FWOP, flooding-related displacement would have a substantial adverse effect on Economics, with the coastal neighborhoods as shown on Figure 2-2 experiencing loss in employment, school district funding, or county and City property and sales tax revenues. Based on the findings of the OSE Report, FWOP conditions would result in business interruption losses of $2.17 billion.

Construction under the TNBP would result in a demand for construction jobs. Additionally, by preserving most businesses through construction of a robust LOD and planning for the incremental removal of some existing land uses, the overall population and tax revenues within the City would likely only experience a slight reduction, if at all, but also shift in location. Implementation of project construction- and displacement-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-9 would be required to reduce socioeconomic effects related to the TNBP. These AMMs would be required for all future construction activity under the TNBP.

Overall, economic effects would be less severe than under FWOP conditions.

2.3.3.1.4 Conclusion

Because the TNBP supports the preservation of existing structures and infrastructure relative to FWOP conditions, and long term supports a more aggressive timeline for sea-level-rise defense, the TNBP would preserve substantially more features and values of the existing community relative to the FWOP. While the TNBP includes alterations to the existing community to support some managed retreat inland along the southern waterfront, the new LOD would not generate construction effects that would divide the community and these features would ensure that future flood events do not physically divide the waterfront neighborhoods.

Long term, these protection measures would avoid the worse effects of the FWOP on communities and neighborhoods, displacements, and economics. Additionally, implementation of project construction- and displacement-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-9 would be required for all future construction activity under the TNBP to reduce socioeconomic effects. This impact would be ***less than significant.***

2.3.3.2 Environmental Justice

As discussed previously, specific census blocks in the study area contain minority- and/or low-income (environmental justice) populations. To identify the potentially disproportionate nature of the identified TNBP effects on these populations, Figure 2-1 shows the environmental justice census blocks, USACE reach boundaries, the TNBP construction footprint and pile-driving locations, and the future worst-case flood inundation in year 2090. Of the 45 census blocks in the study area, 7 census blocks comprise an environmental justice population; Table 2-2 presents the study area acreage relative to the environmental acreage along with related TNBP residual inundation area and construction area.

Table 2-2. TNBP Inundation and Construction Areas (Acres)

	Total Area	Total Residual Inundation Area	Percentage (%) of Inundation to Total Area	Total Construction Area	Percentage (%) of Construction to Total Area
Alternative A Study Area (FWOP)	4,580	1,337	29%	0	0%
Alternative TNBP Study Area	4,580	250	5%	957	21%
Identified Environmental Justice Census Blocks	762	51	7%	131	17%

2.3.3.2.1 Flooding- and Displacement-Related Effects

Less-than-significant effects after AMMs and MMs are implemented are identified related to displacement under the TNBP for the topics of socioeconomics, transportation, and aesthetics.

Less-than-significant effects after AMMs are implemented are identified under the TNBP related to socioeconomics; the TNBP would result in limited impacts on communities after AMMs are implemented. Related to this, residual flooding under the TNBP would be reduced from 1,337 acres to 250 acres of land compared to FWOP conditions, an 81 percent reduction overall. In identified environmental justice census blocks, the TNBP would reduce flooding from 762 acres to 51 acres, a reduction of 93 percent. Total flooding would comprise 5 percent of the study area, and flooding in environmental justice census blocks would comprise 7 percent of said blocks. While residual flooding, and displacement related to residual flooding, would be experienced at a two percent higher concentration within environmental justice census blocks, this 2 percent variation would not rise to the level of high and adverse. In addition, it would be substantially less than the concentration of flooding effects under FWOP conditions, and the flooding reduction in environmental justice census blocks would be higher than the reduction overall. Effects would be reduced to less than significant after AMMs with all mitigation applied equally throughout the study area to all construction-related projects. Thus, the less-than-significant socioeconomic effect after AMMs under the TNBP would not be disproportionately felt by an environmental justice population.

As shown in Table 2-3 below, the reduction in flooding is nearly the same for employed vs. unemployed persons, white vs. minority persons, owner-occupied units vs. rental units, and total households vs. household in poverty.

Table 2-3. TNBP Inundation Reduction Comparison (2090, 100-year storm)

Metric	FWOP (Number)	TNBP Alternative (Number)	Reduction (Percentage)	Delta
Employed	14,358	1,748	88%	
Unemployed	5,644	683	88%	Same
White	10,471	1,338	87%	
Minority (Non-White)	12,042	1,354	89%	+2%
Owner-occupied units	3,515	394	89%	
Renter-occupied units	7,690	939	88%	-1%
Total households	11,204	1,333	88%	
Households in Poverty	1,029	115	87%	-1%

Less-than-significant effects after AMMs are implemented are also identified related to transportation; the TNBP would only experience minimal interruptions to transit lines. While burdened communities may rely on impacted transit systems more readily than other populations, overall, the effects on the transportation system would be distributed throughout the study area.

While flooding would remove visual resources, there would be less effect on visual resources compared FWOP conditions so the TNBP would lower visual aesthetic effects. Similar to flooding effects under socioeconomics, the residual flooding effects on aesthetics would be experienced throughout the study area and would not be disproportionately felt by an environmental justice population.

2.3.3.2.2 Construction-Related Effects

A mixture of significant and unavoidable effects and less-than-significant effects after AMMs are implemented are identified for construction-related activities under the TNBP for the topics of localized air quality and noise.

Air quality effects related to compliance with air quality plans and GHG emissions and climate change are determined to be less than significant after AMMs and one MM are implemented. Air quality effects under the TNBP with respect to public health effects are determined to be significant and unavoidable related to localized exposure of sensitive receptors even with implementation of AMMs and two MMs.

Noise effects under the TNBP are determined to be significant and unavoidable after AMMs are implemented with respect to construction noise and construction vibration. Like air quality effects, for each of these noise effects, AMMs are required that would apply to future construction activities and would reduce negative effects.

Based on GIS data for this construction footprint, construction under the TNBP would cover roughly 957 acres of land; of this area, approximately 131 acres of construction would be within environmental justice census blocks. As such, construction would take place across 21 percent of the study area, with 17 percent of environmental justice census blocks also experiencing construction. Given the similar ratio of construction within environmental census block relative to the study area overall, there is not disproportionately greater construction within areas with environmental justice populations.

As shown in Figure 2-1, while some pile driving would also occur near and within environmental justice census blocks, with residential uses located in census block 105.00/1 (Appendix D-1-2, Section 1, Figure 1-1), most of this activity would be located in census blocks without an environmental justice population. Based on relatively even distribution of construction effects throughout study area census blocks, construction-related effects would be distributed throughout the study area and not localized or felt disproportionally by an environmental justice population. Given the wide distribution of project construction effects under the TNBP, the above air quality and noise effects and related AMMs, would not be disproportionately felt by environmental justice populations.

2.3.3.2.3 Conclusion

Overall, while the TNBP would generate an adverse effect, as discussed above, the distribution of these effects (displacement, flooding, and construction) would be dispersed throughout the study area. Therefore, the adverse environmental effects generated under the TNBP would not be disproportionally felt by a minority or low-income population; the effect would be ***less than significant***.

2.3.4 Alternative B: Nonstructural

Alternative B would have the largest construction footprint of all of the alternatives and therefore the greatest impact of the alternatives on socioeconomics and environmental justice, described in more detail below.

2.3.4.1 Socioeconomics

Alternative B includes floodproofing, modifying, or acquiring and demolishing buildings and infrastructure to reduce flood risks. As sea levels rise, areas with higher flood risks may be managed for responsible retreat, while areas with lower risks would be floodproofed or modified. Nature-based features would be added to retreat areas to reduce flood risks, while policy changes (such as zoning) would be implemented to allow for increased housing density and business relocations in inland areas. Essential utilities and major transportation and transit corridors would be relocated or modified to continue providing service.

Some of the actions in Alternative B, such as modifying or demolishing buildings and infrastructure, could have direct effects on socioeconomics. Under the high sea-level-rise scenario, by 2090 1,493 residential, commercial, industrial, institutional, or other city structures would be removed, and 2,782 would be floodproofed. With respect to roadways and transit, by 2090, 88 miles of roadway and 43.2-miles of trackway would be floodproofed. To support the protection of assets under Alternative B a total of 1,138,301 square feet of building and wharf footprints would be demolished, part of a total demolition footprint of 1,974 acres.

2.3.4.1.1 Communities and Neighborhoods

During the forecast flooding events, inundation would still physically divide the waterfront neighborhoods, inhibiting community function and interaction throughout every reach, similar to FWOP conditions; refer to inundation on Figure 1-1 and Figure 1-3.

Consistent with FWOP conditions, future flooding would cover roughly 1,337 acres of land. However, the acquisition and removal of some buildings and the and the dry-floodproofing of structures under Alternative B would provide a beneficial effect against inundation relative to FWOP conditions.

Under FWOP conditions, inundation by 2090 (with the 100 year storm) would expose 134 acres of parks, 22 miles of MUNI transit routes and 42 miles of streets throughout the four reaches. These same areas would be affected by inundation, but due to floodproofing of roadways and transit trackways, impacts on transportation would be less.

While acquisition of structures for demolition would disrupt existing communities and neighborhoods, the affected structures would otherwise be affected by flooding anyway and relocation could also have an indirect beneficial effect of invigorating other areas within San Francisco and dry-floodproofing structures within the study area would preserve community features through 2090 worst-case scenario flooding.

2.3.4.1.2 Displacement

With respect to inundation, by 2090 (with a 100 year storm), Alternative B would experience the residual inundation of 1,337 acres which is the same as under FWOP conditions and flooding would affect the same locations as the residences, businesses, parks, transit routes and city facilities as under FWOP conditions. However, due to removal of some structures and floodproofing of structures and many miles of roads and transit trackway, the consequences of that flooding would be much lower than under FWOP conditions.

This alternative would require substantial displacement of residences, commercial and industrial businesses, and community and public facilities as part of building acquisition and demolition. According to GIS data, Alternative B would involve the demolition of nearly 1,168 structures covering 1.1 million square feet of building demolition and 44,270 square feet of pier/wharf removal. Implementation of project construction- and displacement-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-9 would be required to reduce socioeconomic effects related to Alternative B. These AMMs would be required for all future construction activity.

Overall, displacement would be less than what would occur under FWOP conditions due to the reduction of flooding disruption.

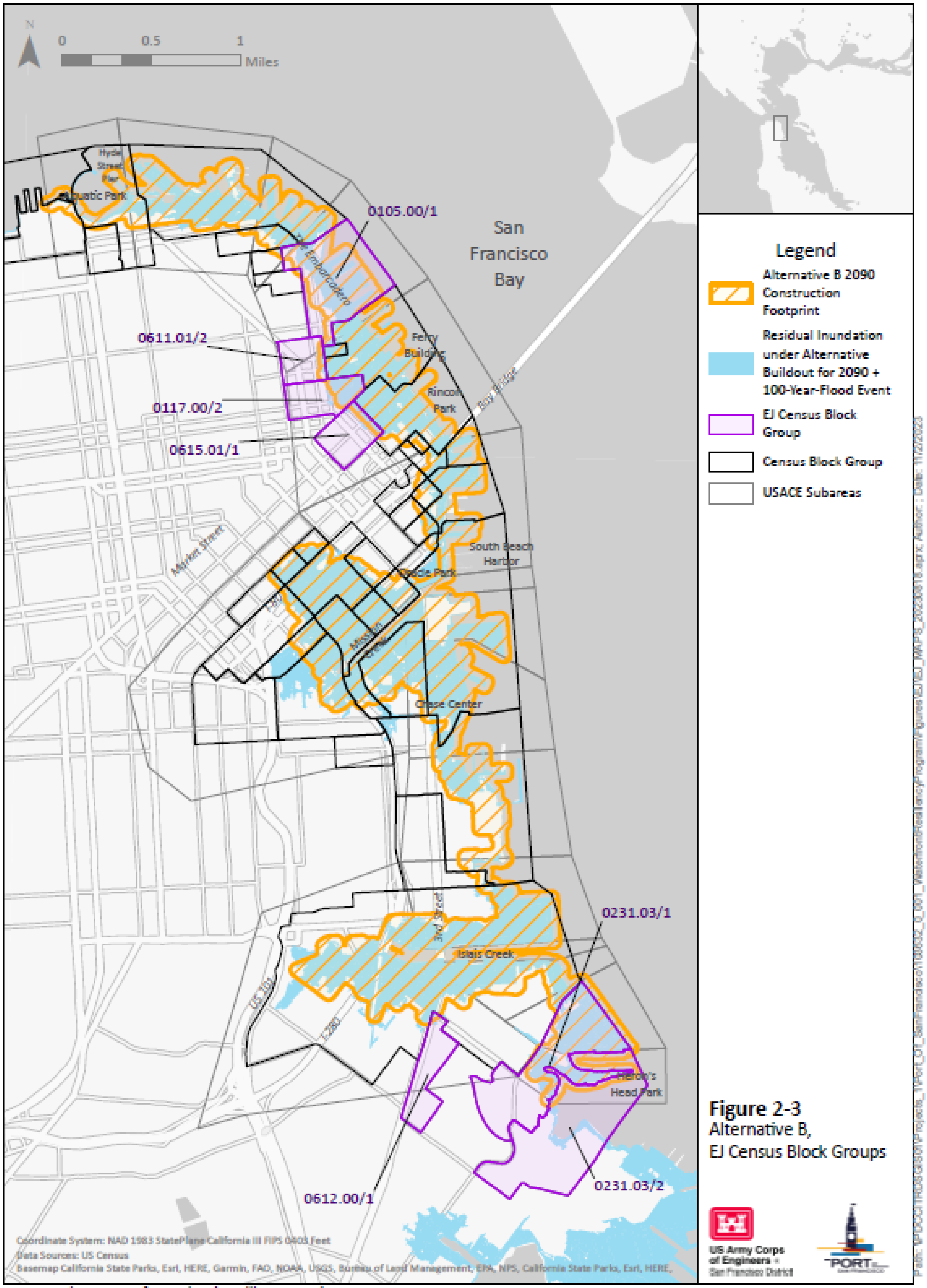
2.3.4.1.3 Economics

Demolition would result in displacement of economic activity, while at the same time demolition would result in an increase in construction-related employment. Additionally, by planning for the staggered removal of residences, commercial and industrial businesses, and community and public facilities, the overall population and tax revenues within the City would experience a shift in location. Implementation of project construction- and displacement-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-9 would be required to reduce socioeconomic effects related to Alternative B. These AMMs would be required for all future construction activity under Alternative B.

Overall, economic effects would be less severe than under the FWOP due to reduction of flooding disruption.

2.3.4.1.4 Conclusion

While future inundation under Alternative B would be similar to that described in Section 3, *Existing and Future Without Project Conditions*, with flooding events physically dividing the waterfront neighborhoods, inhibiting community function and interaction, the planned removal of land uses provided under this alternative would largely mitigate a substantial adverse effect on employment, school district funding, or county and city property and sales tax revenues, and dry-floodproofing would support many coastal-lying features of the City from being irrevocably lost. Implementation of project construction- and displacement-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-9 would be required to reduce socioeconomic effects related to Alternative B. These AMMs would be required for all future construction activity under Alternative B. Overall, this impact would provide beneficial effects when compared with the FWOP and socioeconomic effects would, therefore, be ***less than significant.***



San Francisco Waterfront Flood Resiliency Study
Integrated Feasibility Report / Environmental Impact Statement

Figure 2-3. Alternative B Inundation

2.3.4.2 Environmental Justice

As discussed previously, specific census blocks in the study area contain minority- and/or low-income (environmental justice) populations. To identify the potentially disproportionate nature of the identified Alternative B effects on these populations, Figure 2-3 shows the environmental justice census blocks, USACE reach boundaries, the Alternative B construction footprint, and future worst-case flood inundation in year 2090. Of the 45 census blocks within the study area, 7 census blocks comprise an environmental justice population; Table 2-4 presents the study area acreage relative to the environmental acreage along with related Alternative B residual inundation area and construction area.

Table 2-44. Alternative B Inundation and Construction Areas (Acres)

	Total Area	Total Residual Inundation Area	Percentage (%) of Inundation to Total Area	Total Construction Area	Percentage (%) of Construction to Total Area
Alternative A Study Area (FWOP)	4,580	1,337	29%	0	0%
Alternative B Study Area	4,580	1,337	29%	1,974	43%
Identified Environmental Justice Census Blocks	762	181	24%	272	36%

2.3.4.2.1 Flooding- and Displacement-Related Effects

Less-than-significant effects after AMMs are implemented are identified related to future flooding and displacement under Alternative B for the topics of socioeconomics, transportation, and aesthetics.

Less-than-significant effects after AMMs are implemented under Alternative B are identified related to socioeconomics; Alternative B would result in fewer socioeconomics impacts relative to FWOP conditions. Related to this, future flooding under Alternative B would cover roughly 1,337 acres of land, and of this area approximately 164 acres of flooding would fall within environmental justice census blocks. Total flooding would comprise 29 percent of the study area, and flooding in environmental justice census blocks would comprise 24 percent of these blocks. Future flooding, and displacement related to flooding, would be experienced across the study area, with fewer effects within environmental justice census blocks. Given the wide distribution of flooding and displacement effects under Alternative B and the equal application of AMMs through this area, the less-than-significant effect after AMMs are implemented socioeconomic effect under Alternative B would not be disproportionately felt by an environmental justice population.

While there would still be residual flooding affecting transit with Alternative B, Alternative B would provide floodproofing for transit lines and roadways, which would lower the level of flooding-related disruption compared to FWOP conditions.

While flooding would remove visual resources with floodproofing provided under Alternative B, less structures would be adversely affected and, thus, Alternative B would still have a significant but lower effect on community character than FWOP conditions, particularly in the Southern Waterfront.

2.3.4.2.2 Construction-Related Effects

A mixture of significant and unavoidable effects and less-than-significant effects after AMMs are implemented are identified for construction-related activities under Alternative B for the topics of air quality and noise.

Air quality effects related to compliance with air quality plans and GHG emissions and climate change are determined to be less than significant after AMMs and one MM are implemented. Air quality effects under Alternative B with respect to public health effects are determined to be significant and unavoidable related to localized exposure of sensitive receptors even with implementation of AMMs and two MMs.

Noise effects under Alternative B are determined to be less than significant after AMMs are implemented with respect to construction noise and construction vibration for building removal due to flooding. Like air quality effects, for each of these noise effects AMMs are required that would apply to future construction activities equally throughout the study area and would reduce negative effects.

Construction under Alternative B by 2090 would involve floodproofing of 2,782 structures, 88 miles of roadway and 43.2 miles of trackway along with the demolition of 1,168 structures. As shown in Figure 2-3, this disturbance area would be distributed throughout the study area and would not be localized or felt disproportionally by an environmental justice population. Based on GIS data for this construction footprint and noted in Table 2-3, there would be approximately 1,974 acres of construction activity (floodproofing and demolition) across the 4,580-acre study area; of this construction area 272 acres would be within environmental justice census blocks. As such construction would take place across 43 percent of the study area, with only 36 percent of environmental justice census blocks experiencing construction. Given the wide distribution of project construction effects and equal application of AMMs under Alternative B, the above air quality and noise effects and related AMMs, would not be disproportionately felt by environmental justice populations.

2.3.4.2.3 Conclusion

Overall, while Alternative B would generate significant adverse effects as well as mitigable effects as discussed above, the distribution of these effects would be dispersed throughout the study area. Therefore, the environmental effects generated under Alternative B would not be disproportionally felt by a minority or low-income population; the effect would be ***less than significant***.

2.3.5 Alternative F: Manage the Water, Scaled for Higher Risk

Table 2-5 shows a summary of the socioeconomics and environmental justice impacts associated with Alternative F. Alternative F would experience a similar amount of construction as under the TNBP and therefore would result in similar socioeconomic and environmental justice impacts as the TNBP, described in more detail below.

Table 2-55. Summary of Socioeconomic and Environmental Justice Impacts Associated with Alternative F

Alternative F Socioeconomics and Environmental Justice Impact Rating by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	3	3	3	3	3	3	3	3	3	3	3
O&M Assumptions	1	1	1	1	1	1	1	1	1	1	1
Mitigated Rating	2	2	2	2	2	2	2	2	2	2	2

* Denotes EWN measure.

2.3.5.1 Socioeconomics

Alternative F proposes a coastal flood defense infrastructure that relies on the construction of tide gates, shoreline extensions, levees, raised roads, and floodwalls along the current Bay shoreline, following the “manage the water” strategy. The shoreline is extended into the Bay to make space for underground stormwater storage capacity. Inland drainage modifications may include measures such as consolidation of combined sewer discharge outfalls, new pumps, and green infrastructure. Floodproofing of maritime and industrial facilities is also included, while residual coastal and inland flood risk could be addressed through floodproofing.

Alternative F integrates typical passive flood protection measures near the existing shoreline and would transform some parts of the waterfront to enable active flood response management. Compared to future inundation conditions addressed in Section 3*, Existing and Future Without Project Conditions*, Alternative F provides adaptive measures to increase levee heights for the high sea-level-rise scenario along Illinois

Street and other inland locations such that coastal portions of the plan area (Potrero Hill and Bayview neighborhoods) would experience inundation with 7 feet of sea-level rise. To accommodate these sea-level-rise protection measures, an overall estimate of 1.5 million square feet of building footprints would be demolished and 15,790 linear feet of wharf would be replaced. Direct construction effects related to 2090 sea-level rise would be extensive as Alternative F involves a substantial building alteration effort, and the LOD would move landward to Illinois Street with buildings removed and demolished. Based on GIS data, approximately 839 acres of land would experience construction activity.

2.3.5.1.1 Communities and Neighborhoods

Residual future flooding under Alternative F would cover 403 acres of land, compared to 1,337 acres under FWOP conditions.

Under FWOP conditions, inundation by 2090 (with the 100-year storm) would expose 134 acres of parks, 22 miles of MUNI transit routes and 42 miles of streets throughout the four reaches. By contrast, under the Alternative F, no parks and no MUNI transit routes and only 2 miles of streets would be inundated.

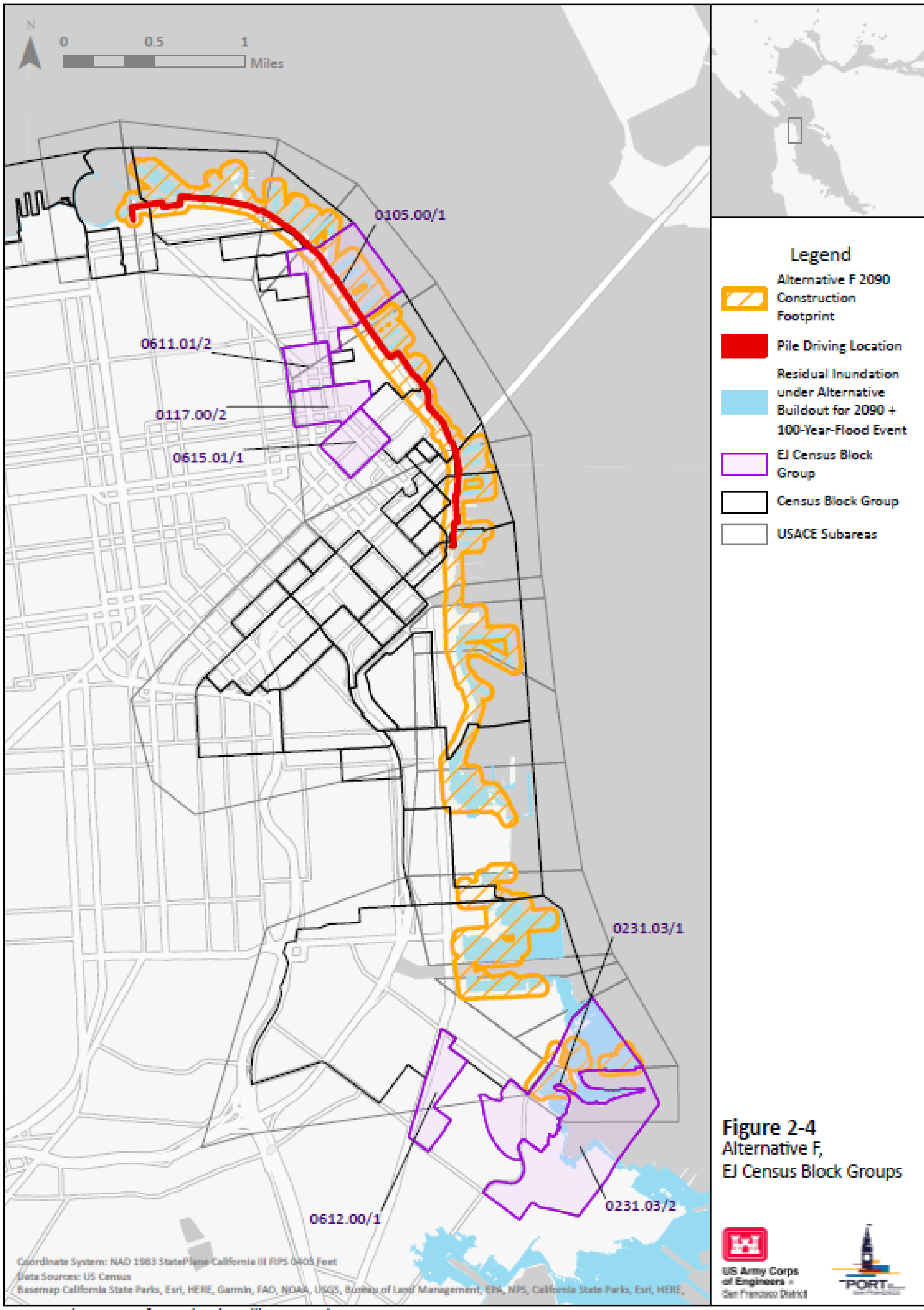
Floodproofing structures and transit systems and construction of an elevated LOD would have beneficial effects on communities and neighborhoods within the plan area by preserving community features during the worst-case scenario flooding through 2090.

Construction related to dry-floodproofing would be limited to short construction periods per project site and would not divide communities. The construction of the Alternative F LOD features would have limited shoreline effects and would not divide a community given their coastal boundary location (Figure 2-4). In addition, use of AMMs would serve to avoid construction disturbance for all construction activities related to communities and neighborhoods.

2.3.5.1.2 Displacement

Under FWOP conditions, in 2090 (with a 100-year storm), flooding would cause the affect residences, commercial and industrial businesses, and community and public facilities in each reach including 11,204 households, 32 affordable housing sites, 127 disadvantaged businesses, 134 acres of open space and 237 public facilities (including Port facilities, community centers, fire and police facilities, libraries, health centers, clinics, and other City department buildings).

With Alternative F, in 2090 (with a 100-year storm), flooding would affect a smaller set of residences, business, and community facilities including 1,437 households, no affordable housing sites, two disadvantaged businesses, no areas of open space and only 92 public facilities.



San Francisco Waterfront Flood Resiliency Study
Integrated Feasibility Report / Environmental Impact Statement

Figure 2-4. Alternative F Inundation

This alternative does not propose any relocation of residences, and community and public facilities, but would require alterations to commercial and industrial businesses, including 1.5 million square feet of demolition and 15,790 linear feet of wharf replacement. Implementation of project construction- and displacement-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-9 would be required to reduce socioeconomic effects related to Alternative F. These AMMs would be required for all future construction activity.

Overall, displacement would be less than what would occur under FWOP conditions, No Action.

2.3.5.1.3 Economics

Based on the findings of the OSE Report, Alternative F, would result in total business interruption costs of $235 million.

Construction under this alternative would result in construction jobs-demand. Additionally, by preserving most businesses through construction of a robust LOD and planning for the incremental removal of some existing land uses, the overall population and tax revenues within the City would likely only experience a slight reduction, if at all, but would also shift in location. Implementation of project construction- and displacement-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-9 would be required to reduce socioeconomic effects related to Alternative F. These AMMs would be required for all future construction activity under Alternative F.

Overall, economic effects would be less severe than under FWOP conditions, No Action.

2.3.5.1.4 Conclusion

Because Alternative F would support the preservation of existing structures and infrastructure relative to FWOP conditions and long-term supports a more aggressive timeline for sea-level-rise defense, Alternative F would preserve substantially more features and values of the existing community relative to the FWOP. While Alternative F includes alterations to the existing community to support some managed retreat inland along the southern waterfront, the new LOD would not generate construction effects that would divide the community. These features would ensure that future flood events do not physically divide the waterfront neighborhoods. Long term, these protection measures would avoid the worse effects of FWOP on employment, school district funding, or county and city property and sales tax revenues. Implementation of project construction- and displacement-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-9 would be required for all future construction activity under Alternative F to reduce socioeconomic effects. This impact would be ***less than significant.***

2.3.5.2 Environmental Justice

As discussed previously, specific census blocks in the study area contain minority- and/or low-income (environmental justice) populations. To identify the potentially disproportionate nature of the identified Alternative F effects on these populations, Figure 2-4 shows the environmental justice census blocks, USACE reach boundaries, the Alternative F construction footprint and pile driving locations, and the future worst-case flood inundation in year 2090. Of the 45 census blocks within the study area, 7 census blocks comprise an environmental justice population; Table 2-6 presents the study area acreage relative to the environmental acreage along with related Alternative F residual inundation area and construction area.

Table 2-66. Alternative F Inundation and Construction Areas (Acres)

	Total Area	Total Residual Inundation Area	Percentage (%) of Inundation to Total Area	Total Construction Area	Percentage (%) of Construction to Total Area
Alternative A Study Area	4,580	1,337	29%	0	0%
Alternative F Study Area	4,580	403	9%	839	18%
Identified Environmental Justice Census Blocks	762	116	15%	129	17%

2.3.5.2.1 Flooding- and Displacement-Related Effects

Less-than-significant effects after AMMs are implemented are identified related to future flooding and displacement under Alternative F for the topics of socioeconomics, transportation, and aesthetics.

Less-than-significant effects after AMMs are implemented are identified under Alternative F related to socioeconomics; Alternative F would result in limited impacts on communities after AMM measures are implemented. Related to this, residual flooding under Alternative F would be reduced from 1,337 acres under FWOP conditions to 403 acres of land, an overall reduction of 70 percent. In environmental justice census blocks, flooding would be reduced from 762 acre to 116 acres, a reduction of 85 percent. Total flooding would comprise 9 percent of the study area, and flooding in environmental justice census blocks would comprise 15 percent of said blocks. While residual flooding, and displacement related to residual flooding, would be experienced at a greater concentration within environmental justice census blocks than the study area, it would still be substantially less than the concentration of flooding effects under FWOP conditions and the percent flooding reduction in environmental justice census blocks will be greater than the reduction overall. Ultimately, given the beneficial flooding prevention measures, the wide distribution of flooding and displacement effects under Alternative F, and the equal application of AMMs through this area, the less-than-significant effect after AMMs are implemented under Alternative F would not be disproportionately felt by an environmental justice population.

As shown in Table 2-7 below, the reduction in flooding is nearly the same for employed vs. unemployed persons, white vs. minority persons, owner-occupied units vs. rental units, and total households vs. household in poverty.

Table 2-7. Alternative F Inundation Reduction Comparison (2090, 100 year storm)

Metric	FWOP (Number)	Alternative F (Number)	Reduction (Percentage)	Delta
Employed	14,358	1,853	88%	
Unemployed	5,644	754	87%	-1%
White	10,471	1,397	87%	
Minority (Non-White)	12,042	1,604	87%	Same
Owner-occupied units	3,515	400	89%	
Renter-occupied units	7,690	1,037	87%	-2%
Total households	11,204	1,437	87%	
Households in Poverty	1,029	138	87%	Same

Less-than-significant effects after AMMs are implemented are identified under Alternative F are also identified related to transportation; Alternative F would only experience inundation of 0.1 mile of BART lines, no MUNI lines, and only 2 miles of streets. While burdened communities may rely on impacted transit systems more readily than other populations, overall, as with the discussion related to socioeconomics, the effects on the transportation system would be distributed throughout the study area.

While residual flooding would remove visual resources, the area of effect would be much smaller with Alternative F compared to FWOP conditions. Similar to flooding effects under socioeconomics, the flooding effects to aesthetics would be experienced throughout the study area and be substantially less than under FWOP conditions and would not be disproportionately felt by an environmental justice population.

2.3.5.2.2 Construction-Related Effects

A mixture of significant and unavoidable effects and less-than-significant effects after AMMs are implemented are identified for construction-related activities under Alternative F for the topics of air quality and noise.

Air quality effects related to compliance with air quality plans, GHG emissions, and climate change are determined to be less than significant after AMMs and one MM are implemented. Air quality effects under Alternative F with respect to public health are determined to be significant and unavoidable related to localized exposure of sensitive receptors even with implementation of AMMs and two MMs.

Noise effects under Alternative F are determined to be significant and unavoidable after AMMs are implemented with respect to construction noise and construction vibration. Like air quality effects, for each of these noise effects AMMs are required that would apply to future construction activities and would reduce negative effects.

Based on GIS data for this construction footprint, construction under Alternative F would cover roughly 839 acres of land; of this area, approximately 129 acres of construction would be within environmental justice census blocks. As such construction would take place across 18 percent of the study area, with 17 percent of environmental justice census blocks also experiencing construction. Given the parallel ratio of construction within environmental census block relative to the study area overall, there is not disproportionately greater construction within areas with environmental justice populations.

As shown in Figure 2-4, while some pile driving would also occur near and within environmental justice census blocks; with residential uses located in census block 105.00/1 (Appendix D-1-2, Noise and Vibration, Figure 1-1), most of this activity would be located in census blocks without an environmental justice population. Based on relatively even distribution of construction effects throughout study area census blocks, construction-related effects would be distributed throughout the study area and not localized or felt disproportionally by an environmental justice population.

Given the wide distribution of project construction effects under Alternative F, the above air quality and noise effects and related AMMs, would not be disproportionately felt by environmental justice populations.

2.3.5.2.3 Conclusion

Overall, while Alternative F would generate significant adverse effects as well as mitigable effects, as discussed above, the distribution of these effects (displacement, flooding, and construction) would be dispersed throughout the study area, additionally the effects are experienced at a substantially reduced percentage than under FWOP conditions. Therefore, the adverse environmental effects generated under Alternative F would not be disproportionally felt by a minority or low-income population; the effect would be ***less than significant***.

2.3.6 Alternative G: Partial Retreat, Scaled for Higher Risk

Table 2-8 shows a summary of the socioeconomics and environmental justice impacts associated with Alternative G. Alternative G would have the second largest construction footprint among the alternatives, and therefore the second largest impact on socioeconomics and environmental justice.

Table 2-8. Summary of Socioeconomic and Environmental Justice Impacts Associated with Alternative G

Alternative G Socioeconomic and Environmental Justice Impact Rating by Measure	**Levee**	**Bridge raise**	**Bulkhead wall/Seawall**	**Roadway Impact**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint	3	3	3	3	3	3	3	3	3	3	3	3
O&M Assumptions	1	1	1	1	1	1	1	1	1	1	1	1
Mitigated Rating	2	2	2	2	2	2	2	2	2	2	2	2

* Denotes EWN measure.

2.3.6.1 Socioeconomics

Alternative G would construct flood defense structures and floodproof buildings in Mission Bay, Islais Creek/Bayview area, and Embarcadero. The alternative involves building levees, floodwalls, seawalls, and closure structures, along with floodproofing and converting some areas to natural and nature-based features. By 2040, the alternative aims to defend against 3.5 feet of sea-level rise and requires reconfiguration of transportation and infrastructure. By 2090, the alternative aims to construct a new levee to defend against up to 7 feet of sea-level rise and establish floodable open space zones. The plan also includes modifying zoning, investing in public access improvements along the creek, and expanding bridges into causeways. In The Embarcadero geography, this alternative involves building an elevated shoreline with a new seawall and short floodwall, reconstructing The Embarcadero roadway, and raising buildings to defend against sea-level rise. The shoreline would be elevated to defend against 7 feet of sea-level rise by 2090. Over the long term, it would establish new open spaces and wetlands, and would require relocating or adapting some buildings and jobs within the retreated areas.

To support these sea-level-rise protection measures, an overall estimate of 8.4 million square feet of building footprints would be demolished and 27,270 linear feet of wharf would be replaced. Direct construction effects related to 2090 sea-level rise, would be extensive as Alternative G involves a substantial building alteration effort, and as the LOD would move further landward relative to Alternative F with more buildings removed and demolished. Based on GIS data approximately 1,629 acres of land would experience construction activity.

Compared to future inundation conditions addressed in Section 3*, Existing and Future Without Project Conditions*, Alternative G provides adaptive measures to increase levee heights for the high sea-level-rise scenario inland locations such that coastal portions of the plan area (SoMa, Potrero Hill, and Bayview Neighborhoods) would experience inundation with 7 feet of sea-level rise.

2.3.6.1.1 Communities and Neighborhoods

Residual future flooding under Alternative G would cover 710 acres of land, compared 1,337 acres under FWOP condition. With respect to transit, it is expected that residual flooding would affect 1.1 miles of Caltrain and 0.1 mile of BART and 3 miles of MUNI routes.

Managed retreat and an elevated LOD would have beneficial effects on communities and neighborhoods within the study area by preserving community features during the worst-case scenario flooding through 2090.

Construction of Alternative G would be extensive to account for elevated roadways and structures, and as the shoreline moves landward along with the LOD. Retreat and required demolition under this alternative would not be limited to the shoreline, expanding shoreward and eliminating entire sections of communities and neighborhoods as a total of 8.4- million square feet of structure footprint would be removed. While this retreat may not specifically divide a community, it would eliminate some portions of the neighborhoods. Throughout required construction under Alternative G, use of AMMs would serve to avoid and limit construction disturbance.

2.3.6.1.2 Displacement

With respect to inundation, by 2090 (with a 100-year storm), Alternative G would experience residual inundation which would affect 1,337 acres compared to 1,337 acres under FWOP conditions. However, due to acquisition and demolition under this alternative many of the uses in this area would already be removed.

Under FWOP conditions, in 2090 (with a 100-year storm), flooding would affect residences, commercial and industrial businesses, and community and public facilities in each reach including 11,204 households, 32 affordable housing sites, 127 disadvantaged businesses, 134 acres of open space and 237 public facilities (including Port facilities, community centers, fire and police facilities, libraries, health centers, clinics, and other City department buildings).

With Alternative G, in 2090 (with a 100-year storm), flooding would affect a smaller set of residences, business, and community facilities including 4,335 households, 10 affordable housing sites, 14 disadvantaged businesses, no open space and 111 public facilities.

This alternative proposes the demolition of residences and community and public facilities and would require alterations to commercial and industrial businesses along wharf structures. As noted previously, retreat and required demolition under this alternative would remove approximately 8.4 million square feet of structure footprints. Implementation of project construction- and displacement-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-9 would be required to reduce socioeconomic effects related to Alternative G. These AMMs would be required for all future construction activity.

Overall, displacement would be less than that experienced under FWOP conditions.

2.3.6.1.3 Economics

Construction under this alternative would result in construction jobs-demand. The planned shoreline elevation and retreat would require the displacement of some businesses that would preserve existing employment along with City property and sales tax revenues, the managed retreat of the shoreline would result in a loss of land uses in the City that generate tax revenues. Overall, implementation of construction and relocation related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-9 would be required to reduce socioeconomic impacts related to Alternative G construction. Based on the findings of the OSE Report, Alternative G would result in business interruption costs of $129 million, much less than under FWOP conditions and less than Alternative F.

2.3.6.1.4 Conclusion

Because Alternative G would support the preservation of many existing structures and infrastructure relative to FWOP conditions and long term, supports a more aggressive timeline for sea-level-rise defense, it would preserve substantially more features and values of the existing community relative to FWOP. However, to address this inundation, Alternative G includes extensive alterations to the existing community to support the managed retreat of the shoreline inland along the southern waterfront rather than defending at the existing shoreline. This preventive retreat-related demolition would fundamentally alter the community connectivity and character in their respective neighborhoods but would also ensure that flood events do not physically divide the waterfront neighborhoods. Long term, these protection measures would avoid the worse effects of the FWOP on employment, school district funding, or county and city property and sales tax revenues. Further, as noted under the *Economics* analysis, above, the potential productivity losses under Alternative G ($129 million) are less than under the FWOP scenario ($2.17 billion). Additionally, implementation of project construction- and displacement-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-9 would be required for all future construction activity under Alternative G to reduce socioeconomic effects. This impact would be ***less than significant.***

2.3.6.2 Environmental Justice

As discussed previously, specific census blocks in the study area contain minority- and/or low-income (environmental justice) populations. To identify the potentially disproportionate nature of the identified Alternative G effects on these populations, Figure 2-5 shows the environmental justice census blocks, USACE reach boundaries, the Alternative G construction footprint, and pile-driving locations (note, there are none for Alternative G), and the future worst-case flood inundation in year 2090. Of the 45 census blocks in the study area, 7 comprise an environmental justice population. Table 2-9 presents the study area acreage relative to the environmental acreage along with related Alternative G residual inundation area and construction area.

Table 2-9. Alternative G Inundation and Construction Areas (Acres)

	Total Area	Total Residual Inundation Area	Percentage (%) of Inundation to Total Area	Total Construction Area	Percentage (%) of Construction to Total Area
Alternative A Study Area (FWOP)	4,580	1,337	29%	0	0%
Alternative G Study Area	4,580	719	16%	1,629	36%
Identified Environmental Justice Census Blocks	762	116	15%	244	32%

2.3.6.2.1 Flooding- and Displacement-Related Effects

Less-than-significant effects after AMMs are implemented are identified related to future flooding and displacement under Alternative G for the topics of socioeconomics, transportation, and aesthetics.

Socioeconomic effects under Alternative G are determined to be less than significant after AMMs; Alternative G would result in fewer effects on divisions of an established community and alterations to community character than FWOP. Related to this, future flooding under Alternative G would be reduced from 1,337 acres under FWOP conditions to 719 acres, an overall reduction of 46 percent. In environmental justice census blocks, flooding would be reduced from 762 acres to 116 acres, a reduction of 85 percent. Total flooding would comprise 16 percent of the study area, and flooding in environmental justice census blocks would comprise 15 percent of these blocks. Therefore, residual flooding, and displacement related to flooding, would be experienced evenly throughout the study area and environmental justice blocks. Given this distribution of flooding and displacement effects under Alternative G, the less-than-significant effect after AMMs are implemented under Alternative G would not be disproportionately felt by an environmental justice population.

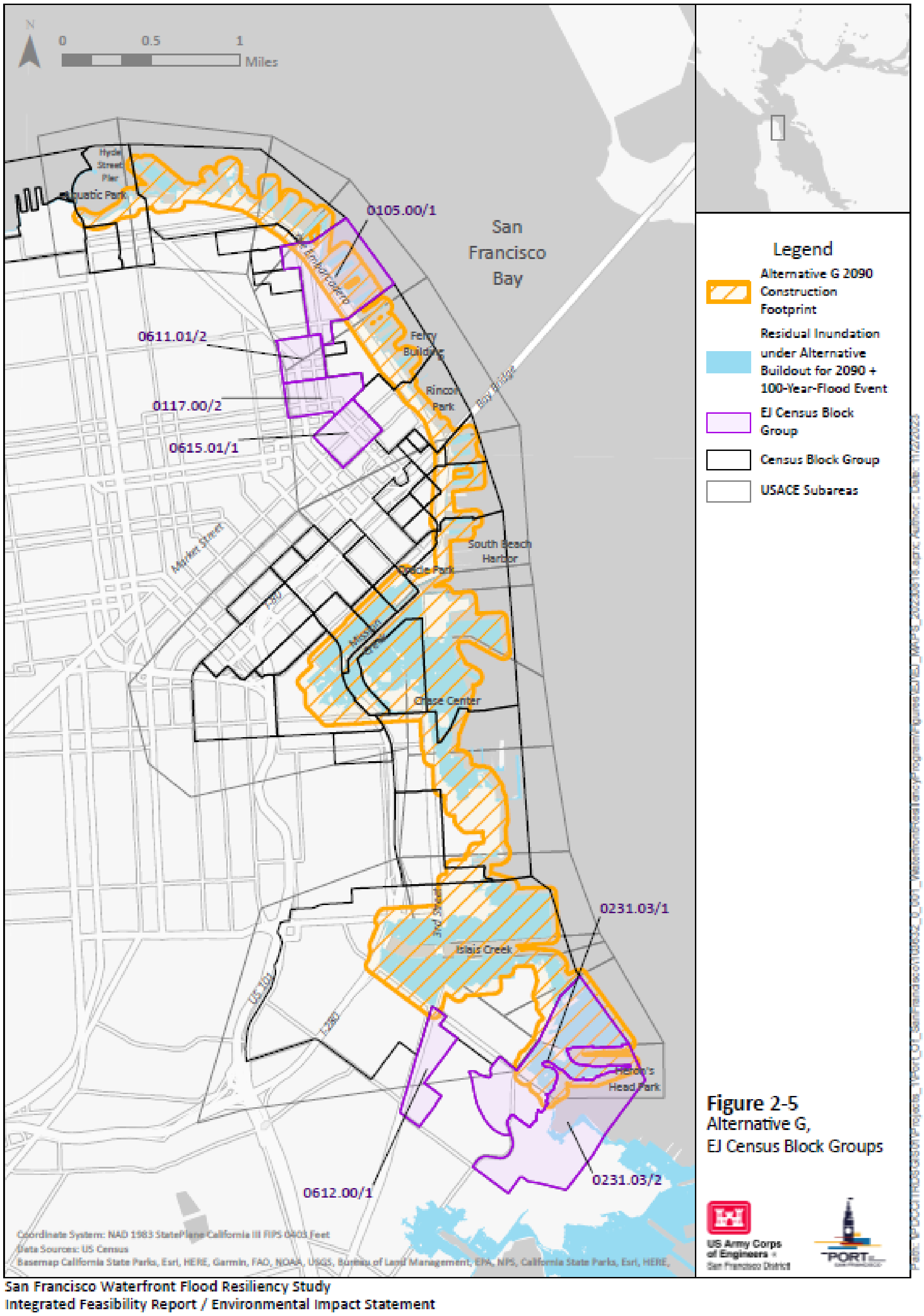


Figure 2-5. Alternative G Inundation

As shown in Table 2-10 below, the reduction in flooding is nearly the same for employed vs. unemployed persons, white vs. minority persons, owner-occupied units vs. rental units, and total households vs. household in poverty.

Table 2-10. Alternative G Inundation Reduction Comparison (2090, 100-year storm)

Metric	FWOP (Number)	Alternative G (Number)	Reduction (Percentage)	Delta
Employed	14,358	5,926	60%	
Unemployed	5,644	2,100	63%	+3%
White	10,471	4,031	62%	
Minority (Non-White)	12,042	4,992	59%	-3%
Owner-occupied units	3,515	1,395	60%	
Renter-occupied units	7,690	2,941	62%	+2%
Total households	11,204	4,335	61%	
Households in Poverty	1,029	469	62%	+1%

Alternative G would have lower effects on transportation than FWOP conditions as Alternative G would only result in compromised capacity of transit associated with inundation of 1.1 miles of Caltrain, 0.1 mile of BART, and 3 miles of MUNI routes by 2090, which is less than the effects with FWOP conditions. While burdened communities may rely on affected transit systems more heavily than other populations, overall, the effects on the transportation system, as with socioeconomic effect would be distributed throughout the study area.

Shoreline elevation and retreat measures would remove and obstruct visual resources, but the area of visual resources removed due to flooding would be much less than with FWOP conditions. Similar to flooding effects under socioeconomics, the flooding effects on aesthetics would be experienced throughout the study area and would not be disproportionately felt by an environmental justice population.

2.3.6.2.2 Construction-Related Effects

A mixture of significant and unavoidable effects and less-than-significant effects after AMMs are implemented are identified for construction-related activities under Alternative G for the topics of air quality and noise.

Air quality effects related to compliance with air quality plans, GHG emissions, and climate change are determined to be less than significant after AMMs and one MM are implemented. Air quality effects under Alternative G with respect to public health effects are determined to be significant and unavoidable related to localized exposure of sensitive receptors even with implementation of AMMs and two MMs.

Noise effects under Alternative G are determined to be less than significant after AMMs are implemented with respect to construction noise and construction vibration. Like air quality effects, for each of these noise effects AMMs are required that would apply to future construction activities and would reduce negative effects.

Construction under Alternative G would cover roughly 1,629 acres. Of this area, approximately 244 acres of construction would be within environmental justice census blocks. The total construction footprint would comprise 36 percent of the study area, and construction in justice census blocks would comprise 32 percent of these blocks. As shown in Figure 2-5, there would be no pile driving associated with this alternative. Based on relatively even distribution of construction effects throughout study area census blocks, construction-related effects would be distributed throughout the study area and not localized or felt disproportionally by an environmental justice population.

Alternative G would result in the demolition and displacement of 8.4 million square feet of structure footprint due to construction, of which 3 percent is in census blocks with environmental justice populations. The identified construction-related effects would be distributed throughout the study area and not localized or felt disproportionally by an environmental justice population. Given the wide distribution of construction effects under Alternative G, the above air quality, noise, socioeconomic, and transportation effects and related AMM's would not be disproportionately felt by environmental justice populations.

2.3.6.2.3 Conclusion

Overall, while Alternative G would generate adverse effects, as discussed above, the distribution of these effects (displacement, flooding, and construction) would be dispersed throughout the study area. Therefore, the adverse environmental effects generated under Alternative G would not be disproportionally felt by a minority or low-income population; the effect would be ***less than significant***.

2.3.7 Independent Measures for Consideration

Table 2-11 shows a summary of the socioeconomic and environmental justice impacts associated with the independent measures.

Table 2-11. Summary of Socioeconomic and Environmental Justice Impacts Associated with the Independent Measures

Independent Measures Air Quality Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	3	3	3	3	3	3	3
O&M Assumptions	2	2	2	2	2	2	2
Mitigated Rating	1	1	1	1	1	1	1

* Denotes EWN measure.

2.3.7.1 Socioeconomics

2A - Robust Coastal Defense of Ferry Building and Agriculture Building

The Robust Coastal Defense of Ferry Building and Agriculture Building independent measure would realign the coastal flood defense structure adjacent to the bayside edge of the Ferry Building and possibly the Agriculture Building along The Embarcadero. This measure would not negatively alter established communities or neighborhoods, nor would it displace residences or business. By defending these structures, this action would support the continued economic activity provided by these resources. Long term, this independent measure would avoid the negative effects of FWOP on socioeconomics at this location. Additionally, implementation of construction-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-7 would be required for construction activity under this measure. This impact would be ***less than significant.***

2B - Coarse Beach at Rincon Park

The Coarse Beach at Rincon Park independent measure would reduce wave hazards, support nearshore ecology, and provide public water access at Rincon Park along The Embarcadero. This measure would not negatively alter established communities or neighborhoods, nor would it cause displacement of residences or business. By defending structures along The Embarcadero, this action would support the continued economic activity provided by resources nearby. Long term, this independent measure would avoid the negative effects of FWOP on socioeconomic effects at this location. Additionally, implementation of project construction-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-7 would be required for construction activity under this measure. This impact would be ***less than significant.***

3A - Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves

The Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves independent measure aims to elevate the existing shoreline from the Bay Bridge to the entrance of Mission Creek. Instead of expanding the shoreline outward into the Bay, this measure focuses on raising the existing shoreline. Additionally, it involves a redesign of the northbound lanes of The Embarcadero roadway. This measure would not negatively alter established communities or neighborhoods, nor would it cause displacement of residences or business. By defending the shoreline at this location and improving The Embarcadero Roadway, this action would support the continued community connectivity and economic activity provided at this location. Long term, this independent measure would avoid the negative effects of FWOP on socioeconomic effects at this location. Additionally, implementation of project construction-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-7 would be required for construction activity under this measure. This impact would be ***less than significant.***

3B - McCovey Cove North Curb Extension

The McCovey Cove North Curb Extension independent measure would raise the shoreline in line with the current shoreline edge on the north side of McCovey Cove, along Oracle Park. This measure would not negatively alter established communities or neighborhoods, nor would it cause displacement of residences or business. By defending the shoreline on the north side of McCovey Cove, along Oracle Park, this action would support the continued economic activity provided by these resources. Long term, this independent measure would avoid the negative effects of FWOP on socioeconomic effects at this location. Additionally, implementation of project construction-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-7 would be required for construction activity under this measure. This impact would be ***less than significant.***

3C - Planted Levee on Mission Bay

The Planted Levee on Mission Bay independent measure would occur south of Pier 50 and would be designed to reduce wave hazards, support nearshore ecology, and provide public water access. This measure would not negatively alter established communities or neighborhoods, nor would it displace residences or business. By defending the coastline at this location, this action would support the continued economic activity provided in Mission Bay. Long term, this protection measure would avoid the negative effects of FWOP on socioeconomic effects at this location. Additionally, implementation of project construction-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-7 would be required for construction activity under this measure. This impact would be ***less than significant.***

4A - Inland Coastal Flood Defense at Southwest Islais Creek

The Inland Coastal Flood Defense at Southwest Islais Creek independent measure would include conversion of some industrial lands and public facilities to provide public water access, open space, and ecological benefits. The activities would occur east of 3rd Street, north of Evans Avenue, and west of Interstate 280. This measure would not negatively alter established communities or neighborhoods, rather it would provide improved recreation and water access under future sea-level-rise inundation. To provide this new open space and ecological habitat, this independent measure would require the removal of some industrial land uses and public facilities. However, by removing these structures it would prevent them from future flooding and support the continued economic activity provided by this region overall. Long term, this independent measure would avoid the negative effects of the FWOP on socioeconomic effects at this location. Additionally, implementation of project construction- and displacement-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-9 would be required for construction activity under this measure. This impact would be ***less than significant.***

Living Seawall

The Living Seawall independent measure would reduce wave hazards while supporting nearshore ecology wherever current maritime uses and pier configurations allow. This measure would not negatively alter established communities or neighborhoods, nor would it cause the displacement of residences or businesses. By reducing wave hazards while supporting nearshore ecology where current maritime uses and pier configurations allow this action would support the continued economic activity provided by resources nearby. Long term, this protection measure would avoid the negative effects of FWOP on socioeconomics at this location. Additionally, implementation of project construction-related measures under AMM-CIA-EJ-1 through AMM-CIA-EJ-7 would be required for construction activity under this measure. This impact would be ***less than significant.***

2.3.7.2 Environmental Justice

2A - Robust Coastal Defense of Ferry Building and Agriculture Building

While the Robust Coastal Defense of Ferry Building and Agriculture Building independent measure would involve 32 acres of construction-related activity, none of this would be located in an environmental justice census block. Therefore, while this action would generate adverse effects related to environmental justice, air quality, noise, and transportation, the distribution of these effects (displacement, flooding, and construction) would not disproportionately affect a minority or low-income population. Therefore, the adverse environmental effects generated under this independent measure would not be disproportionally felt by a minority or low-income population; the effect would be ***less than significant***.

2B - Coarse Beach at Rincon Park

While the Coarse Beach at Rincon Park independent measure would involve 26 acres of construction-related activity, none of this would be located in an environmental justice census block. Therefore, while this action would generate adverse effects related to environmental justice, air quality, noise, and transportation, the distribution of these effects (displacement, flooding, and construction) would not disproportionately affect a minority or low-income population. Therefore, the adverse environmental effects generated under this independent measure would not be disproportionally felt by a minority or low-income population; the effect would be ***less than significant***.

3A - Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves

While the Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves independent measure would involve 62 acres of construction-related activity, none of this would be located in an environmental justice census block. Therefore, while this action would generate adverse effects related to aesthetics, environmental justice, air quality, noise, and transportation, the distribution of these effects (displacement, flooding, and construction) would not disproportionately affect a minority or low-income population. Therefore, the adverse environmental effects generated under this independent measure would not be disproportionally felt by a minority or low-income population; the effect would be ***less than significant***.

3B - McCovey Cove North Curb Extension

While the McCovey Cove North Curb Extension independent measure would involve 13 acres of construction-related activity, none of this would be located in an environmental justice census block. Therefore, while this action would generate adverse effects related to environmental justice, air quality, noise, and transportation, the distribution of these effects (displacement, flooding, and construction) would not disproportionately affect a minority or low-income population. Therefore, the adverse environmental effects generated under this independent measure would not be disproportionally felt by a minority or low-income population; the effect would be ***less than significant***.

3C - Planted Levee on Mission Bay

While the Planted Levee on Mission Bay independent measure would involve approximately 16 acres of construction-related activity, none of this would be located in an environmental justice census block. Therefore, while this action would generate adverse effects related to aesthetics, environmental justice, air quality, noise, and transportation, the distribution of these effects (displacement, flooding, and construction) would not disproportionately affect a minority or low-income population. Therefore, the adverse environmental effects generated under this independent measure would not be disproportionally felt by a minority or low-income population; the effect would be ***less than significant***.

4A - Inland Coastal Flood Defense at Southwest Islais Creek

While the Inland Coastal Flood Defense at Southwest Islais Creek independent measure would involve 74 acres of construction-related activity, and none of this construction would be located in environmental justice census block, the 200-foot buffer from construction activity would overlap slightly with the corner of census block 612.00/1, which is identified as an environmental justice population. Therefore, while this action would generate adverse effects related to environmental justice, air quality, noise, and transportation, the distribution of these effects, specifically construction, would only slightly, and not disproportionately affect a minority or low-income population. Therefore, the adverse environmental effects generated under this independent measure would not be disproportionally felt by a minority or low-income population; the effect would be ***less than significant***.

Living Seawall

While the Living Seawall independent measure would involve construction-related activity in Reaches 1, 2, and 3, this activity would be limited to the shoreline. In addition, of all the coastal census block groups, this activity would extend through only three census blocks comprising an environmental justice population. Therefore, while this action would generate adverse effects related to environmental justice, air quality, noise, and transportation, the distribution of these effects (displacement, flooding, and construction) would not disproportionately affect a minority or low-income population. Therefore, the adverse environmental effects generated under this independent measure would not be disproportionally felt by a minority or low-income population; the effect would be ***less than significant***.

3.0 Mitigation

The following avoidance, minimization, and mitigation measures would be required for all alternatives.

AMM-CIA-EJ-1: EIS Outreach and Communication

Outreach and communication of impacts throughout the design and construction phases during the following stages: (1) Consideration of adverse effects and potential project design modifications; (2) Identification of disproportionately high and adverse effects, and; (3) Development of mitigation. The Port and/or USACE will also conduct additional outreach and communication to unhoused persons during the design and construction phases. An outreach plan for unhoused persons will be developed, in coordination with local agencies and non-profit organizations that work with underserved communities and those experiencing homelessness.

AMM-CIA-EJ-2: Construction and Transportation Management Plan

A Construction and Transportation Management Plan will be developed and implemented by the City and San Francisco Public Works (Public Works) to manage construction routes; road, bikeway and sidewalk closures; and detours for vehicles, transit, bicyclists, and pedestrians in areas that are not actively in preparation for or in process of being demolished. Where access cannot be maintained, temporary detours for cars, bicyclists, pedestrians, and transit will be provided to maintain access to existing residences and businesses for the duration of construction per measures provided in the San Francisco Municipal Transportation Agency (SFMTA) Bluebook. Pedestrian access around construction areas will be preserved at all times. Periodic sidewalk, plaza, or crosswalk closures may occur during sidewalk reconstruction and utility work, and detours will be provided. For all pedestrian facilities, the alternate path of travel will meet the minimum width required to maintain Americans with Disabilities Act compliance.

AMM-CIA-EJ-3: Construction Loading Zones

Loading areas within active construction zones will be relocated as close to the construction zone as practical. Temporary loading zones may be possible under some circumstances.

AMM-CIA-EJ-4: Access Change Notices and Coordination

Advanced notice and coordination with emergency service providers and school officials will minimize potential temporary impacts from access changes, routing and scheduling. USACE and the City will coordinate with service providers as design and phasing is further developed.

AMM-CIA-EJ-5: Utility Relocation and Notification

Utility lines will be relocated by the utility companies, in coordination with the City. Potentially affected utility customers will be notified of potential service disruptions before relocation.

AMM-CIA-EJ-6: Targeted Outreach

Targeted outreach to businesses in the project area will take place to accommodate the loading/unloading needs of each business.

AMM-CIA-EJ-7: Homeless Outreach

The City will conduct targeted outreach to homeless persons within the construction area to notify them at least three days in advance of construction activities.

AMM-CIA-EJ-8: Property Acquisition

Where project construction requires displacement, the City will ensure fair and equitable treatment of affected persons related to relocation assistance and real property acquisition per the Uniform Relocation Assistance and Real Property Acquisition Policies Act.

AMM-CIA-EJ-9: Relocation Implementation Plan

If required, a relocation implementation plan will be prepared to support affected property owners in the event of real property acquisition (could apply to utilities).

4.0 Cumulative and Other Impacts

The 2090 plan-date is the cumulative study timeframe for socioeconomics and environmental justice, and the City is the study area. While there are various land use plans and policies to address regional planning for the future sea-level-rise conditions in the City (refer to Appendix D-1-7, Land Use), at present, there are no actionable items to the scale as the Alternatives B, F, and G, the TNBP, or the independent measures. FWOP conditions in the cumulative environment would result in significant and unavoidable affects to socioeconomics, while Alternatives B, F, G, the TNBP and the independent measures, with implementation of the nine AMMs would reduce avoidable affects. However, given the range of possible future flood inundation and the possible changes in occupancy and land uses between existing conditions and 2090 unrelated to the alternatives, the cumulative impact would be too ***speculative for meaningful consideration.***

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SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY, CA

DRAFT APPENDIX D-1-4 TRANSPORTATION

JANUARY 2024

USACE TULSA DISTRICT | THE PORT OF SAN FRANCISCO

US Army Corps of Engineers

PORT OF SAN FRANCISCO

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Acronyms and Abbreviations

Acronym	Definition
ABAG	Association of Bay Area Governments
AC Transit	Alameda-Contra Costa Transit District
BART	Bay Area Rapid Transit
CalTrans	California Department of Transportation
CTMP	Construction Traffic Management Plan
EWN	Engineering with Nature
FWOP	Future Without Project
GGT	Golden Gate Transit
HSR	High Speed Rail
MME	Muni Metro East
MPO	Metropolitan Planning Organization
MTC	Metropolitan Transportation Commission
MUNI	Municipal Railway
PCJPA	Peninsula Corridor Joint Powers Authority
SamTrans	San Mateo County Transit
SFCTA	San Francisco County Transportation Authority
SFMTA	San Francisco Municipal Transportation Agency
SGI	Seismic Ground Improvements
SoMa	South of Market
WETA	Water Emergency Transportation Authority

1.0 Introduction

This section will address transportation in the area of the project including temporary (construction) and permanent effects on movement of vehicles (major arterials, highway access), train, light rail and bus transit, ferry, pedestrian and bicycle use and access.

2.0 Affected Environment

2.1.1 Regulatory Framework

2.1.1.1 Federal Regulations

There are no federal transportation regulations applicable to the Project.

2.1.1.2 Regional Regulations and Plans

2.1.1.2.1 Plan Bay Area 2050

At the state level, the Sustainable Communities and Climate Protection Act of 2008 mandated the coordination of transportation and land use planning efforts for each metropolitan planning organization (MPO) in California. Under this act, MPOs must adopt a "sustainable communities strategy" as part of their regional transportation plan, including strategies for land use, housing and transportation to reduce greenhouse gas emissions. The San Francisco Bay Area's MPO, a combined partnership of the Metropolitan Transportation Commission (MTC) and the Association of Bay Area Governments (ABAG), initiated Plan Bay Area 2050 in summer 2019 (SFMTA, 2021)

Plan Bay Area 2050 is the Bay Area's 30-year regional plan long-range plan adopted by the MTC and ABAG. The plan was developed in collaboration with Bay Area residents, partner agencies, and nonprofit organizations. It lays out a $1.4 trillion vision for a more equitable and resilient future for Bay Area residents. Thirty-five strategies make up the heart of the plan to improve housing, the economy, transportation and the environment across the Bay Area's nine counties.

Plan Bay Area 2050 serves as the Bay Area's Regional Transportation Plan, as required by federal regulations, and the Sustainable Communities Strategy, as required by state statute. Locally near the San Francisco Waterfront, the Transportation Plan discusses adding new bus routes to service future development sites in Hunters Point and Candlestick Point; a new transbay crossing between Oakland and downtown San Francisco; the Caltrain extension into downtown San Francisco; and investments in regional trails including the Bay Trail.

2.1.1.2.2 Water Emergency Transportation Authority's Water Transportation System Management Plan

The Water Emergency Transportation Authority (WETA) is a regional agency authorized by the State to operate a comprehensive San Francisco Bay Area public water transit system. In 2009, the WETA adopted the Water Transportation System Management Plan, which complements and reinforces other transportation emergency plans that will enable the Bay Area to restore mobility after a regional disaster.

2.1.1.2.3 San Francisco Bay Trail Plan

The Association of Bay Area Governments administers the San Francisco Bay Trail Plan. The San Francisco Bay Trail is a multi-purpose recreational trail that, when complete, will encircle San Francisco Bay and San Pablo Bay with a continuous 500-mile network of bicycling and hiking trails; to date, 338 miles of the alignment have been completed (Association of Bay Area Governments 2020).

2.1.1.3 Local Regulations and Plans

2.1.1.3.1 City and County of San Francisco General Plan

The Transportation Element of the General Plan is composed of objectives and policies that relate to the eight aspects of the citywide transportation system: General Regional Transportation, Congestion Management, Vehicle Circulation, Transit, Pedestrians, Bicycles, Citywide Parking, and Goods Management. The Transportation Element references San Francisco's Transit-First Policy in its introduction. It contains objectives and policies, including objectives related to locating development near transit investments, encouraging transit use, and regulating traffic signal timing to emphasize transit, pedestrian, and bicycle traffic as part of a balanced multimodal transportation system.

The San Francisco Municipal Transportation Agency (SFMTA) is a department of the City and County of San Francisco responsible for the management of all ground transportation in the city. The SFMTA has oversight over the Municipal Railway (Muni) public transit, as well as bicycling, paratransit, parking, traffic, walking, and taxis. SFMTA operates the City's transportation systems and prepared the SFMTA Strategic Plan 2021-2024 (SFMTA 2021).

2.1.1.3.2 Transit-First Policy

In 1998, San Francisco voters amended the City Charter (Charter Article 8A, Section 8A.115) to include a Transit-First Policy, which was first articulated as a City and County of San Francisco (City) priority policy by the Board of Supervisors in 1973. The Transit-First Policy is a set of principles that underscore the City's commitment that travel by transit, bicycle, and foot be given priority over the private automobile. These principles are embodied in the policies and objectives of the Transportation Element of the City General Plan (General Plan).

2.1.1.3.3 San Francisco Bicycle Plan

The San Francisco Bicycle Plan (Bicycle Plan) describes a City program to provide the safe and attractive environment needed to promote bicycling as a transportation mode. The Bicycle Plan identifies the citywide bicycle route network and establishes the level of treatment (i.e., Class I, Class II, or Class III facility) on each route. The Bicycle Plan also identifies near-term improvements, long-term improvements, and minor improvements that would be implemented to facilitate bicycling in San Francisco.

2.1.1.3.4 Better Streets Plan

The San Francisco Better Streets Plan (Better Streets Plan) focuses on creating a positive pedestrian environment through measures such as careful streetscape design and traffic-calming measures to increase pedestrian safety. The Better Streets Plan includes guidelines for the pedestrian environment, which it defines as the areas of the street where people walk, sit, shop, play, or interact.

2.1.1.3.5 Construction Regulations Blue Book

The San Francisco MTA published the Regulations for Working in San Francisco Street, also named the “Blue Book”. This provides direction for agencies working in the City, utility crews, private contractors and other organizations that work on city streets. These regulations set the requirements for working with pedestrian, bicycle, transit, and other traffic to cost the least interference (SFMTA 2023a).

2.1.1.3.6 Blue Greenway

The Port of San Francisco produced the Blue Greenway document to identify a trail and associated recreational and green infrastructure through the implementation of the San Francisco Bay Trail, Bay Area Water Trail, and neighborhood green corridors to advocate for waterfront access. The Blue Greenway parallels the southern waterfront from Mission Creek to the San Francisco city limits south of Hunters Point (Port of San Francisco, 2012).

2.1.2 Existing Condition

This section describes the existing transportation conditions within the project area or construction area, encompassing 7.5 miles from Aquatic Park to Heron’s Head Park and providing a variety of transportation facilities and services, both on the water and throughout the City. Transportation, including all the ways people travel in San Francisco, is overseen primarily by the San Francisco Municipal Transportation Agency, with additional responsibilities overlapping with San Francisco Public Works, the San Francisco County Transportation Authority, and the Port of San Francisco. Additional regional transportation providers provide service to, from, and within San Francisco, including Alameda-Contra Costa Transit District (AC Transit), Bay Area Rapid Transit

(BART), Caltrain, Golden Gate Transit (GGT), WETA, and San Mateo County Transit (SamTrans). The transportation network consists of roadways, local and regional transit facilities, and bicycle and pedestrian networks. Descriptions of these facilities are provided below.

2.1.2.1 Roadway Network

The following includes a discussion of existing roadway systems in the project area, including roadway designations, the number of lanes, and traffic flow directions. The roadway network includes freeways, major arterials, transit preferential streets, secondary arterials, recreational streets, collector and local streets, primary emergency priority routes, and freight truck routes. Detailed descriptions of these functional classifications are provided in the Transportation Element of the General Plan (City and County of San Francisco 2014). The Transportation Sub-Appendix 1, Figures 1 through 11 for each Alternative, includes a map of roadways throughout the Project area.

The project area is served by three highways: Interstates 80 and 280, and U.S.101.

Interstate 80 (I-80) connects San Francisco and the East Bay in an east–west direction via the San Francisco-Oakland Bay Bridge. In San Francisco, the highway connects to U.S. 101 in the Mission Creek subarea.

U.S. 101 links San Francisco to the Peninsula/South Bay and to the North Bay via the Golden Gate Bridge. Local access to I-80 from the project area is provided via access ramps located on Fremont Street in the Ferry Building subarea, Harrison and Brannan streets in the South Beach subarea, and Seventh and Eighth streets in the Mission Creek subarea. The Embarcadero feeds several Bay Bridge access routes.

Interstate 280 (I-280) serves San Francisco and the Peninsula/South Bay. The northern terminus of I-280 is located at King and Brannan streets in the Mission Creek subarea. I-280 runs south from there to San Jose. In San Francisco, the highway connects to U.S. 101 in the Islais Creek subarea. Local access to I-280 from the project area is provided via access ramps located on Pennsylvania Avenue, 18th Street, and Mariposa Street in the Mission Creek subarea; at Pennsylvania Avenue and Cesar Chavez in the Islais Creek subarea; and at Indiana Street in the Pier 80 subarea.

2.1.2.2 Local Access

The roadway network in the project area is generally an east–west and north–south grid. Local access is generally provided by arterial and local roadways in proximity to the project area. Descriptions of these roadways are presented below. Roadways are assumed to have no on-street parking or bicycle facilities unless otherwise noted.

The Embarcadero is a major north–south roadway that connects San Francisco's Fisherman's Wharf subarea with the South Beach subarea where it becomes King Street. The roadway also runs through the Ferry Building, Northeast Waterfront, and Pier 31 to 35 subareas, providing direct access to port facilities, including the Ferry

Building Terminal and James R. Herman Cruise Terminal. The Embarcadero operates with two-way traffic, with generally two travel lanes in each direction between Second and Howard streets, three lanes in each direction between Howard Street and Don Chee Way, three northbound lanes and two southbound lanes between Don Chee Way and Broadway, two lanes in each direction between Broadway and North Point Street, two northbound lanes and one southbound lane between North Point Street and Powell Street, and one lane in each direction between Powell Street and the road's northern terminus at Fisherman's Wharf*.* The Embarcadero has Class II bike lanes in both directions between North Point Street and King Street. Between Broadway and Folsom Street on the east side of the Embarcadero, there is a Class IV separated bikeway. The Promenade along the Embarcadero is a Class I bike lane. Muni light rail and streetcar routes operate in the center median with raised center-island transit stops along the corridor. The roadway is designated as a Primary Arterial Street, Transit Preferential Street, and Freight Truck Route in the General Plan (City and County of San Francisco 2014) and a Primary Emergency Priority Route in the San Francisco Emergency Response Plan (City and County of San Francisco 2017).

Jefferson Street is an east–west roadway that connects Hyde Street and The Embarcadero through the Aquatic Park and Fisherman's Wharf subareas. This roadway provides direct access to Aquatic Park and the Hyde Street Pier. The roadway operates with two-way traffic, with generally one travel lane in each direction. The roadway is designated as a Recreational Street in the General Plan.

Beach Street is an east–west roadway that connects Polk Street and The Embarcadero through the Aquatic Park and Fisherman's Wharf subareas. This roadway provides direct access to Aquatic Park and the Maritime Museum. The roadway operates with two-way traffic, with generally one travel lane in each direction between Polk and Powell streets and generally two travel lanes in each direction between Powell Street and The Embarcadero. The roadway generally has on-street parallel parking on both sides. The roadway is designated as a Recreational Street in the General Plan.

Broadway is an east–west roadway that connects Lyon Street and The Embarcadero through the Northeast Waterfront subarea. The roadway operates with two-way traffic, generally with two travel lanes in each direction and on-street parallel parking on both sides. The roadway is designated as an Arterial Street in the General Plan and a Primary Emergency Priority Route in the San Francisco Emergency Response Plan.

Washington Street is an east–west roadway that connects Steiner Street to The Embarcadero through the Ferry Building and Northeast Waterfront subareas. In the vicinity of the project area, the roadway operates with two-way traffic, with generally two lanes in each direction between The Embarcadero and Drumm Street; however, the roadway also operates with one-way traffic westbound, with one travel lane between Drumm and Battery streets. On-street parallel and 45-degree angled parking is intermittently provided on both sides of the street. The roadway is designated as an

Arterial Street in the General Plan and a Primary Emergency Priority Route in the San Francisco Emergency Response Plan.

Harrison Street is an east–west roadway in the vicinity of the Primary Construction Zone that connects Cesar Chavez and The Embarcadero through the Ferry Building, South Beach, and Mission Creek subareas. This roadway provides access to I-80 and the Bay Bridge from the project area. In the vicinity of the project area, the roadway operates with two-way traffic, with generally one eastbound travel lane and three westbound travel lanes between Essex Street and The Embarcadero. The roadway is designated as an Arterial Street in the General Plan and a Primary Emergency Priority Route in the San Francisco Emergency Response Plan.

Bryant Street is an east–west roadway in the vicinity of the Primary Construction Zone that connects Cesar Chavez and The Embarcadero through the Mission Creek and South Beach subareas. This roadway provides access to I-80 and the Bay Bridge from the project area. Near the project area, Bryant Street operates with two-way traffic, with generally one westbound and two eastbound travel lanes as well as 45-degree diagonal on-street parking on both sides.

Third Street is a north–south roadway that connects Market Street and Bayshore Boulevard through the Ferry Building, South Beach, Mission Rock, Mission Bay, Pier 70, Pier 80, Cargo Way, and Islais Creek subareas. Transit operates in the median south of Channel Street. This roadway provides primary north–south access for port facilities at Piers 48, 50, 52, 54, 70, 80, 90, 92, and 94 to 96. Third Street includes the Lefty O'Doul Bridge in China Basin and Third Street Bridge in Islais Creek. The roadway operates with one-way traffic northbound, with generally four travel lanes between Market and King streets; however, the roadway also operates with two-way traffic, with generally two travel lanes in each direction between King Street and Bayshore Boulevard. On-street parking is intermittently provided on both sides of the street. The roadway has a designated Class III bike route between Cargo Way and Bayshore Boulevard through the Islais Creek subarea and Class IV bikeways crossing over Lefty O'Doul Bridge. The roadway is designated as an Arterial Street and Transit Preferential Street in the General Plan and a Primary Emergency Priority Route in the San Francisco Emergency Response Plan.

Fourth Street is a north–south roadway that connects Market and 16th streets through the South Beach, Mission Creek, and Mission Rock subareas and incudes the Peter R. Maloney Bridge in China Basin. Transit operates in the median between Harrison and Channel Streets. Near the project, the roadway operates with two-way traffic, with generally one northbound lane and two southbound lanes between Bryant and Channel streets and generally one lane in each direction between Channel and 16th streets. Fourth Street is a Class II bike route between Channel and 16th streets and Class IV bikeway between Mission Bay Boulevard North and Mission Bay Boulevard South. The roadway is designated as an Arterial Street in the General Plan and a Primary Emergency Priority Route in the San Francisco Emergency Response Plan.

Terry A. Francois Boulevard is a north–south roadway that connects the San Francisco Bay Trail to Illinois Street through the Mission Rock and Mission Bay subareas. This roadway provides direct access to port facilities at Piers 48, 50, 52, and 54. The roadway operates with two-way traffic, with generally two travel lanes in each direction. The roadway has a Class IV separated bikeway along the east side of the street.

Cesar Chavez is an east–west roadway that connects Noe Street and Maryland Street through the Islais Creek and Pier 80 subareas. This roadway provides direct access to port facilities at Pier 80. The roadway operates with two-way traffic, generally two travel lanes in each direction between Guerrero and Third streets and generally two eastbound and one westbound travel lane between Third and Maryland streets. The roadway generally has on-street parallel parking on both sides. It also has Class IV separated bike lanes in each direction between Kansas and Mississippi streets, Class II bike lanes in each direction between Indiana and Third streets, and a Class III bike route between Third and Illinois streets. The roadway is designated as an Arterial Street in the General Plan and a Primary Emergency Priority Route in the San Francisco Emergency Response Plan.

Cargo Way is an east–west roadway that connects Third and Jennings streets through the Cargo Way and Pier 94 to 96 subareas. This roadway serves as a primary access route to port facilities at Piers 90, 92, and 94 to 96. The roadway operates with generally two travel lanes in each direction and has a Class IV two-way cycle track along the south side of the street between Illinois and Jennings streets and Class II bike lanes in each direction between Third and Illinois streets.

Evans Avenue is an east–west roadway that connects Cesar Chavez and Hunters Point Boulevard through the Islais Creek and Heron's Head subareas and provides direct access to Heron's Head Park. The roadway operates with two-way traffic, with generally two travel lanes in each direction and intermittent on-street parallel parking on both sides. The roadway has Class II bike lanes in both directions between Third Street and Keith Street, Class III bike routes from Cesar Chavez Street to Third Street, and a Class IV bikeway between Keith Street and through Hunters Point Boulevard to Hawes Street. The roadway is designated as an Arterial Street in the General Plan and a Primary Emergency Priority Route in the San Francisco Emergency Response Plan.

Amador Road is an east–west and north–south roadway that connects Cargo Way/Illinois Street and Jennings Street through the Cargo Way and Pier 94 to 96 subareas and provides direct access to Pier 92 and Pier 94 to 96. The roadway operates with two-way traffic, with generally one travel lane in each direction.

Illinois Street is a north–south roadway that connects 16th Street and Cargo Way through the Mission Bay, Pier 70, Pier 80, Islais Creek, and Cargo Way subareas. This roadway provides primary north–south access to port facilities at Piers 70 and 80. The roadway operates with two-way traffic, with generally one travel lane and Class II bike lanes in each direction. Illinois Street includes the Illinois Street Bridge over Islais Creek.

2.1.3 Transit Network

The Project area is well served by San Francisco Municipal Railway (Muni) local public transit service, with 11 Muni bus and rail routes. Regional service is provided by Caltrain and the San Francisco Bay Ferry operated by WETA. The Transportation Sub-Appendix 1 includes a map of transit lines operating within the Project area for each alternative.

2.1.3.1 San Francisco Municipal Railway

Muni operates buses, cable cars, and light rail services within the City. Two light rail lines, two heritage streetcars, and seven Muni bus routes traverse the project area. Muni lines, maintenance facilities, and general transit utilities serving the project area are described below (SFMTA, 2023b).

<u>Muni Routes</u>

T-Third is a local light rail and subway service that operates from 6 a.m. to 12 a.m. (midnight) on weekdays with 10-minute headways during the a.m. peak period and the p.m. peak period. This route operates along Third Street, and Fourth Street, through the Islais Creek, Cargo Way, Pier 80, Pier 70, Mission Bay, Mission Rock, South Beach, and Ferry Building subareas before going underground at The Embarcadero near Howard Street via the Muni/BART tunnel portal and continuing below Market Street with stops at Embarcadero Station. In addition, the new T-Third light rail extension to downtown operates on Fourth Street in the Mission Creek subarea before going underground via the new Central Subway tunnel portal near the intersection of Fourth and Bryant streets.

N-Judah is a local light rail service operates from 6 a.m. to 12 a.m. (midnight) on weekdays with 10-minute headways during the a.m. and p.m. peak periods. This route operates along King Street and The Embarcadero through the South Beach and Ferry Building subareas before going underground at The Embarcadero near Howard Street via the Muni/BART tunnel portal and continuing below Market Street with stops at Embarcadero Station.

F-Market & Wharfs is a local heritage streetcar service that operates from 7 a.m. to 10 p.m. with 17-minute headways during the a.m. peak period and 13-minute headways during p.m. peak periods. This route operates along Market Street, Steuart Street, Don Chee Way, The Embarcadero, Jefferson Street, Jones Street, and Beach Street through the Ferry Building Northeast Waterfront, Pier 31 to 35, and Fisherman's Wharf subareas.

15-Bayview Hunters Point Express is a local bus service that operates from 5 a.m. to 10 p.m. on weekdays with 10- to 15-minute headways and weekends from 8 a.m. to 10 p.m. with 12- to 20-minute headways. This route operates along Bayview neighborhood streets including Palou Avenue, Ingalls Street, Northridge Road, Kiska Road, Kirkwood Avenue, Jerrold Avenue, and Hudson Avenue before continuing along 3rd Street and 4th Street to the Financial District.

19-Polk is a local bus service that operates from 5 a.m. and 10 p.m. with 15-minute headways during the a.m. and p.m. peak periods. This route operates along Polk, Beach, and North Point streets through the Aquatic Park subarea and along Evans Avenue in the Islais Creek subarea.

22-Fillmore is a local bus service operating 24 hours per day with approximately six-minute headways during the a.m. and seven-minute headways during the p.m. peak periods. This route operates along 18th, Tennessee, 20th, and Third streets in the Pier 70 subarea.

39-Coit is a local bus service that operates from 9 a.m. to 7 p.m. with 20-minute headways during the p.m. peak period. This route operates along Powell Street, North Point Street, The Embarcadero, and Jefferson Street in the Fisherman's Wharf subarea.

44-O'Shaughnessy is a local bus service operating 24 hours per day with 10-minute headways during the morning and midday weekday and 15-minute headways during the evening weekdays. The route operates along Evans Avenue, Middle Point Road and Palou Avenue in Reach 4 and continues northwesterly along Silver Avenue, O'Shaughnessy Boulevard, 7th Avenue, 9th Avenue, 6th Avenue and terminating on California Street.

48-Quintara/24th Street is a local bus service operating 24 hours per day with generally 15-minute headways during the a.m. and p.m. peak periods. This route operates along 22nd, Tennessee, and Illinois streets in the Pier 70 subarea.

49-Van Ness/Mission is a local bus service that operates from 5 a.m. to 12 a.m. (midnight) with approximately 6 minutes headways during the a.m. and p.m. peak periods. This route operates on Van Ness Avenue in the Aquatic Park subarea.

55-16th Street is a local bus service that operates from 5 a.m. to 10 p.m. with approximately 15-minute headways during the a.m. and p.m. peak periods. This route operates along 16th Street, Third Street, Mission Boulevard, and Merrimac Street through the Mission Creek and Mission Bay subareas and provides service between the Mission Bay neighborhood and the 16th Street BART station.

Maintenance and Operation Facilities

In addition to the many different Muni routes along the waterfront, Muni also operates different maintenance and operation facilities to support buses and light rail services.

Kirkland Yard is a 72-year-old bus yard located in the northern waterfront near Fisherman's Wharf and Pier 39. It currently has three maintenance bays, an outdoor bus wash, and bus parking.

Tunnel Portals provide access to the underground transit features and include the **Ferry Portal, Folsom Portal**, and **Central Subway Portal**.

Embarcadero Station is a key station that connects BART and Muni service and is the closest station to the Ferry Building.

Third Street Bridge over Mission Creek is a roadway bridge that is also part of the San Francisco Bay Trail.

Fourth Street Bridge over Mission Creek is a roadway bridge that carries railroad tracks for the T-Third light rail line and access for other vehicles to the Muni Metro East Maintenance Facility.

Mission Bay Loop is a light rail track for the T-Third line that provides turn around capabilities for special events and during peak periods. The Mission Bay Loop is in Reach 3.

Muni Metro East Maintenance Facility (MME) is a 16.9-acre site owned by SFMTA to service and store light rail vehicles. This facility is located in Reach 4.

1399 Marin Facility is a 3.2-acre site that serves a bus acceptance yard, rail track shop and streetcar storage facility for Muni in Reach 4.

Islais Creek Motor Coach Facility is a maintenance and operations yard for Muni bus service and provides additional storage space for hybrid motor coaches. This facility is located in Reach 4.

Third Street Bridge over Islais Creek is a roadway bridge that carries railroad tracks for the T-Third light rail line.

Illinois Street Bridge over Islais Creek is a roadway bridge that is also part of the San Francisco Bay Trail.

1570 Burke Storage Facility *is* for bus and trolley parts and supplies.

Substations, includes King, Phelps, and Illinois, located throughout the system to supply uninterrupted power to transit vehicles and facilities.

Special Trackwork and Vent Work

Various track crossovers and tail tracks are located throughout the system along the Embarcadero, Third Street, and King Street.

Fourth & King Special Trackwork is located in Reach 3 near the Fourth & King Caltrain Station and Fourth Street Bridge.

Don Chee Way trackwork is located near the Ferry Building and intersects with the Embarcadero rail.

6th & King Pocket Track and Operator Rest Station is located in Reach 3 near the I-280 roadway and on- and off-ramps.

Vent Structure for Muni Metro Turn-Back Facility is underground east of the existing Embarcadero Station.

Pull-in/Pull-out tracks located at 25th Street and Third Street and Cesar Chavez Street and Third Street.

Transit Infrastructure and Utilities

Critical components of transit infrastructure are not limited to infrastructure that is above the surface. There are specific transit utilities that are required to efficiently operate a robust public transit system. The SFMTA maintains and operates several different systems to operate the railroad and bus trolley system. The easily, visible physical components include the railroad tracks, traction power system (includes the overhead contact system), switches, signal equipment and drainage infrastructure. Emergency systems such as blue light equipment, emergency light systems, and fire protection and monitoring systems are required for safety during emergency events. The train control system, power system, and communication radios include both hardware and software for everyday operations. The transit infrastructure and utilities are present at several locations throughout the SFMTA systems and specific locations are not identified in this document. (SFMTA, 2017)

2.1.3.2 Regional Transit Providers

BART provides regional commuter rail service between the East Bay/South Bay (from Antioch, Richmond, Dublin/Pleasanton, and Berryessa/North San Jose), San Mateo County (from San Francisco International Airport and Millbrae), and San Francisco, with operating hours normally from 5 a.m. to midnight on weekdays, 6 a.m. to midnight on Saturdays, and 8 a.m. to midnight on Sundays and major holidays. In the vicinity of the Project area, BART operates underground in the Transbay Tube across San Francisco Bay, crossing under the seawall near the Ferry Building and continuing below Market Street through the Ferry Building subarea where it makes stops at Embarcadero Station. BART’s Transbay Tube ventilation facilities are also located near the Ferry Building within the Ferry Building subarea.

Caltrain provides passenger rail service on the Peninsula between San Francisco and downtown San Jose, with stops in San Mateo and Santa Clara counties. Within San Francisco, Caltrain service currently terminates at the Fourth/King station in the Mission Creek subarea. However, the Caltrain Downtown Extension Project, renamed the Portal, would extend Caltrain service and add future underground high-speed rail service to the Salesforce Transbay Terminal below Townsend and Second streets through the South Beach and Ferry Building subareas.

Caltrain is governed by the Peninsula Corridor Joint Powers Authority (PCJPA) which also owns the railroad right-of-way to downtown San Jose. The PCJPA also allows limited freight traffic from Union Pacific Railroad to operate on the peninsula railroad tracks.

Golden Gate Transit (GGT) is operated by the Golden Gate Bridge, Highway, and Transportation District and provides bus and ferry service between the North Bay (Marin and Sonoma counties) and San Francisco. GGT operates 8 commuter bus routes into San Francisco. GGT bus service operates on North Point Street, The Embarcadero, and Van Ness Avenue through the Northeast Waterfront, Pier 31 to 35, Fisherman’s

Wharf, and Aquatic Park subareas. GGT also operates ferry service between the North Bay and San Francisco between 7 a.m. and 8 p.m. on weekdays, with headways between 30 and 90 minutes, depending on the time of the day and day of the week. The ferry service connects Larkspur and Sausalito with the Ferry Building in the Ferry Building subarea.

Alameda-Contra Costa Transit (AC Transit) operates Transbay bus service between the East Bay and San Francisco's Salesforce Transit Center in the Ferry Building subarea. AC Transit operates 20 Transbay bus lines with up to 140 buses at peak hour during weekdays. AC Transit uses a dedicated bus bridge that provides direct access to the Salesforce Transit Center's Level 3 bus deck from I-80 and the Bay Bridge.

San Mateo County Transit (SamTrans) provides bus service throughout San Mateo County and portions of San Francisco. SamTrans operates four bus routes in San Francisco that operate primarily along Mission Street, with some routes also operating on The Embarcadero, Washington Street, Drumm Street, Market Street, Steuart Street, Ninth Street, and 10th Street in the Ferry Building and Mission Creek subareas.

WETA operates the San Francisco Bay Ferry service from San Francisco at Pier 41, the Ferry Building, Oracle Park ferry terminal and Pier 48 ½ ferry terminals.

Pier 41 ferry terminal is located in the Fisherman's Wharf subarea in Reach 1 at the intersection of Powell Street and The Embarcadero, providing ferry service to Alameda, Oakland, Vallejo, and Mare Island.

The ***Ferry Building ferry terminal*** is located in the Ferry Building subarea in Reach 2, providing ferry service to Alameda, Harbor Bay, Oakland, Richmond, Vallejo, and Mare Island.

The ***Oracle Park ferry terminal*** is located in the South Beach subarea at Oracle Park in Reach 3, providing ferry service to Alameda, Oakland, Vallejo, and Mare Island.

The **Pier 48 ½** ***ferry terminal*** is located in the Mission Bay subarea in Reach 3 along Terry A. Francois Boulevard near the Chase Center. This terminal provides daily ferry service to Oyster Point in South San Francisco and special event service from Oakland and Alameda to event and games at the Chase Center.

In addition, Pier 1½ is located in the Ferry Building subarea at the intersection of Washington Street and The Embarcadero, providing public boat access and water taxi service. Pier 33 is located in the Pier 31 to 35 subarea near the intersection of Bay Street and The Embarcadero, providing ferry service to Alcatraz Island.

2.1.4 Bicycle Facilities

The following includes a discussion of city-designated on-street bicycle facilities in the Project area that are part of the San Francisco Bicycle Network. On-street bicycle facilities include Class I bikeways (bike paths with an exclusive right-of-way for use by bicyclists or pedestrians), Class II bike lanes (bike lanes striped within the paved areas of roadways and established for the preferential use of bicyclists), Class III bikeways (signed bike routes that allow bicycles to share travel lanes with vehicles), and Class IV cycle tracks (areas for exclusive use by bicyclists that include physical separation from motor vehicle traffic). The Transportation Sub-Appendix includes figures with the bicycle network within the Project area.

2.1.4.1 Class I Bike Paths

The San Francisco Bay Trail (Bay Trail), also known as the Blue Greenway from the ballpark south, runs along the entire project area. The Bay Trail is a planned 500-mile hiking and biking path that will encircle San Francisco and San Pablo Bays and follow the shoreline of nine counties. Several paved and street segments of the Bay Trail are complete within the Project area along the waterfront, joining Aquatic Park to Heron's Head Park, except for two segments that are planned between Aquatic Park and Fisherman's Wharf and in the Mission Rock subarea (San Francisco Bay Trail 2023). The Blue Greenway is a City project to improve the southerly portion of the Bay Trail as well as the newly established Bay Area Water Trail and associated waterfront open space system. The alignment of the Blue Greenway generally follows the alignment of the Bay Trail and Bay Area Water Trail from Mission Creek on the north to the county line on the south.

2.1.4.2 Class II Bike Lanes

The Embarcadero has Class II bike lanes in both directions between North Point Street and King Street through Pier 31 to 35, Northeast Waterfront, Ferry Building, and South Beach subareas. Between Broadway and Folsom Street on the east side of the Embarcadero, there is a Class IV separated bikeway.

North Point Street has Class II bike lanes in both directions between Larkin Street and The Embarcadero through the Aquatic Park, Fisherman's Wharf, and Pier 31 to 35 subareas.

Illinois Street has Class II bike lanes in both directions between Terry A. Francois Boulevard and 18th Street, 19th and Marin Street up to the Illinois Street Bridge. Class II bike lanes are also found after the Illinois Street Bridge to Cargo Way.

Fourth Street has Class II bike lanes between Channel and 16th streets.

Brannan Street eastbound, is designated as a Class II bike lane between Colin P Kelly Jr. Street and The Embarcadero through the South Beach subarea. ***Evans Avenue*** has Class II bike lanes in both directions between Third Street and Keith Street.

2.1.4.3 Class III Bike Routes

Broadway is designated as a Class III bike route between Mason Street and The Embarcadero through the Northeast Waterfront subarea.

Market Street is designated as a Class III bike route between Eighth and Steuart streets through the Ferry Building subarea.

Steuart Street is designated as a Class III bike route between Market and Mission streets through the Ferry Building subarea.

Mission Street is designated as a Class III bike route between Steuart Street and The Embarcadero through the Ferry Building subarea.

Brannan Street westbound, is designated as a Class III bike route between Colin P Kelly Jr. Street and The Embarcadero through the South Beach subarea.

Townsend Street is designated as a Class III bike route between Second Street and The Embarcadero through the South Beach subarea.

Third Street is designated as a Class III bike route between Cargo Way and Bayshore Boulevard through the Islais Creek subarea.

Evans Avenue has Class III bike routes from Cesar Chavez Street to Third Street.

2.1.4.4 Class IV Separated Bikeways

The Embarcadero has a Class IV bikeway between Broadway and Folsom Street on the east side of the Embarcadero.

Howard Street has a Class IV bikeway in the westbound direction between Main Street and The Embarcadero through the Ferry Building subarea.

Folsom Street has a Class IV bikeway in the eastbound direction between Essex Street and The Embarcadero through the Ferry Building subarea.

Evans Avenue has a Class IV bikeway between Keith Street and through Hunters Point Boulevard to Hawes Street.

Illinois Street has Class IV bikeways between 18th and 19th and across the Illinois Street Bridge.

Third Street has a Class IV bikeway crossing over Lefty O'Doul Bridge through the South Beach and Mission Rock subareas.

Fourth Street has a Class IV bikeway between Mission Bay Boulevard North and Mission Bay Boulevard South.

Terry A. Francois Boulevard has a Class IV two-way cycle track along the east side of the street between San Francisco Bay Trail and Illinois Streets through the Mission Rock and Mission Bay subareas.

16th Street has Class IV separated bike lanes in both directions between Terry A. Francois Boulevard and Illinois Street, and between Third Street and Owens Street through the Mission Bay subarea.

Cargo Way has a Class IV two-way cycle track along the west side of the street between Illinois and Jennings streets.

2.1.5 Parking Facilities

The project area includes many areas designated for parking or buildings with parking facilities near the waterfront. The San Francisco County Transportation Authority (SFCTA) conducted a parking census which estimated undocumented parking spaces. Off-street, nonresidential parking spaces citywide, with undocumented spaces, were extrapolated to be 172,000. These parking spaces can be located in either private or public lots, or parking garages. Within a narrower study area, labelled the Northeast Quadrant which includes Reaches 1, 2 and 3, the total off-street, nonresidential parking spaces are estimated to be 87,400 including undocumented parking spaces. Of those 87,400 parking spaces in the study area, approximately 34,000 spaces are within three high-congestion neighborhoods, the Financial District and Union Square in Reach 2 and East SoMa, in Reach 3. On-street parking spaces are in addition to the above and number 28,800 metered on-street spaces citywide. (SFCTA, 2016)

In addition, there are many Port-owned parking locations located near the waterfront or on pier structures. Overall, these parking locations contain approximately 12,300 spaces and will be analyzed for potential parking losses. Some of the Port's larger parking facilities include the Pier 39 parking garage (1,110 parking spaces) in Reach 1 and Pier 30 (1,130 parking spaces) in Reach 3. Pier 80 with 6,806 general parking spaces is a 70-acre site currently utilized for distribution of cars from overseas located in Reach 4 (Pasha, 2016). A more detailed table of Port-owned parking locations is included in the Transportation Sub-Appendix. The Port-owned parking will be reviewed for potential impacts (Port, 2023b).

2.2 Environmental Consequences

2.2.1 Assessment Method

The basis for the transportation analysis will analyze the existing transportation infrastructure and systems and proposed transportation improvements in the Project area. The existing transportation infrastructure is based on data collected from City of San Francisco, SFMTA, BART, MTC, Caltrain and WETA. Anticipated transportation improvements will be included that appear to be reasonably foreseeable by 2040.

The transportation projects that are reasonably foreseeable include raising the Third Street Bridge over Islais Creek, the extension of existing rail and proposed high-speed rail (HSR) service from Fourth and King Station to the Salesforce Transit Center by the Portal project, and the Mission Bay ferry terminal. The Notice of Preparation for the Environmental Impact Report was published on May 31, 2023 by the San Francisco Planning Department. The proposed replacement bridge would accommodate new transit tracks, travel lanes for private vehicles, two pedestrian/bicycle paths, and would be resilient to predicted sea-level rise. Construction would be approximately 24 months and is anticipated to begin in spring 2025 at the earliest. During construction, detours for T-Third Street light rail, vehicles, and pedestrians would be in place between Marin Street and Cargo Way. For transit passengers on the T-Third Street light rail a bus shuttle would be used and bus route 15 – Bayview Hunters Point Express would be detoured around the project site. (SF Planning, 2023). The Portal project is managed by the Transbay Joint Powers Authority (TJPA) and would extend existing Caltrain service from the current terminus at Fourth and King Station approximately 1.3 miles to the Salesforce Transit Center. This project would be a tunnel and would connect with the existing train box located beneath the multimodal hub, the Salesforce Transit Center. Once future high-speed rail service develops in California, the Portal would also serve to extend service to downtown San Francisco. The Portal is anticipated to be in service in 2032 and high-speed rail service is anticipated to reach San Francisco in 2033 (TJPA, 2023 and California HSR Authority, 2022). The Mission Bay ferry terminal is anticipated to begin construction in 2024 and would have the capability for two ferry boats to berth simultaneously to serve the Chase Center area in Reach 3. This ferry terminal is located at Pier 64 ½, near Terry Francois Boulevard and 16th Street, and would replace the temporary ferry terminal at Pier 48½. Therefore, the temporary Pier 48 ½ ferry terminal was not evaluated for impacts since all existing ferry traffic would transition to the Mission Bay ferry terminal when completed. These three transportation projects are anticipated to be complete by the first action in 2040 (Port, 2021 and Port, 2023a).

2.2.2 Basis of Significance

This section will address transportation in the area of the project including temporary (construction) and permanent effects on movement of vehicles (major arterials, highway access), train, light rail and bus transit, ferry, pedestrian and bicycle use and access. Impacts will be determined by looking at:

- Short-term or long-term disruptions of existing transportation services
- Relocation or prolonged flooding of major transportation infrastructure
- Introduction of substantial long-term detours for different modes of transportation
- Substantial loss of parking spaces

2.2.3 Effects

Existing transportation infrastructure and systems, and anticipated changes to these under each alternative are evaluated in this section for each of the alternatives.

Construction Impact Summary

In the absence of flood-control actions under the FWOP condition, direct and indirect transportation impacts would still occur. Direct transportation impacts would be related to construction in response to flooding and emergency repairs. Indirect transportation impacts would be as areas become inundated more frequently and unplanned retreat begins. As areas become more inundated, retreat would occur in a less systematic or planned fashion, creating unplanned transportation impacts. Without planning for increasing inundation frequency and intensity, there could be transportation disruptions that result in long detours or reduced frequency for transit. Prolonged or intermittent flooding of transportation corridors due to storm events and, independently or in combination with high tide events, can lead to traffic shifting to alternative routes either as directed to by emergency construction detours or as the travelling public seeks more consistent and safer routes less prone to flooding. This could result in longer routes for the travelling public and add vehicles to potentially over-capacity traffic corridors further from the San Francisco Waterfront.

With implementation of the project alternatives, both direct and indirect impacts to transportation will occur temporarily during construction. Permanent impacts will be associated with roadway, bike path, sidewalk, and transit redesign, and re-routing in areas of raised elevation or narrowing of roadways to accommodate the levees and walls.

Temporary Transportation Impacts

Temporary impacts to transportation and disruption of normal commute patterns will occur in retreat areas due to inundation and demolition in inland areas from construction of the measures to protect the waterfront from inundation. Construction of the measures would have mutli-layered temporary impacts which include increased construction traffic, transportation corridor closures for construction staging areas and while construction measures are being built, among other temporary impacts discussed below.

In areas of retreat and inundation under each alternative, traffic will be temporarily disrupted due to inundation causing road, bike path, and sidewalk closures until such time as retreat or floodproofing are complete. Access to transit, bus stops, and rail stations may be inundated periodically as flooding becomes more frequent. Measures may be insufficient to protect facilities from inundation, requiring frequent closures or repairs. Transit facilities and related infrastructure are susceptible to damage from flooding and critical to operating the full transit system. The existing transit systems require uninterrupted power and reliable infrastructure at track level to operate effectively and many of these transit utility components have a high vulnerability to fail when exposed to flooding. Replacement of failed equipment may take several weeks to months to restore function. These impacts will diminish once flood control measures are implemented, other than in the identified retreat areas before retreat is complete. Compared to the FWOP, less area will be inundated with implementation of the measures, so that flooding frequency, duration, and intensity would be lower with implementation of alternatives, a beneficial impact of the construction alternatives.

For the areas that are being protected by the measures, temporary impacts to transportation will occur directly from construction staging and construction-related traffic and construction detours and lane/road/sidewalk/path closures. Indirect impacts would include disruption of existing travel patterns and increased potential congestion on other roadways as traffic (vehicular, transit, bicycles and pedestrian traffic) are routed around or away from construction areas.

Installation of seismic ground improvements will disrupt vehicle, bike, pedestrian and transit traffic for the durations of the seismic improvement work in any given location. It will require movement of equipment and along those areas where ground improvements will occur, restricting transportation and access as work proceeds.

Water-based construction activities including some pile driving and work from barges can restrict access or create the need for detouring recreational and commercial boating. Construction on the Bay is coordinated with the Port and Coast Guard and certain activities would require presence of monitoring boats to keep safe work areas for on-water work. In general, these impacts are ***less than significant with mitigation.***

In addition to the direct effects of road and/or lane and sidewalk and trail closures, construction-related traffic will directly increase traffic in areas near construction and along haul routes. Construction-related traffic includes trucks bringing materials (such as concrete, steel, lumber), fill, and equipment to work sites and staging areas; construction worker commutes to work sites; and off-hauling of construction debris, excavation, and demolition debris. Construction haul trucks to and from sites will likely take major roads and arterials to the major highways including I-80, I-280, and US 101, increasing traffic and congestion at intersections and on roadways. The duration of construction at any given site will depend on design and construction plans to be prepared in later project phases.

Since the San Francisco waterfront, especially in the northern reaches, is already heavily urbanized, there are few potential staging areas close to the work zones; staging will require parking lot and road or lane closures. Work within the roadways will require detours for vehicles, bicycles, transit, and pedestrians during the period of construction at any given location. The precise areas and duration of closures, detours, and traffic disruption will not be known until later in planning phases and are not known at this time. Access to buildings and facilities may be hampered by placement of materials and equipment, construction activity, or active movement of machinery.

Construction activities will indirectly affect transportation by increasing construction-related traffic near construction areas and along haul routes; involve lane, road, transit, bikeway, and sidewalk closures at various stages of construction to allow work to process safely; and affect access by restricting parking and creating detours for transportation facilities. Construction detours are expected to be established as roads and lanes are closed, and may include vehicular traffic, relocation of bus or transit stops, and in extreme cases, rerouting of transit rail. Construction detours for rail (in particular along the Embarcadero and 4th Street bridge) will be more disruptive as the rail systems have few redundancies or potential detour routes which would have direct impacts to transit routes and indirect impacts by restricting access to maintenance facilities such as the Metro East Maintenance Facility. Commuters and travelers may change routes to avoid construction areas, increasing congestion on other streets, or changing modes of travel or avoiding areas entirely. Close communication of construction schedules, durations, road, trail, sidewalk, transit, and parking closures and detours will be needed.

Staging and work areas will be established for each construction project. Road, lane, sidewalk, bike lane closures, relocation of bus stops, and possible disruption of access to transit stations may occur depending on precise locations and construction access required. Construction Traffic Management Plans will be coordinated with the City and transit agencies as described in AMMs, specifically AMM-TR-1. Although, this may reduce the level of impacts to minor or moderate in most cases, the larger measures, such as where ground improvements or roadway changes are occurring along the Embarcadero or Third Street, near major arterials and access to highways, this impact will remain substantial.

Depending on the precise location and duration of construction restrictions, these temporary impacts may be short- or long-term, localized or more regional, and will range from minor to substantial. Minimization measures described in this section including preparation of Construction Traffic Management Plans and close coordination with transportation providers, the City, Caltrans, Port, and the public will reduce the severity of temporary direct and indirect impacts to transportation.

Permanent Transportation Impacts

Permanent impacts will result from transportation system redesign around new levees, walls, some areas of raised elevations, and retreat areas. Certain measures will have permanent impacts on existing transportation facilities and roadways such as narrowing of roadways to accommodate raising roads and buildings, and transportation system changes such as removing bridges, installing tide gates, and creation of levees that will permanently block access to some areas. Transit and transportation re-routing around retreat areas and constructed facilities will be required in some cases.

Construction of levees and raising building and wharf elevations can not only affect access during construction but new elevations and slopes may change slopes within intersections and roadway approaches, change driveway and trail slopes and accessibility. Rail lines and light rail tracks are particularly susceptible to changes in elevation and slopes and may not be able to cross these new elevated areas and levees.

The design of levees and slopes in relation to roadways, bikeways, transit routes, and sidewalks can create barriers and impede movement due to the slopes and geometrics of the measures. Roadway intersections such as along the Embarcadero or near the I-280 on- and off-ramps near Islais Creek will need to accommodate raised elevations or be redesigned and raised as needed to incorporate the new geometry. Pedestrian, bicycle, and ADA compliant access along some areas of the waterfront will require well-planned ramps to allow continued access.

Residual flooding would impact existing transportation services by flooding transportation infrastructure causing these transportation modes to be either permanently or intermittently unusable. Transit services especially light rail, subway, and the electric trolley network would require advanced work to relocate the associated infrastructure and modify transit routes not protected by the given alternatives.

Permanent transportation impacts would cause major disruptions in transportation circulation from changes in elevation and inundation in retreat areas. With implementation of AMMs, specifically AMM-TR-8, these impacts would be coordinated and planned for re-design to maintain adequate circulation near the San Francisco Waterfront. In general, permanent transportation impacts would range from minimal to substantial depending on the importance of the transportation corridor.

Operational Impact Summary

Measures may not protect against all flood risks including those from inland flooding, requiring periodic closures due to flooding and flood repair activities. Once measures are implemented and construction completed, roadway and facility maintenance would require regular inspections and repairs, but in general would be within the types of operations and maintenance currently taking place for the Port, City, and transit agencies. In general, these impacts would be ***less than significant.***

Use of deployable flood barriers along bridges, however, can interrupt traffic and disrupt access for hours and days, and would be of **greater significance**.

2.2.3.1 Total Net Benefits Plan

Impacts to transportation from the Total Net Benefits Plan (TNBP) are provided in Table 2-1 below.

Table 2-1: Summary of Transportation Impacts Associated with the TNBP

TNBP Transportation Impact Rating by Measure	**Bay Fill**	**Levee**	**Bulkhead wall/Seawall**	**Deployable Flood Gate**	**Roadway Impact**	**Sheetpile Wall**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint (First Action)	*3*	*3*	*3*	*2*	*4*	*1*	*3*	*3*	*3*	*1*	*1*	*1*	*1*	*1*

Construction/Footprint (Second Action)	*3*	*1*	*3*	*1*	*4*	*1*	*3*	*1*	*3*	*1*	*1*	*1*	*1*	*1*
O&M Assumptions	*1*	*1*	*1*	*3*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Mitigated Rating	*3*	*3*	*3*	*3*	*4*	*1*	*3*	*3*	*3*	*1*	*1*	*1*	*1*	*1*

* Indicates Engineering with nature Methods

2.2.3.1.1 Short-term or Long-term Disruptions of Existing Transportation Services

The adverse impacts to transportation from the TNBP range from low to high depending on the measures and location. The TNBP could cause disruptions to existing transportation systems from installing seawalls, T-walls, and levees along the Embarcadero in Reaches 2 and 3 and Terry Francois Boulevard in Reach 3 during the first action (see Table 2-2 and Table 2-3). The most severe impacts will be from disruption of the Embarcadero during implementation of seismic ground improvements and raising the main buildings in Reach 2. During the second action, seawalls would be installed along the Embarcadero in Reaches 1 and 3, and Terry Francois Boulevard in Reach 3. The Terry Francois Boulevard during both actions would impact sections of the Bay Trail during construction. These wall installations during both first and second action would add bay fill behind the walls within the existing roadway corridor. Conducting the seismic ground improvements, completing wall installation and adding bay fill to these areas would be a multi-phased construction project that could take several years to complete. The TNBP First Action and Second Action construction is anticipated to take 10 years each to complete. In contrast, addition of Engineering with Nature measures will have relatively short-term and minor impacts to transportation, with import of fill and pile-driving work expected to take place from the water.

Deployables on the Third Street, Fourth Street and Illinois Street bridges would be installed with the TNBP during the first action. Constructing the deployable barriers on the three bridges would likely require temporary closures of these bridges during construction. These bridges are critical connections points along the waterfront where Muni light rail tracks traverse the Fourth Street bridge and the Bay Trail traverses the Third Street and Illinois Street bridges. Temporary detours would be possible for the Bay Trail by adding additional mileage to utilize the adjacent bridges at Mission and Islais Creeks. However, temporarily relocating the Muni light rail tracks from the Fourth Street bridge would require a new light rail approach to the adjacent Third Street bridge and moving the associated utility infrastructure to support light rail service. In addition, the Fourth Street bridge serves as the only connection for rail vehicles from the northern service areas to the Muni Metro East Maintenance Facility in Reach 3 and an alternative access route would also need to be identified for rail vehicle service and maintenance. Alternatively, a bus bridge could be used but would cause a major inconvenience and transit time to light rail line riders. These transit impacts would more severely impact residents in Reach 3 and 4 as the Muni Third Street light rail connects the southern reaches with the many employment opportunities in downtown San Francisco.

During operations, the deployables would be activated during major flooding events. Deployment of this infrastructure would last hours or days during storm surge and/or high tide events as sea levels rise. This would cause major interruptions to transportation services that are fixed in place with limited options for detours. Either permanent new routes would need to be identified or temporary routes that are protected from flooding events and easy to implement would need to be identified and constructed.

In conclusion, the impacts to the Embarcadero and Terry Francois Boulevard and the Third Street, Fourth Street, and Illinois Street bridges would have a **significant and unavoidable** impact to roadway users in Reach 1, 2, and 3; transit riders in Reach 3 and 4; and Bay Trail users in all reaches.

Detailed impacts for the TNBP for roadway construction and transit facility impact tables are provided below (Table 2-2 and Table 2-3). For more detailed analysis for roadway impacts based on roadway class, see Transportation Attachment 1.

Table 2-2: TNBP Roadway Construction Impacts by Reach

Reach	Roadway	Construction Measure	Length (miles)
First Action			
2	Embarcadero	Seawall/ SGI	0.79 & 0.04
3	Embarcadero	T-wall/ SGI	0.28 & 0.14
3	Embarcadero	SGI	0.10
3	Third Street Bridge	Deployable	0.04
3	Fourth Street Bridge	Deployable	0.04
3	Terry Francois Boulevard	T-wall/SGI/Paved Levee	0.12
3	Terry Francois Boulevard	T-wall/SGI	0.07
3	Terry Francois Boulevard	Levee/ EWN/SGI	0.09
3	Terry Francois Boulevard	Paved Levee/SGI	0.13
4	Illinois Street Bridge	Deployable	0.09
Second Action			
1	Jefferson Street	T-Wall/ Wall Impact/ SGI	0.06 & 0.11
1	Embarcadero	Seawall/ SGI	0.75
3	Embarcadero	Seawall/ Bay Fill	0.54
3	Terry Francois Boulevard	Seawall/ Bay Fill	0.44

Note: EWN = Engineering with Nature, SGI = Seismic Ground Improvements

Table 2-3. TNBP Transportation Facility Construction Impacts by Reach

Reach	Facility	Construction Measure	Length (miles)	Service
First Action				
1	Pier 41 ferry terminal	Curb Extension/ Rebuilt Wharf	NA	WETA
2	Embarcadero rail lines	Seawall/ SGI	0.79	MUNI
2	Bay Trail (Embarcadero)	Seawall/SGI	0.79 & 0.04	MTC
2	Bay Trail (Embarcadero)	Seawall/ Planted Levee/ SGI	0.18	MTC
2	Ferry Building ferry terminal	Rebuilt Wharf/Elevate Buildings/ Curb Extension	NA	WETA
3	Embarcadero Rail Lines	T-wall/ SGI	0.28 & 0.14	MUNI
3	Embarcadero Rail Lines	SGI	0.10	MUNI
3	Bay Trail (Embarcadero)	T-wall/ SGI	0.28 & 0.14	MUNI
3	Bay Trail (Embarcadero)	SGI	0.10	MUNI
3	Bay Trail (Embarcadero)	T-wall/ Paved Levee/ SGI	0.22	MTC
3	Bay Trail (Giants Ballpark)	Curb Extension/Wall Impact/ SGI	0.18	MTC
3	Oracle Park ferry terminal access	Curb Extension/Wall Impact/ SGI	NA	WETA
4	Bay Trail (Third Street Bridge)	Deployable	0.04	MTC
3	Rail lines along Fourth Street	Deployable	0.04	MUNI
3	Bay Trail (Terry Francois)	Levee/ EWN/SGI	0.09	MTC
3	Bay Trail (Terry Francois)	Planted Levee/ EWN/SGI	0.11	MTC
3	Bay Trail (Terry Francois)	Paved Levee/SGI	0.13	MTC
Second Action				
1	Jefferson Street rail lines	T-Wall/ Wall Impact/ SGI	0.09	MUNI
1	Bay Trail (Embarcadero)	Seawall/ SGI	0.75	MTC
1	Embarcadero rail lines	Seawall/ SGI	0.55	MUNI
1	Pier 41 ferry terminal	Wharf Rebuild/ Seawall/ SGI	NA	WETA
3	Embarcadero rail lines	Seawall/ Bay Fill	0.54	MUNI
3	Bay Trail (near King Street)	Seawall/ Bay Fill/ Planted Levee	0.22	MTC
3	Bay Trail (Giants Ballpark)	Seawall/ Bay Fill	0.18	MTC
3	Oracle Park ferry terminal access	Seawall/ Planted Levee/ Bay Fill	NA	WETA
3	Bay Trail (Terry Francois)	Seawall/ Bay Fill	0.17	MTC
3	Bay Trail (Terry Francois)	EWN / SGI	0.10	MTC

Reach	Facility	Construction Measure	Length (miles)	Service
4	Bay Trail (Illinois Street Bridge)	Deployable	0.09	MTC

Note: EWN = Engineering with Nature, SGI = Seismic Ground Improvements

2.2.3.1.2 Relocation or prolonged flooding to major transportation infrastructure

The TNBP would stabilize the existing waterfront shoreline and rely on deployables to protect bridges at their current elevation. Some buildings would be demolished during the First action including approximately one building in Reach 1, zero buildings in Reach 2, five buildings in Reach 3, and five buildings in Reach 4. During the Second action, seven buildings in Reach 1, zero buildings in Reach 2 and 3, and four buildings in Reach 4 would be demolished. These areas with demolished buildings do not include any major transportation infrastructure. The TNBP would have minimal impact on transportation infrastructure along the waterfront.

SFMTA did review the TNBP as it is comprised of parts of other alternatives (Alternatives E, F, and G) and those evaluated facilities were included in the Table 2-4. However, some facilities were not evaluated as part of Alternative D which comprises part of the TNBP. For the SFMTA facilities that were evaluated for this alternative, the Second action was shown to have a 50% reduced capacity at the 1399 Marin and 20% reduced capacity to the Islais Facility during construction and no impact during operations compared to conditions today.

The TNBP would implement AMM-TR-4: Include Transit Access in CTMP and AMM-TR-9 for Alternatives where railroad access and related infrastructure are changed substantially along with AMM-TR-1 to minimize impacts. This alternative would cause minimal disruptions to transportation infrastructure near the waterfront especially compared to the FWOP or Alternative B. A **less than significant impact** is anticipated for all reaches for TNBP on transit facilities.

Table 2-4: Expected Reduced Capacity by Transportation Facility and Asset in Year 2090*

Reach	Transportation Infrastructure	2090	
		Construction	Operation
1	Kirkland Yard	None	None
2	Ferry Portal	None	None
3	Central Subway Portal	None	None
3	Fourth & King Special Trackwork	None	None
3	King Street Substation	None	None
3	Third Street Bridge over Mission Creek	N/E	N/E

3	Fourth Street Bridge over Mission Creek	None	None
3	6th & King Pocket Track and Operator Rest Station	None	None
3	Mission Bay Loop	None	None
3	Illinois Substation	None	None
4	Muni Metro East	None	None
4	1399 Marin Facility	50%	None
4	Islais Creek Facility	20%	None
4	Third Street Bridge over Islais Creek	None	None
4	Illinois Street Bridge over Islais Creek	N/E	N/E
4	1570 Burke Storage Facility	None	None
4	Phelps Substation	None	None

Source: Waterfront Resiliency Transportation Assessment (SFMTA, 2022)

* This table was assembled based on SFMTA analysis for Alternatives A, E, F and G. Portions of Alternatives E and G are part of the TNBP alternative. Some facilities were not evaluated for the TNBP alternative and are marked as “N/E = Not Evaluated.”

Note: Cells with SFMTA analysis in grey are a greater impact than Alternative A or the FWOP condition. Only operations could be evaluated for this purpose since Alternative A has no construction. N/E = Not Evaluated

2.2.3.1.3 Introduction of substantial long-term detours for different modes of transportation

The TNBP would introduce substantial temporary, in some cases long-term, detours for all Reaches and across different modes of transportation. This alternative would affect major roadways; have impacts to rail vehicles that utilize the Embarcadero in Reaches 1, 2 and 3; the bridges for Third Street and Fourth Street over Mission Creek in Reach 3; and the Illinois Street over Islais Creek in Reach 4. The bridges would implement deployables during the First Action at Third Street, Fourth Street, and Illinois Street bridges. Also, the reduction in space for the Embarcadero could also lead to the potential minimization or removal of the Bay Trail, roadway, and rail tracks in Reaches 2 and 3 during the First Action and Reaches 1 and 3 during the Second Action. In Reach 3, improvements to Terry Francois Boulevard would also impact the roadway and Bay Trail in both the First Action and Second Action. This significant retreat would also disrupt existing transportation infrastructure and services that pass through these areas.

The impacts to the Embarcadero and the associated systems (roadway, Bay Trail, and rail transit), Terry Francois Boulevard (roadway and Bay Trail), and the three bridges (roadway, Bay Trail, and rail transit) would result in long-term, temporary detours during construction and potentially operations. With implementation of AMM-TR-1, AMM-TR-2, AMM-TR-3, AMM-TR-4, and AMM-TR-5, TNBP would result in **less than significant impact** across all reaches by the Second Action.

2.2.3.1.4 Substantial loss of parking spaces or access

The TNBP would result in roadway impacts to the Embarcadero in both First action and Second action. Approximately 1.12 miles of the Embarcadero in Reach 2 would be impacted under First action and 0.75 miles in Reach 1 and 0.52 miles in Reach 3 of the Embarcadero would be impacted under Second action. The TNBP minimizes flooding to the Embarcadero by raising the street, reducing the width of the Embarcadero, or both. Construction would be disruptive to the waterfront area, and ground improvements will require lane, parking, bike path and sidewalk closures, and some travelers may avoid the area or find alternative methods to avoid parking or access issues. Overall, the TNBP would not result in permanent direct impacts to parking or loss of parking. However, indirect impacts from reduced parking activity and access could impact parking lot usage and revenues.

Pier parking would be impacted by construction for TNBP and waterfront land-based parking may have access changes during construction. The TNBP would include roadway impacts to the Embarcadero near Pier 27 during TNBP First action and Pier 30 during TNBP Second action. The Pier 39 parking garage would remain accessible through existing entrances and exits located on nearby streets but would likely need to close the Embarcadero exit driveway. The TNBP minimized flooding to the Embarcadero by raising the street, which in some places will reduce the width of the Embarcadero. Embarcadero construction would be disruptive and could result in temporarily closing access to the pier and pier parking lots and drivers avoiding the area during construction. Pier 80 in Reach 4 would be preserved by a curb extension and seismic ground improvements in TNBP First action and rebuilding the wharf, seawall and levee installation in TNBP Second action.

The TNBP would have both direct impacts to parking from closures during construction and indirect impact to parking under first and second action from construction in the area anticipated to last up to 10 years each. With implementation of AMM-TR-1, which would minimize impacts from parking losses and access during construction, the impact would be ***less than significant impact with mitigation***.

2.2.3.2 Alternative B: Nonstructural

2.2.3.2.1 Short-term or long-term disruptions of existing transportation services

Alternative B includes floodproofing, demolition, and raising in place or relocating buildings and infrastructure to reduce coastal flooding risk. Most of the Alternative B improvements would be floodproofing buildings and infrastructure which would include a short-term disruption to construct the floodproofing measures and could be re-opened as a transportation facility in the same location. Transportation services are expected to remain in place while some buildings and piers may be demolished. If transportation facilities are impacted, those facilities would be floodproofed under Alternative B. Short-term transportation disruptions may occur as the public shifts to new temporary routes.

Although, many transportation facilities would remain in their existing location, these are critical corridors for transit (both bus and rail), vehicle traffic, ferries, bicyclists and pedestrians that would be disrupted during construction. The Embarcadero in Reaches 1 and 2 will be fully floodproofed in phases as 2115 approaches as seen in Table 2-5, Table 2-6 and Table 2-7. This floodproofing will need to provide temporary routes for all modes of travel during construction. Floodproofing the Embarcadero is expected to be a multi-year effort in a high-density corridor for transportation services. In addition, Third Street is an important corridor for Reaches 3 and 4 as it provides one of the two crossing points for both Mission and Islais Creek. The Third Street corridor also has Muni light rail connecting the southern neighborhoods of San Francisco with downtown. Implementation of AMM-TR-1, AMM-TR-2, AMM-TR-3, and AMM-TR-4 and AMM-TR-5 would minimize these disruptions but are not expected to fully mitigate for this impact. The floodproofing of Embarcadero and Third Street are expected to be multi-year construction efforts that would disrupt the nearby waterfront communities. With implementation of AMM-TR-1 through AMM-TR-5, the impact would be **significant and unavoidable** in all reaches.

Table 2-5 and Table 2-6 below show the impacts to roadways that would occur under this scenario. For more detailed analysis for roadway impacts based on roadway class, see Transportation Sub-Appendix 1.

Table 2-5: Alternative B Roadway Impacts by Reach (Year 2040 and 2065)

Reach	Roadway	Construction Measure	Length (miles)
Year	**2040**		
2	Embarcadero	Floodproofing	0.77
3	Third Street	Floodproofing	0.46
3	Fourth Street	Floodproofing	0.18 and 0.34
3	Terry A Francois Boulevard	Floodproofing	0.47
3	I-280 On and Off-ramps	Floodproofing	0.23 & 0.16 & 0.04
3	Illinois Street	Floodproofing	0.08
4	Third Street	Floodproofing	0.17 & 0.29
4	Cesar Chavez Street (partially or fully obstructs access to I-280)	Floodproofing	0.26 miles
4	Evans Avenue	Floodproofing	0.38
4	Amador Road	Floodproofing	0.39

Year	2065		
1	Jefferson Street	Floodproofing	0.29
2	Embarcadero	Floodproofing	0.34 & 0.18
2	Broadway	Floodproofing	0.11
3	Harrison Street	Floodproofing	0.06
3	I-80 On-ramps at 5th Street	Floodproofing	0.07 & 0.07
3	Terry A. Francois Boulevard	Floodproofing	0.10 & 0.09
4	Evans Avenue	Floodproofing	0.17 & 0.18
4	Third Street	Floodproofing	0.12 miles

Table 2-6: Alternative B Roadway Impacts by Reach (Year 2090 and 2115)

Year	2090		
1	Jefferson Street	Floodproofing	0.23
1	Beach Street	Floodproofing	0.61
1	Embarcadero	Floodproofing	0.67
2	Washington Street	Floodproofing	0.10
3	Embarcadero	Floodproofing	0.49
3	Washington Street	Floodproofing	0.02
3	Bryant Street	Floodproofing	0.12 & 0.03 & 0.04
3	Third Street	Floodproofing	0.09 & 0.19
3	Fourth Street	Floodproofing	0.38 & 0.03
3	I-280 substructure	Floodproofing	0.18
3	Terry A. Francois Boulevard	Floodproofing	0.20
4	Cargo Way	Floodproofing	0.02
Year	**2115**		
3	Harrison Street	Floodproofing	0.01
3	I-280 Off-ramps	Floodproofing	0.02 & 0.06
3	Bryant Street	Floodproofing	0.07
3	Embarcadero/King Street	Floodproofing	0.27
3	I-280 Substructure	Floodproofing	0.02
3	Fourth Street	Floodproofing	0.04
3	Third Street	Floodproofing	0.05
3	Illinois Street	Floodproofing	0.05
4	Illinois Street	Floodproofing	0.03

4	Cargo Way	Floodproofing	0.04
4	Evans Way	Floodproofing	0.08
4	Third Street	Floodproofing	0.07

Table 2-7 below shows the transportation facilities that would be impacted under Alternative B projected for year 2040, 2065, 2090 and 2115.

Table 2-7: Alternative B Transportation Facility Construction Impacts by Reach (Year 2040, 2065, 2090 and 2115)

Reach	Facility	Construction Measure	Length (miles)	Service
Year 2040				
1	Bay Trail (Embarcadero)	Floodproofing	0.07	MTC
1	Pier 41 ferry terminal access	Retreat	NA	WETA
2	Bay Trail (Embarcadero)	Floodproofing	0.86	MTC
2	Embarcadero light rail tracks	Floodproofing	0.77 miles	MUNI
2	Ferry Building ferry terminal	Floodproofing	NA	WETA
3	Fourth & King Yard	Floodproofing	~15 acres	Caltrain
3	T-Third light rail tracks (Third Street)	Floodproofing	0.44 & 0.18 acre	MUNI
3	Future Mission Bay ferry terminal	Floodproofing/ Retreat	NA	WETA
3	Bay Trail (Terry Francois Boulevard)	Floodproofing	0.50 miles	MTC
3	Bay Trail (Illinois Street)	Floodproofing	0.04 miles	MTC
4	T-Third light rail tracks (Third Street)	Floodproofing	0.17 & 0.29	MUNI
4	Bay Trail (Illinois Street & Cargo Way)	Floodproofing	0.12 & 0.12	MTC
Year 2065				
1	Jefferson Street rail tracks	Floodproofing	0.28	MUNI
1	Bay Trail (Embarcadero)	Floodproofing	0.05 & 0.04	MTC
1	Pier 41 ferry terminal access	Floodproofing	NA	WETA
2	Embarcadero light rail tracks	Floodproofing	0.34 & 0.18	MUNI
2	Bay Trail (Embarcadero)	Floodproofing	0.36 & 0.06	MTC
3	Bay Trail (near Giants Ball Park)	Floodproofing	0.21	MTC
3	Future Mission Bay ferry terminal	Floodproofing	NA	WETA
3	Bay Trail (Terry Francois Boulevard, Illinois Street)	Floodproofing	0.11	MTC
4	T-Third light rail tracks (Third Street)	Floodproofing	0.12 miles	MUNI
4	Caltrain Railroad tracks	Floodproofing	0.22	Caltrain

Reach	Facility	Construction Measure	Length (miles)	Service
4	Bay Trail (Cargo Way)	Floodproofing	0.08	MTC
Year 2090				
1	Jefferson Street	Floodproofing	0.23	MUNI
1	Pier 41 ferry terminal access	Floodproofing	NA	WETA
1	Beach Street	Floodproofing	0.61	MUNI
1	Embarcadero	Floodproofing	0.67	MUNI
1	Bay Trail (Embarcadero)	Floodproofing	0.69	MTC
3	Embarcadero	Floodproofing	0.49	MUNI
3	Bay Trail (Embarcadero)	Floodproofing	0.49	MTC
3	Fourth Street	Floodproofing	0.38	MUNI
3	Caltrain tracks	Floodproofing	0.21	Caltrain
3	Third Street	Floodproofing	0.19	MUNI
4	Third Street	Floodproofing	0.17 & 0.30	MUNI
4	Caltrain tracks	Floodproofing	0.03	Caltrain
4	Bay Trail (Cargo Way)	Floodproofing	0.02	MTC
Year 2115				
3	Embarcadero/King Street	Floodproofing	0.27	MUNI
3	Caltrain Tracks	Floodproofing	0.02	Caltrain
3	Bay Trail (near Giants Ball Park)	Floodproofing	0.40	MTC
3	Third Street	Floodproofing	0.05	MUNI
4	Third Street	Floodproofing	0.07	MUNI
4	Caltrain Tracks	Floodproofing	0.02	Caltrain
4	Bay Trail (Illinois Street)	Floodproofing	0.03	MTC
4	Bay Trail (Cargo Way)	Floodproofing	0.05	MTC

2.2.3.2.2 Relocation or prolonged flooding to major transportation infrastructure

For Alternative B, the transportation facilities would be floodproofed to limit travel disruptions from flooding. Infrequent flooding may occur during high tide events or storm surges interrupting transportation services during these times. This flooding is anticipated to be short-term as in hours or days of disruption. As the sea level rises, the transportation infrastructure would be floodproofed to minimize disruptions for all modes of travel from flooding. By floodproofing transportation facilities, there will be more reliable flood protection compared to the FWOP.

Retreat zones would be identified and phased as infrequent flooding occurs. Critical city infrastructure, such as transportation corridors, subject to infrequent flooding would be floodproofed to prevent physical damage but would incur periodic disruptions. As businesses and residences are evacuated from these infrequent flooding areas, or retreat zones, the transportation systems serving those areas may become obsolete and these transportation corridors would be part of the retreat. In these cases, relocations of transportation infrastructure may occur.

Relocation may occur as part of the planned construction for Alternative B. These impacts related to construction were included as part of the Effect TR-1 Alternative B discussion above. The impact would be **less than significant** for all reaches.

2.2.3.2.3 Introduction of substantial long-term detours for different modes of transportation

For Alternative B, no long-term detours would be planned as part of floodproofing, raising in place, or retreat. Critical city systems, including transportation systems, could be identified for floodproofing or relocation. As these transportation systems are modified to meet Alternative B, temporary long-term detours could be created to accommodate construction or relocation of a transportation facility. Any areas identified as a retreat zone would plan for temporary detours and work to identify and implement new permanent routes for all users. Substantial long-term detours are likely for the Embarcadero and Third Street corridors. For both the Embarcadero and Third Street, transit riders, auto drivers, bicyclists and pedestrians would be required to potentially endure substantial long-term detours. Bicycle and pedestrian traffic for the Embarcadero would include those that utilize the Embarcadero sidewalks along with the Bay Trail. Implementation of AMM-TR-1, AMM-TR-2, AMM-TR-3, AMM-TR-4 and AMM-TR-5 would minimize these disruptions but are not expected to fully mitigate for this impact. Alternative B would have a **less than significant impact with mitigation,** compared to FWOP, by introducing substantial long-term detours.

2.2.3.2.4 Substantial loss of parking spaces

Alternative B would result in retreat in frequently inundated areas, displacing some buildings inland to avoid flooding. The associated parking for the relocated buildings and on-street parking is likely to be substantially less than the parking spaces removed. Several buildings would begin to be demolished in 2090 in Reaches 3 and 4, and the same would occur in Reaches 1 and 2 by 2115. The pier parking would remain in place by floodproofing the piers with parking, including Pier 27, Pier 30 and Pier 80. There would be a substantial loss of parking spaces. TR-AMM-1 would be implemented to limit parking space losses during Alternative B construction. With implementation of TR-AMM-1, the impact is ***significant and unavoidable*** for Reaches 3 and 4 in 2090 and Reaches 1 and 2 in 2115.

2.2.3.3 Alternative F: Manage the Water, Scaled for Higher Risk

Impacts to transportation from Alternative F are provided in Table 2-8 below.

Table 2-8: Summary of Transportation Impacts associated with Alternative F

Alternative F **Transportation Impact Rating by Measure**	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	*4*	*4*	*3*	*4*	*3*	*3*	*3*	2	2	2	2
O&M Assumptions	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Mitigated Rating	*4*	*4*	*3*	*4*	*3*	*3*	*3*	2	2	2	2

2.2.3.3.1 Short-term or long-term disruptions of existing transportation services

Alternative F would maintain most of the existing waterfront and reinforce or raise the existing infrastructure while extending the waterfront Bayward with 50 feet of fill in place. However, in transportation corridors close to the San Francisco Bay, construction impacts will occur at the Embarcadero northbound roadway lane and rail lines as it is raised with bay fill and nearby pier buildings are elevated and moved to accommodate rising sea levels in 2040 in Reaches 1, 2, and 3. Also in the same construction phase, levees will be put in place along the Bay Trail and Terry Francois Boulevard, a tide gate will be added to McCovey Cove, and Engineering with Nature features installed at Heron’s Head Park. In 2090, the Bay Trail will be impacted from construction for a paved levee in Reach 1; planted levee in Reach 3 near Oracle Park and Terry Francois Boulevard and Illinois Street; and engineering with nature in Heron’s Head Park in Reach 4. Both moderate and substantial direct and indirect transportation impacts are anticipated due to the extended work areas and duration of construction along the Embarcadero.

During 2040 and 2090, the ferry terminals along the San Francisco Waterfront would all be impacted and service would likely need to be modified or temporarily relocated while construction is ongoing. In 2040, all the ferry terminals, Pier 41, Ferry Building, Oracle Park, and Mission Bay, would be disrupted by building walls, adding bay fill, or tide gates built in the vicinity of the existing ferry terminals. The tide gate at McCovey Cove would bisect the existing Oracle Park ferry terminal and the ferry terminal would need to be relocated to maintain service. In 2090, construction is expected near the Ferry Building and Oracle Park ferry terminals. The ferry terminals are located in Reach 1, 2, and 3 and are expected to have impacts from Alternative F. No ferry terminals are located in Reach 4. AMM-TR-5: Include water traffic management in CTMP would be implemented to help minimize the impacts to the ferry terminals.

For both Alternative F phases, construction is estimated to take 10 years to complete. The construction work along the Embarcadero will disrupt several different transportation modes including vehicular traffic, bike paths, and sidewalks as well as some transit disruptions, and water traffic via ferry will disrupted from construction near the ferry terminals. Implementation of AMM-TR-1, AMM-TR-2, AMM-TR-3, AMM-TR-4 and AMM-TR-5 would minimize these disruptions but are not expected to fully mitigate for this impact. Overall, Alternative F would incur a ***significant and unavoidable impact*** with implementation of avoidance and minimization measures due to impacts in Reaches 1, 2, and 3.

The extent of these disruptions are shown below in Table 2-9. For more detailed analysis for roadway impacts based on roadway class, see Transportation Sub-Appendix 1.

Table 2-9: Alternative F Roadway Construction Impacts by Reach

Reach	Roadway	Construction Measure	Length (miles)
Year 2040			
1	Embarcadero	T-wall/ SGI	0.44
1, 2, 3	Embarcadero	Seawall/ SGI	2.00
3	Terry Francois Boulevard	SGI	0.21 & 0.08
4	Amador Street	SGI/Paved Levee	0.39
Year 2090			
1	Embarcadero	Paved Levee	0.18
3	Terry Francois Boulevard	Levee	0.41
3	Illinois Street	Planted Levee	0.20
4	Amador Street	Paved Levee	0.39

Notes: SGI = Seismic Ground Improvements

2.2.3.3.2 Relocation or prolonged flooding to major transportation infrastructure

Alternative F would allow much of the existing waterfront features to remain in place and rely on water pumps to remove floodwaters. This alternative would have minimal to moderate impact on transportation corridors along the waterfront. In 2090, several buildings would be demolished in Reach 3 and 4 due to anticipated sea-level rise. These areas with demolished buildings do not include any major transportation infrastructure.

SFMTA reviewed Alternative F with their existing facilities and found four facilities would be impacted, as shown in Table 2-10. In 2040, Islais Creek facility (a motor coach maintenance and operations facility) would be impacted at 20% and 1399 Marin facility (a Muni motor coach acceptance yard, rail track shop, and street car storage facility) would be impacted at 50% from construction. Mission Bay Loop (a turn-around light rail loop) would be impacted at 100% during construction and operations and Muni Metro East (a light rail vehicle maintenance and storage yard) would be impacted at 50% during construction in 2090. No other SFMTA facilities were identified as impacted during construction or operations for Alternative F.

Table 2-10 below shows the transportation facilities that would be impacted under Alternative F.

Table 2-10: Alternative F Transportation Facility Construction Impacts by Reach

Reach	Facility	Construction Measure	Length (miles)	Service
Year 2040				
1	Embarcadero rail lines	T-wall/SGI	0.25	MUNI
1	Bay Trail (Embarcadero)	T-wall/ SGI	0.44	MTC
1	Pier 41 Ferry Terminal	Curb Extension	NA	WETA
2	Ferry Building ferry terminal	Bay Fill/Seawall	NA	WETA
1, 2, 3	Embarcadero rail lines	Seawall/ SGI	2.00	MUNI
1, 2, 3	Bay Trail (Embarcadero)	Seawall/ SGI	2.24	MTC
3	Bay Trail (Giants Ballpark)	Planted Levee/SGI	0.22	MTC
3	Oracle Park Ferry Terminal	Tide Gate	NA	WETA
3	Bay Trail (Terry Francois)	Levee/SGI	0.18	MTC
3	Bay Trail (Terry Francois)	Planted Levee/SGI	0.08	MTC
4	Bay Trail (Heron's Head Park)	EWN/SGI	0.09	MTC
Year 2090				
1	Bay Trail (Embarcadero)	Paved Levee/Curb Extension/Wall Impact	0.44	MTC
2	Ferry Building ferry terminal	Curb Extension/Wall Impact	NA	WETA
3	Bay Trail (near Giants Ballpark)	Planted Levee	0.22	MTC
3	Oracle Park Ferry Terminal	Tide Gate/Pump Station	NA	WETA
3	Future Mission Bay Ferry Terminal	Planted Levee	NA	WETA

Reach	Facility	Construction Measure	Length (miles)	Service
4	Bay Trail (Terry Francois and Illinois Street)	Planted Levee	0.58	MTC

Note: EWN = Engineering with Nature, SGI = Seismic Ground Improvements

Other SFMTA assets that would be impacted include the T-Third light rail line operating at reduced capacity and the Illinois Street bridge at reduced capacity by the end of the century. The SFMTA facilities, Islais Creek, 1399 Marin and Muni Metro East, described in the above paragraph provide critical facilities to maintain and operate the Muni buses and light rail including the T-Third Light Rail line. The Mission Bay loop provides increased reliability by allowing the light rail to turn around for special events and during peak service periods to provide additional service. Comparing to the FWOP, these same facilities would be impacted, although additional facilities would be impacted under FWOP as shown in Table 2-11. The T-Third light rail is a critical service to connect the communities in Reach 3 and 4 to the central business district. Due to these impacts, SFMTA determined that transit degradation would be a low impact during mid-century and medium impact by the end of the century during construction.

During operations, Alternative F would result in no impact by mid-century and a medium impact across all geographies by end of century. This compares to Alternative A with a low-impact by mid-century and a high-impact by end of century without storm surge and high for the FWOP condition with storm surge for both phases.

Alternative F would need to implement AMM-TR-4: Include Transit Access in CTMP and AMM-TR-9 for Alternatives where railroad access and related infrastructure are changed substantially along with AMM-TR-1 to minimize impacts. Alternative F would cause disruptions to transportation infrastructure due to relocating infrastructure, although much less relocations and flooding would occur compared to Alternative A. Therefore, Alternative F would have a ***less than significant impact*** compared to FWOP for transit by the end of the century for all reaches. This impact would most acutely be felt in Reach 3 and 4 from impacts to the T-Third line.

Table 2-11: Alternative F Expected Reduced Capacity by Transportation Facility and Asset

Transportation Infrastructure	Reach	2040		2090	
		Construction	Operation	Construction	Operation
Kirkland Yard	1	None	None	None	None
Ferry Portal	2	None	None	None	None
Central Subway Portal	3	None	None	None	None
Fourth & King Special Trackwork	3	None	None	None	None
King Street Substation	3	None	None	None	None

Transportation Infrastructure	Reach	2040		2090	
		Construction	Operation	Construction	Operation
Third Street Bridge over Mission Creek	3	N/E	N/E	N/E	N/E
Fourth Street Bridge over Mission Creek	3	None	None	None	None
6th & King Pocket Track and Operator Rest Station	3	None	None	None	None
Mission Bay Loop	**3**	None	None	**100%**	**100%**
Illinois Substation	3	None	None	None	None
Muni Metro East	4	None	None	**50%**	None
1399 Marin Facility	**4**	**50%**	None	None	None
Islais Creek Facility	**4**	**20%**	None	None	None
Third Street Bridge over Islais Creek	4	None	None	None	None
Illinois Street Bridge over Islais Creek	4	N/E	N/E	N/E	N/E
1570 Burke Storage Facility	4	None	None	None	None
Phelps Substation	4	None	None	None	None

Source: Waterfront Resiliency Transportation Assessment (SFMTA, 2022)

Cells with SFMTA analysis in grey are a greater impact than Alternative A or the FWOP condition. Only operations could be evaluated for this purpose since Alternative A has no construction. N/E = Not Evaluated

2.2.3.3.3 Introduction of substantial long-term detours for different modes of transportation

Alternative F has most of the San Francisco Waterfront remaining in place to the extent possible that will accommodate sea-level rise, by extending the waterfront into the Bay and reducing some of the transportation effects during construction compared to other alternatives. Several building demolitions would occur near Pier 45 in Reach 1 and two building demolitions would occur near Pier 68 in Reach 3. During the 2090 phase, approximately four buildings would be demolished near Pier 45 and approximately 35 on piers or properties at the waterfront in Reach 3 and 4. Accessing locations near the demolition sites may become more difficult during this activity, however this is not anticipated to generate substantial long-term detours. No new impacts were identified that would introduce substantial long-term detours for different modes of transportation outside those described above for construction and flooding.

There will be disruptions related to construction along the Embarcadero, Terry Francois Boulevard, T-Third light rail, ferry service and Bay Trail. However, bridges crossing Mission and Islais Creek would remain open during implementation of this alternative. The Embarcadero, Terry Francois Boulevard, Amador Street and portions of Illinois Street would be elevated during the construction phases for Alternative F. The process to elevate these roadways, relocate ferry service, the Bay Trail and associated utility infrastructure would be a long-term construction effort. This construction would result in detours to avoid these streets. Although these detours are anticipated to be multi-year and, therefore, long-term, these detours are not anticipated to be substantial in length. Alternative F would protect most of the existing San Francisco Waterfront infrastructure in place and nearby alternative routes would be feasible. While relocating transit routes, especially light rail, would take advanced planning and movement of related utilities, it would be expected to be in close proximity to the existing route.

Alternative F would maintain much of the transportation corridors and facilities in place. Construction to elevate transportation corridors would introduce new long-term detours but these are not expected to be substantial in length. With implementation of AMM-TR-1, AMM-TR-2, AMM-TR-3, AMM-TR-4, and AMM-TR-5, Alternative F would result in **less than significant** for all reaches.

2.2.3.3.4 Substantial loss of parking spaces and access

Alternative F would maintain most of the existing San Francisco Waterfront and keep many of the existing uses in place. Construction for 2040 and 2090 is estimated to be 10 years for each phase. For 2040, the northbound lane of the Embarcadero would be reconstructed with seismic ground improvements and the wharf area extended into the Bay, with likely lane bike and sidewalk closures during ground improvement. This along with the improvements to the wharves and piers to add walls and floodproof the buildings would require space for construction equipment staging and working parking. The construction work would temporarily lower the number of parking spaces available for public use near the Embarcadero in Reach 1, 2, and 3 as well as disrupt pedestrian and bike access as the Embarcadero walkway and piers and wharves are elevated. The same effect may occur from the paved levee construction and floodproofing buildings in Reach 4 near Islais Creek but to a lesser extent. Overall, no major parking space losses are anticipated but nearby construction may reduce the volume of available parking spaces to the public.

Pier parking would not be abandoned until 2090 for Alternative F. Overall, waterfront land-based parking, such as the Pier 39 parking garage, may have access changes during both construction phases and require new or modified access points but their facilities would largely remain intact. For pier parking in 2040, Pier 27 and Pier 30 may be difficult to reach due to waterfront construction of T-walls and seawalls, seismic ground improvements to the northbound Embarcadero lane, extending of the waterfront on fill, and floodproofing wharf buildings. This multi-phased construction could take years to complete and drivers and bicyclists, transit users, and pedestrians may avoid Reaches 1, 2, and 3, and vehicles may avoid parking in the area. Pier 80 would have similar concerns, although less extensive, from construction of a paved levee and floodproofing two buildings on the pier. Since Pier 80 is used for private commercial use, the tenant may need to reduce or modify operations during construction of these features. By 2090, construction in Reaches 1, 2, and 3 would be reduced to installation of curb extensions and wall impacts. There could still be difficulty accessing Pier 27 and

Pier 30 but overall construction in the area would be significantly reduced compared to 2040. Pier 80 would be susceptible to sea-level rise and the Pier 80 buildings would be demolished leading to likely abandonment of Pier 80 and reducing commercial parking in Reach 4.

Construction would limit the number of parking spaces and disrupt pedestrian and bicycle access available to the public at various locations for approximately 10 years during 2040 and 2090 phases. The abandonment of Pier 80 would reduce the number of parking spaces in Reach 4, although Pier 80 parking is currently for private commercial use. Implementation of AMM-TR-1 would minimize these parking losses for this impact. The impact to parking and access would be ***less than significant impact with mitigation***.

2.2.3.4 Alternative G: Partial Retreat, Scaled for Higher Risk

Impacts to transportation from Alternative G are provided in Table 2-12 below. For more detailed analysis for roadway impacts based on roadway class, see Transportation Sub-Appendix 1.

Table 2-12: Summary of Transportation Impacts associated with Alternative G

Alternative G **Transportation Impact Rating by Measure**	**Levee**	**Bridge raise**	**Vertical wall**	**Bulkhead wall/seawall**	**T-wall**	**Wharf**	**Ecological armoring***	**Embankment shoreline***	**Marsh***	**Coarse beach***	**Ecotone levee***
Construction/Footprint	*4*	*5*	*3*	*4*	*4*	*3*	*4*	*4*	*4*	*4*	*4*
O&M Assumptions	*1*	*3*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Mitigated Rating	*4*	*4*	*3*	*4*	*4*	*3*	*4*	*4*	*4*	*4*	*4*

2.2.3.4.1 Short-term or long-term disruptions of existing transportation services

Alternative G would raise several critical transportation corridors while retreating in many of the lower lying areas by 2090 along the waterfront, creating a need to redesign the transportation system in these areas. The Bay Trail and Embarcadero roadway and rail lines would be reinforced by installing a seawall and seismic ground improvements that would disrupt much of Reach 1, 2 and part of Reach 3 with substantial construction in the 2040 phase. In Reach 3 during the 2040 construction phase, both 3rd Street and

Fourth Street bridges and their approaches would be elevated to accommodate sea-level rise. This would also impact the T-Third light rail line that crosses the Fourth Street bridge and Bay Trail that crosses the Third Street bridge. In Reach 4 during 2040, the Illinois bridge and its approaches and the Third Street bridge approaches over Islais Creek would need to be constructed. The Third Street bridge over Islais Creek would be elevated as part of a separate project. The Third Street bridge carries the T-Third light rail line and the Illinois Street bridge carries the Bay Trail. In 2040, the ferry terminals would have more minor impacts, compared to Alternative F, as the curb extensions are installed along the piers. Roadway and Transportation facility impacts are summarized in Table 2-13 and Table 2-14.

In 2090, there would be minor impacts to Embarcadero areas in Reach 1, 2 and 3 from construction. Substantial impacts to the transportation system in the Mission Bay area would occur as the existing systems in the area are abandoned during retreat and re-routing would be needed for T-Third light rail, neighborhood roadway connections, Bay Trail, future Mission Bay ferry terminal, and Caltrain services. Areas near Islais Creek would also be abandoned in 2090 and would require re-routing of the T-Third light rail line, Bay Trail, Caltrain services, and roadway connections. Re-routing these transportation connections would be one of the first activities to occur prior to demolition of the buildings and would likely become a permanent re-routing of these services. Transit degradation during construction is anticipated to be at a ‘medium’ level for SoMa (Reach 2), Mission Bay (Reach 3) and South Bayshore (Reach 4) by 2040 and at a ‘high’ level for all waterfront geographies by 2090. Additional work may be required at the Caltrans I-280 ramps and at Cesar Chavez.

Alternative G construction for both phases is estimated to take 10 years each. The construction work during 2040 along the Embarcadero and the demolition in 2090 of the Mission Bay and Islais Creek areas will disrupt several different transportation modes, ranging from moderate to severe impacts. Implementation of AMM-TR-1, AMM-TR-2, AMM-TR-3, AMM-TR-4 and AMM-TR-5 would minimize these disruptions but are not expected to fully mitigate for this impact. Overall, Alternative G would incur a ***significant and unavoidable*** impact with implementation of avoidance and minimization measures.

Table 2-13: Alternative G Roadway Construction Impacts by Reach

Reach	Roadway	Construction Measure	Length (miles)
Year 2040			
1	Jefferson Street	T-Wall/ Wall Impact/ SGI	0.06 & 0.11
1, 2, 3	Embarcadero	Seawall/ SGI	2.52
3	Third Street (Bridge and Approaches)	Bridge Elevation	0.26

Reach	Roadway	Construction Measure	Length (miles)
3	Fourth Street (Bridge and Approaches)	Bridge Elevation	0.35
4	Illinois Street	Bridge Elevation/Planted Levee/SGI	0.32
4	Amador Street	Bridge Elevation/Planted Levee/SGI	0.06
4	Cargo Way	Bridge Elevation/Planted Levee/SGI	0.20
4	Cesar Chavez Street	Bridge Elevation/Planted Levee/SGI	0.29
4	Third Street	Planted Levee/SGI	0.16 & 0.12
Year 2090			
3	Third Street	Planted Levee/SGI	0.09
3	Third Street	EWN	0.01 & 0.66
3	Third Street	Planted Levee/SGI	0.20
3	Fourth Street	EWN	0.11 & 0.55
3	I-280 and Off and On-ramps	EWN	0.49
3	Terry Francois Boulevard	EWN	1.01
4	Illinois Street	Paved Levee/ SGI	0.18
4	Illinois Street	Planted Levee/EWN/Bridge Demolition	0.32
4	Cesar Chavez Street	EWN	0.59
4	I-280 Off and On-ramps	EWN	0.10 & 0.12
4	Third Street	EWN / Roadway Impact	0.18 & 0.30
4	Cargo Way	EWN / Roadway Impact	0.14
4	Amador Street	EWN	0.33
4	Evans Avenue	EWN	0.42

Note: EWN = Engineering with Nature, SGI = Seismic Ground Improvements

Table 2-14: Alternative G Transportation Facility Construction Impacts by Reach

Reach	Facility	Construction Measure	Length (miles)	Service
Year 2040				
1	Jefferson Street rail lines	Sheetpile Wall/ SGI	0.09	MUNI
1, 2, 3	Embarcadero rail lines	Seawall/ SGI	2.32	MUNI
1, 2, 3	Bay Trail (Embarcadero)	Seawall/SGI	2.50	MTC
2	Bay Trail (Embarcadero)	Seawall/ Planted Levee/ SGI	0.18	MTC

Reach	Facility	Construction Measure	Length (miles)	Service
2	Ferry Building ferry terminal	Rebuilt Wharf/Elevate Buildings/ Curb Extension	NA	WETA
3	Bay Trail (near King Street)	Planted Levee/SGI	0.22	MTC
3	Bay Trail Giants Ballpark)	Curb Extension/Wall Impact/ SGI	0.18	MTC
3	Oracle Park ferry terminal access	Curb Extension/Wall Impact/ SGI	NA	WETA
3	Bay Trail (Third Street Bridge)	Bridge Elevation	0.06	MTC
3	Third Street Light Rail	Bridge Elevation	0.25	MUNI
3	Bay Trail (Terry Francois)	T-Wall/ Wall Impact/ SGI	0.15	MTC
3	Bay Trail (Terry Francois)	Planted Levee/SGI	0.11	MTC
3	Bay Trail (Terry Francois)	Curb Extension/ Wall Impact/ SGI	0.14	MTC
4	Bay Trail (Illinois Street)	Bridge Elevation/Planted Levee/SGI	0.32	MTC
4	Bay Trail (Cargo Way)	Bridge Elevation/Planted Levee/SGI	0.15	MTC
4	Caltrain Railroad tracks	Planted Levee/SGI	0.16	Caltrain
4	Third Street Light Rail	Planted Levee/SGI	0.16 & 0.12	MUNI
Year 2090				
1, 2, 3	Bay Trail (Embarcadero)	Curb Extension/ Wall Impact	2.68	MTC
1	Pier 41 ferry terminal access	Curb Extension/ Wall Impact	NA	WETA
2	Ferry Building ferry terminal access	Curb Extension/ Wall Impact	NA	WETA
3	Bay Trail (near King Street)	Planted Levee	0.22	MTC
3	Bay Trail (Giants Ballpark)	Curb Extension/ Wall Impact	0.18	MTC
3	Oracle Park ferry terminal access	Curb Extension/ Wall Impact	NA	WETA
3	MUNI Rail tracks on King Street	Planted Levee/SGI	0.51	MUNI
3	Caltrain Railroad tracks	EWN	0.45	Caltrain
3	Bay Trail (Mission Bay)	EWN	0.69	MTC
3	Future Mission Bay ferry terminal	EWN	NA	WETA
3	Third Street Light Rail	EWN	0.11 & 0.65	MUNI
3	Third Street Light Rail	Planted Levee/SGI	0.20	MUNI
3	Bay Trail (Illinois Street	Curb Extension/Wall Impact	0.09	MTC
4	Third Street Light Rail	Paved Levee/SGI	0.18 & 0.30	MUNI
4	MUNI Metro East Facility	EWN	16.9 acres	MUNI

Reach	Facility	Construction Measure	Length (miles)	Service
4	Bay Trail (Illinois Street)	Paved Levee/SGI	0.18	MTC
4	Bay Trail (Illinois Street)	Planted Levee/EWN/Bridge Demo	0.32	MTC
4	Bay Trail (Cargo Way)	EWN / Roadway Impact	0.14	MTC
4	Caltrain Railroad Tracks	EWN	0.29	Caltrain

Note: EWN = Engineering with Nature, SGI = Seismic Ground Improvements

2.2.3.4.2 Relocation or prolonged flooding to major transportation infrastructure

Alternative G includes a larger retreat than the other alternatives, with flooding and demolishing portions of the project area. The majority of these demolitions would occur in the 2090 construction phase. During 2040, approximately eight buildings in Reach 1, two buildings in Reach 3, and four buildings in Reach 4 would be demolished. The existing transportation infrastructure to these buildings would remain open after demolition. There are several areas that include Engineering with Nature measures but none are planned for areas with ground-level transportation corridors in 2040.

By 2090, the Mission Bay and Islais Creek area will be experiencing inundation and planned retreat would take place as the 2090 construction phase begins. The Mission Bay community and Islais Creek area would be left to retreat flood and buildings would be demolished. For Mission Bay, this would result in the flooding of portions of Fourth Street, T-Third Street light rail, Third Street, Terry Francois Boulevard, I-280 substructure, Illinois Street, Bay Trail and Caltrain railroad tracks in Reach 3. In addition, the future Mission Bay ferry terminal would be inaccessible. Near Islais Creek, portions of Illinois Street, Third Street, T-Third Street light rail, Bay Trail, Cesar Chavez Street, Caltrain railroad tracks, I-280 substructure and off- and on-ramps, Evans Avenue, Cargo Way, Amador Road.

For transportation facilities, SFMTA identified several locations that would be impacted by Alternative G. As shown in Table 2-15, this would have a periodic effect on transit operations in 2040 from the Fourth Street bridge over Mission Creek. After 2090, the following facilities would be impacted during operations Islais Creek Facility, 1399 Marin Facility, Fourth & King special trackwork, 6th & King Pocket Track & Operator Rest Station, Mission Bay Loop, Illinois Substation, and Fourth Street Bridge over Mission Creek. For network effects by the end of the century, the Embarcadero would operate at reduced capacity with no rail lines, I-80 Fourth & King Ramps would operate at reduced capacity, Mission Bay streets, Third Street bridge, Fourth Street bridge, T-Third light rail, Illinois Street Bridge, and I-280 off- and on-ramps would be impacted. Two areas would experience more severe impacts than under Alternative A FWOP: Fourth & King special trackwork would experience 100 percent impact compared to periodic impact under Alternative A, and Mission Bay Loop would experience 100 percent impact compared to frequent impact under Alternative A. From these impacts, transit degradation is anticipated to be at a low impact level in all waterfront neighborhoods by mid-century after construction is complete. By the end of century, all communities along the waterfront will be impacted at a high level for transit degradation after construction is complete for Alternative G. These transit degradation impacts are the same as the FWOP or Alternative A without storm surge.

Table 2-15. Alternative G Expected Reduced Capacity by Transportation Facility and Asset

Transportation Infrastructure	Reach	2040		2090	
		Construction	Operation	Construction	Operation
Kirkland Yard	1	None	None	None	None
Ferry Portal	2	None	None	None	None
Central Subway Portal	3	None	None	None	None
Fourth & King Special Trackwork	3	None	None	100%	100%
King Street Substation	3	None	None	None	None
Third Street Bridge over Mission Creek	3	N/E	N/E	N/E	N/E
Fourth Street Bridge over Mission Creek	3	Periodic	Periodic	100%	100%
6^{th} & King Pocket Track and Operator Rest Station	3	None	None	100%	100%
Mission Bay Loop	3	None	None	100%	100%
Illinois Substation	3	None	None	100%	100%
Muni Metro East	4	None	None	50%	None
1399 Marin Facility	4	50%	None	100%	100%
Islais Creek Facility	4	20%	None	100%	100%
Third Street Bridge over Islais Creek	4	None	None	None	None
Illinois Street Bridge over Islais Creek	4	N/E	N/E	N/E	N/E
1570 Burke Storage Facility	4	None	None	None	None
Phelps Substation	4	None	None	None	None

Source: Waterfront Resiliency Transportation Assessment (SFMTA, 2022)

Note: Cells with SFMTA analysis in grey are a greater impact than Alternative A or the FWOP condition. Only operations could be evaluated for this purpose since Alternative A has no construction. N/E = Not Evaluated

Alternative G is expected to have a significant and unavoidable impact due to transportation infrastructure from flooding the communities of Mission Bay in Reach 3 and Islais Creek in Reach 4, and relocation of transportation facilities to serve the public at a similar level. However, compared to FWOP, Alternative G would plan for relocations and accommodating flooding and implement AMM-TR-1, AMM-TR-2, AMM-TR-3, AMM-TR-4, and AMM-TR-5. AMM-TR-8 and AMM-TR-9 would also be implemented to avoid disruptions to roadways and railroads with advanced design refinements. With mitigation, Alternative G would have a ***less than significant*** impact compared to Alternative A.

2.2.3.4.3 Introduction of substantial long-term detours for different modes of transportation

Alternative G would introduce substantial detours for all Reaches and across different modes of transportation. This alternative would affect major roadways and rail impacts to vehicles that utilize the Embarcadero in Reaches 1 and 2; the Reach 3 approaches and bridges for Third and Fourth Street over Mission Creek; and the Reach 4 Islais Creek bridge approaches for Third Street and Illinois Street, and the Illinois Street bridge by 2040. The reduction in space for the Embarcadero could also lead to the potential minimization or removal of the Bay Trail in Reaches 1 and 2.

By 2090, significant portions of neighborhoods are proposed for retreat and demolition starting at Mission Creek and extending to south of Islais Creek in Reaches 3 and 4. This significant retreat would also disrupt existing transportation infrastructure and services that pass through or exist in these retreat areas and require redesign of major transportation systems. The project impacts in 2090 would require new permanent detours to be identified for I-80 King Street off- and on-ramps, MTA Third Street Light Rail in Reaches 3 and 4, and I-280 Cesar Chavez Street interchange and ramps in Reach 4. The retreat areas would also lead to impacts to the Bay Trail and Blue Greenway along Terry Francois Boulevard and Illinois Street in Reaches 3 and 4.

The SFMTA analysis identified several areas of their infrastructure impacted by Alternative G by 2090 (Table 2-15). Starting in Reaches 1, 2, and 3, the Embarcadero would require reduced capacity and there would be limited space for rail for public transit. In Reach 3, the I-80 King Street off- and on-ramps would be reduced capacity, and Third Street and Fourth Street Bridges, Mission Bay Streets, SFMTA Third Street Light Rail would be impacted for operations. In Reach 4, Caltrain and the Third Street bridge over Islais Creek would be impacted during construction, and Illinois Street Bridge over Islais Creek and I-280 approaches near Islais Creek would be impacted during operations. After construction is complete for Alternative G, transit degradation would be ‘low’ for all geographies by 2040 and ‘high’ for all geographies by 2090.

Overall, the impacts to the Embarcadero, approaches and bridges over Mission Creek and Islais Creek, Terry Francois Boulevard, and I-280 would result in substantial and potentially permanent detours for different transportation modes. However, compared to

FWOP, these detours and associated infrastructure could be moved with advanced planning. Alternative G would have a **less than significant impact** across all reaches.

2.2.3.4.4 Substantial loss of parking spaces and access

Alternative G would result in sea-level rise flooding impacting inland areas in 2090 within Reaches 3 and 4. By 2040, approximately 12 buildings would be demolished in Reaches 1, 3, and 4. Overall, Alternative G for Year 2040 would only minimally disrupt the parking space supply and utilization except for ground improvements and construction along the waterfront in Reaches 1 and 2. For 2090, numerous buildings in Reaches 3 and 4 would be demolished to accommodate sea-level rise. Flooding would having substantial impacts to on-street parking and parking lots in these reaches. However, there would also be a reduction in parking need as nearby buildings and destinations are subject to increased inundation and retreat is implemented, displacing uses in a large area. Overall, there would be a reduction in parking in all reaches by 2090 in Alternative G but that may also be coupled with reduction in need for parking as areas of the city are abandoned.

Pier and some land-based parking would be impacted by the further inland line of defense for Alternative G. This alternative would floodproof the buildings on Pier 80 in Reach 4 in 2040 currently utilized for auto distribution from overseas. In 2090, the buildings on Pier 80 would be demolished and pier structure would be converted to Engineering with Nature measures. Pier 27 with 125 parking spaces in Reach 2 and Pier 30 with 1,130 parking spaces in Reach 3 would have curb extensions installed around the piers and roadway impacts in 2040 which may directly impact the parking locations for the pier parking or access to parking from the Embarcadero during construction. Pier 27 and Pier 30 parking would remain in place for 2090 with a curb extension and wall impact along the Embarcadero. The Pier 39 parking garage would remain largely intact while access changes may be required during construction. Whether the new curb along the Embarcadero would prevent cars from parking on piers would need to be determined.

Alternative G would result in less parking spaces available by 2090 with the combination of sea-level rise flooding reducing the need for parking in waterfront areas. The impact to parking would be a ***significant and unavoidable impact***.

2.2.3.5 Independent Measures:

Impacts to transportation from the Independent Measures are provided in Table 2-16 below. For more detailed analysis for roadway impacts based on roadway class, see Transportation Sub-Appendix 1.

Table 2-16: Summary of Transportation Impacts associated with Independent Measures

Independent Measures Transportation Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	*3*	*3*	*3*	*2*	*2*	*2*	*2*
O&M Assumptions	*1*	*1*	*1*	*1*	*1*	*1*	*1*
Mitigated Rating	*3*	*3*	*3*	*2*	*2*	*2*	*2*

The Independent Measure Living Seawalls or Vertical Shoreline would likely disrupt transportation corridors with construction equipment and temporary detours. The locations for Living Seawalls are to be determined and, therefore, this impact is considered ***too speculative for meaningful consideration*** *for all transportation impacts*.

2.2.3.5.1 Short-term or long-term disruptions of existing transportation services

The Independent Measures would impact different important transportation corridors along the San Francisco waterfront. All the Independent Measures would impact one of the major corridors except for Independent Measures 3A, Bay Bridge to South Beach Raised Shoreline with Rebuilt Wharves, and 4A, Inland Coastal Flood Defense at Southwest Islais Creek.

Independent Measure 3B, McCovey Cove North Curb Extension, would impact the Bay Trail and access to the Oracle Park ferry terminal; this measure would have a ***less than significant impact*** with implementation of AMM-TR-1, AMM-TR-2, AMM-TR-3, and AMM-TR-5**.** Independent Measure 4A would impact Evans Avenue which is a major east-west roadway for Reach 4 but does not serve multiple types of transportation users, and therefore, this would a ***less than significant impact*** with implementation of AMM-TR-1.

Independent Measures 2A, Robust Coastal Defense of Ferry Building and Agricultural Building, 2B, Coarse Beach at Rincon Park, 3A, and 3C, Planted Levee on Mission Bay, would temporarily disrupt major roadways which serve different users through transit, drivers, pedestrians, and bicyclists. These independent measures would have a ***significant and unavoidable impact*** with implementation of measures AMM-TR-1, AMM-TR-2, AMM-TR-3, AMM-TR-4 and AMM-TR-5.

Table 2-17: Independent Measures Roadway and Transportation Facility Construction Impacts

Reach	Roadway	Construction Measure	Length (miles)
Independent Measure 2A			
2	Embarcadero Roadway	Seawall/ SGI	0.27
2	Embarcadero rail lines	Seawall/ SGI	0.27
2	Bay Trail	Seawall/ SGI	0.27
2	Ferry Building ferry terminal	Rebuilt Wharf	NA
Independent Measure 2B			
2	Embarcadero Roadway	Seawall/ EWN/ Planted Levee/ SGI	0.09
2	Embarcadero Rail Lines	Seawall/ EWN/ Planted Levee/ SGI	0.09
2	Bay Trail	Seawall/ EWN/ Planted Levee/ SGI	0.27
Independent Measure 3A			
3	Embarcadero Roadway	Seawall/ SGI	0.62
3	Embarcadero Rail Lines	Seawall/ SGI	0.62
3	Bay Trail	Seawall/ SGI	0.62
3	Bay Trail (near King Street)	Planted Levee/ SGI	0.22
Independent Measure 3B			
3	Bay Trail (Giants Ballpark)	Curb Extension/ Wall Impact/ SGI	0.18
3	Oracle Park ferry terminal access	Curb Extension/ Wall Impact/ SGI	NA
Independent Measure 3C			
3	Terry Francois Boulevard	Levee/ SGI	0.12
3	Bay Trail	Levee/ SGI	0.21
Independent Measure 4A			
4	Evans Avenue Roadway	EWN/ Curb Extension/ Seawall	0.41

Note: EWN = Engineering with Nature, SGI = Seismic Ground Improvements

2.2.3.5.2 Relocation or prolonged flooding to major transportation infrastructure

The Independent Measures, with the exception of Independent Measure 4A, would not result in prolonged flooding to or relocation of transportation facilities. Independent Measure 2A, 2B, 3A, 3B, and 3C have ***no impact*** to flooding transportation facilities.

Independent Measure 4A would convert the urban area bound by the Islais Creek channel to the north, I-280 to the west, Evans Avenue to the south, and Third Street to the east to Engineering with Nature features including conversion to open space and parkland, allowing measures that would be susceptible to regular flooding. This measure would allow flooding to a portion of Evans Avenue, and portions of the substructure of I-280 and its ramps. Evans Avenue is a east-west arterial that is a key part of local traffic circulation. Independent Measure 4A would be a ***significant and unavoidable impact*** to transportation infrastructure.

2.2.3.5.3 Introduction of substantial long-term detours for different modes of transportation

The Independent Measures may introduce reduced transportation corridors that would reduce capacity or access for different users during operations. These corridor width reductions are most impactful on the Embarcadero and Terry Francois Boulevard from the Independent Measures.

Independent Measure 3B would not impact major transportation corridors and should be able to return to pre-construction operations transportation use and access for Bay Trail users and ferry terminal passengers. Independent Measure 3C would impact Terry Francois Boulevard and could reduce capacity for roadway vehicles, pedestrians, and bicyclists. Independent Measure 4A would flood Evans Avenue and remove this east-west connection in Reach 4. Independent Measures 3B, 3C and 4A would have a ***less than significant impact*** after implementation of AMM-TR-1, AMM-TR-2, AMM-TR-3, and AMM-TR-5.

Independent Measures 2A, 2B, and 3A would impact the Embarcadero and could reduce the transportation capacity for roadway, rail transit, pedestrians and bicyclists. Independent Measures 2A, 2B and 3A would have ***significant and unavoidable impacts*** with implementation of AMM-TR-1, AMM-TR-2, AMM-TR-3, AMM-TR-4 and AMM-TR-5.

2.2.3.5.4 Substantial loss of parking spaces and access

The Independent Measures 2A, 2B, and 3B would have temporary impacts to parking and access during construction but not permanent impact on private and public parking access nor reduce on-street or pier parking. These measures would have **minor, less than significant impact** on parking space loss.

Independent Measure 3A is expected to impact on-street parking in the area and access to the Pier 30 parking lot (1,130 parking spaces) during construction. As final design advances for Measure 3A, on-street parking may be removed to allow for more space for other modes of transportation. Independent Measure 3A is anticipated to have a **less than significant impact** to parking spaces.

Independent Measure 3C is anticipated to reduce access to the parking lot for Pier 52, approximately 60 parking spaces, during construction. Once the project is built, access to the parking limit would be fully restored. Independent Measure 3C would have a **less than significant impact** to parking loss.

Independent Measure 4A would impact on-street parking and private parking for mostly industrial businesses. This would reduce the number of parking spaces available after the project construction is complete in Reach 4. Independent Measure 4A would have a **significant and unavoidable impact** by reducing the parking spaces count in Reach 4.

2.2.4 Mitigation

In order to avoid or minimize impacts to transportation during construction and operations, the following measures would be implemented as part of the project alternatives.

AMM-TR-1: Prepare Construction Traffic Management Plans (CTMP) for construction of the Project.

A series of CTMPs would be prepared as the actions are planned, in consultation with appropriate agencies (City of San Francisco, SFMTA, WETA, Caltrans, BART, SamTrans, Golden Gate Transit, Muni, Caltrain and HSR) to determine safe access to and movement through the Project area during construction. These plans will be prepared based on the specific location, duration, and work space needed for a given project a activity. Plans will include a communication plan for agencies and public.

The CTMP would include project specific-information on expected hours of construction, duration of construction at a given location, and will includes measures such as:

- compliance with SFMTA blue book for Regulations for Working in San Francisco Streets
- Identification of road and/or lane, bike path, sidewalk closures; bus and transit route or stop modification, if any; bus bridges if needed for rail transit; and identification of any Identification of detour routes for different travel modes
- emergency services alternative routes for essential services
- delivery vehicle access to local businesses
- coordination with San Francisco Unified School District and other local schools to ensure safe access to school for students, faculty, and the public
- identify construction truck haul routes for transport of construct materials, waste disposal for heavy construction vehicles
- identify off-street parking for construction related vehicles

AMM-TR-2: Include Pedestrian Access in CTMP

Maintain access on existing sidewalks and trails in the waterfront area. Provide suitable detour routes if construction will obstruct pedestrian routes. Any pedestrian detours would need to comply with Americans with Disabilities Act (ADA). Coordinate with SFMTA on pedestrian access and potential obstructions to pedestrian movement. Coordinate with MTC on Bay Trail access and potential detours.

AMM-TR- 3: Include Bicycle Access in CTMP

Maintain access on existing bike lanes and pathways through the Project area during construction or provide a satisfactory detour for bicycles. Coordinate with SFMTA on bicycling routing and any potential detours. Coordinate with MTC on Bay Trail access and potential detours.

AMM- TR- 4: Include Transit Access in CTMP

Maintain access or provide alternative route and stops to transit within the waterfront area. Coordinate with SFMTA, BART, SamTrans, Golden Gate Transit, Muni, and any other local transit service providers. The public will be notified of any changes in transit routes or access during construction.

AMM- TR-5: Include water traffic management in CTMP

Maintain access or provide temporary locations to docks and piers utilized for boarding and operations of public ferries, public recreational vessels, private vessels, and freight boats. Include coordination with relevant parties including WETA, Golden Gate Ferry, and San Francisco Bay Ferry.

AMM- TR-6: Restrict Construction Hours

- Limit construction work that must occur between 8:00 p.m. and 7:00 a.m. Any work that is needed between these times will need to comply with applicable noise and vibration measures.

AMM-TR-7: Coordinate with the City of San Francisco for major public events

- Coordinate with the City of San Francisco on major public events that may reduce or restrict construction to allow efficient transportation for larger crowds.

AMM-TR-8: For Alternatives where roadway access is changed substantially

The USACE and the Port will coordinate closely with the City and transit agencies on the need for modifications to the City's transportation system in response to areas that might otherwise be isolated by construction of the measures. During the PED phase, design engineers will coordinate with transportation agencies and where minor changes can be made to minimize impacts, these will be incorporated into the design. This could include, for instance, minor modifications to alignment of levees to one side of an existing road so as not to affect traffic once constructed. Prior to implementation of any measures that cause permanent changes or lengthy construction disruptions to the roadway system, coordination will occur to identify modifications to the roadway system and incorporate planning for these measures into the future City and Caltrans transportation network. Examples of areas to be evaluated would include areas such as reconfiguration of the I-280 on/off ramps at Cesar Chavez Street, or to the approaches to the Bay Bridge, as well as changes to circulation patterns with narrowing of the Embarcadero or incorporation of changes to Terry Francois Blvd.

AMM-TR-9: For Alternatives where railroad access and related infrastructure are changed substantially

The USACE and the Port will coordinate closely with the City and agencies that utilize railroad tracks throughout the project area. These agencies include, but are not limited to, SFMTA, Caltrain, BART, and Union Pacific Railroad. During the PED phase, design engineers will coordinate with the appropriate transportation agencies and where minor changes can be made to minimize impacts, these will be incorporated into the design. This coordination will include transit route and operations and maintenance facility access. Operations and maintenance facilities could include railroad access to vehicle storage yards, maintenance-of-way infrastructure, vehicle service and cleaning facilities. The Muni Metro East (MME) facility access is of particular importance to service vehicles and infrastructure. This coordination would also include minor changes to designs to minimize impacts to related transit infrastructure, such as communication systems, electrical supply, and safety systems, among other transportation infrastructure, for existing transit operations.

2.3 Cumulative and Other Impacts

Indirect impacts could occur to neighborhoods beyond the construction areas from changes to transit and transportation systems. Modifications to the Muni system could affect the Hunter's Point Bayview neighborhood outside the project's area. Cumulative impacts of other construction projects that could be taking place when constructions starts, and cumulative effects to transit or transportation users, will be considered as part of the construction and traffic management plans to be prepared for elements of the project as work progresses as described in the mitigation section.

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Transportation D-1-4
Sub-Appendix 1

Alternative B 2040

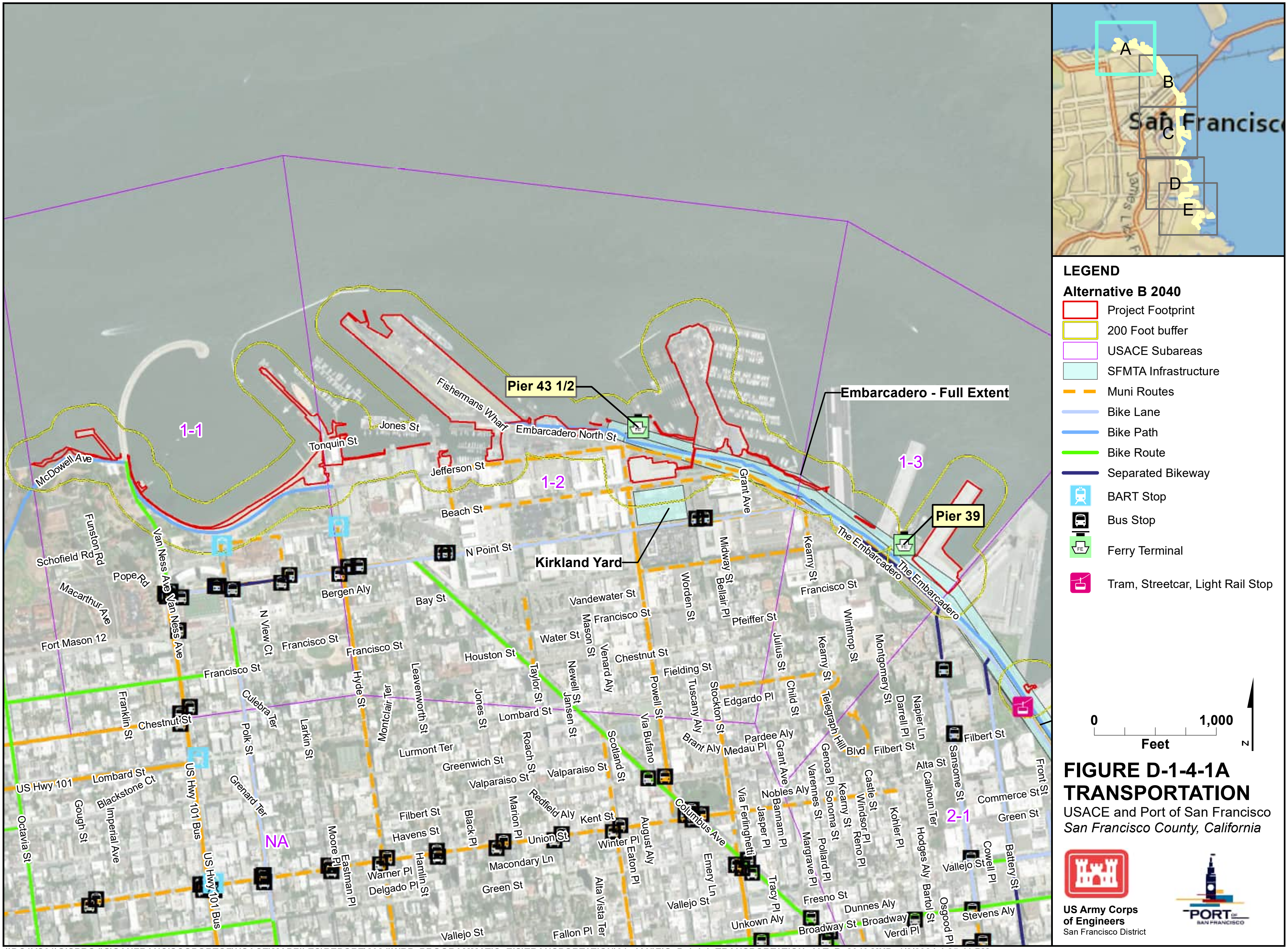


FIGURE D-1-4-1A TRANSPORTATION

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-1_TRANSPORTATION_ALT_B_2040.MXD 1/2/2024 4:25:11 PM

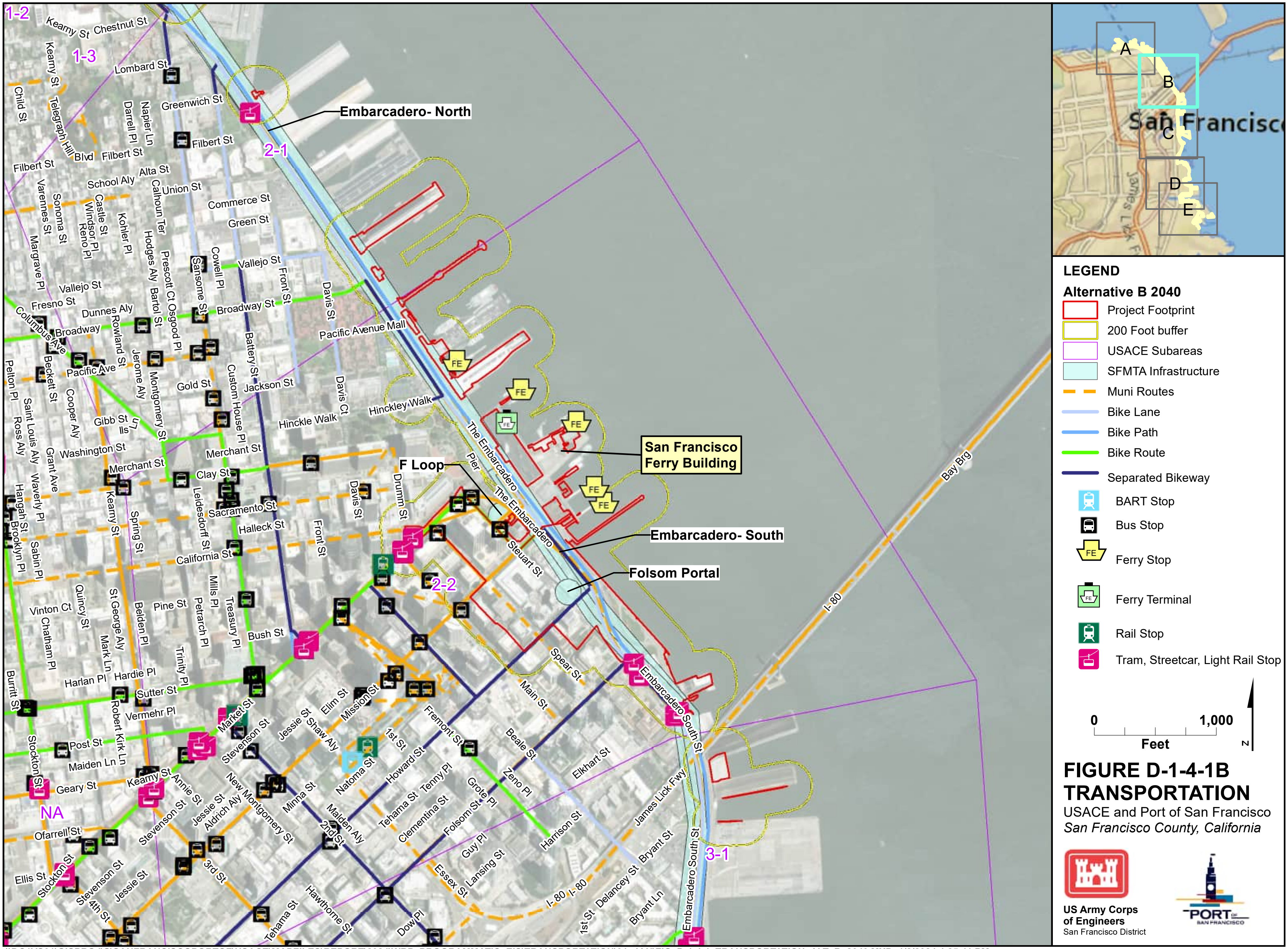
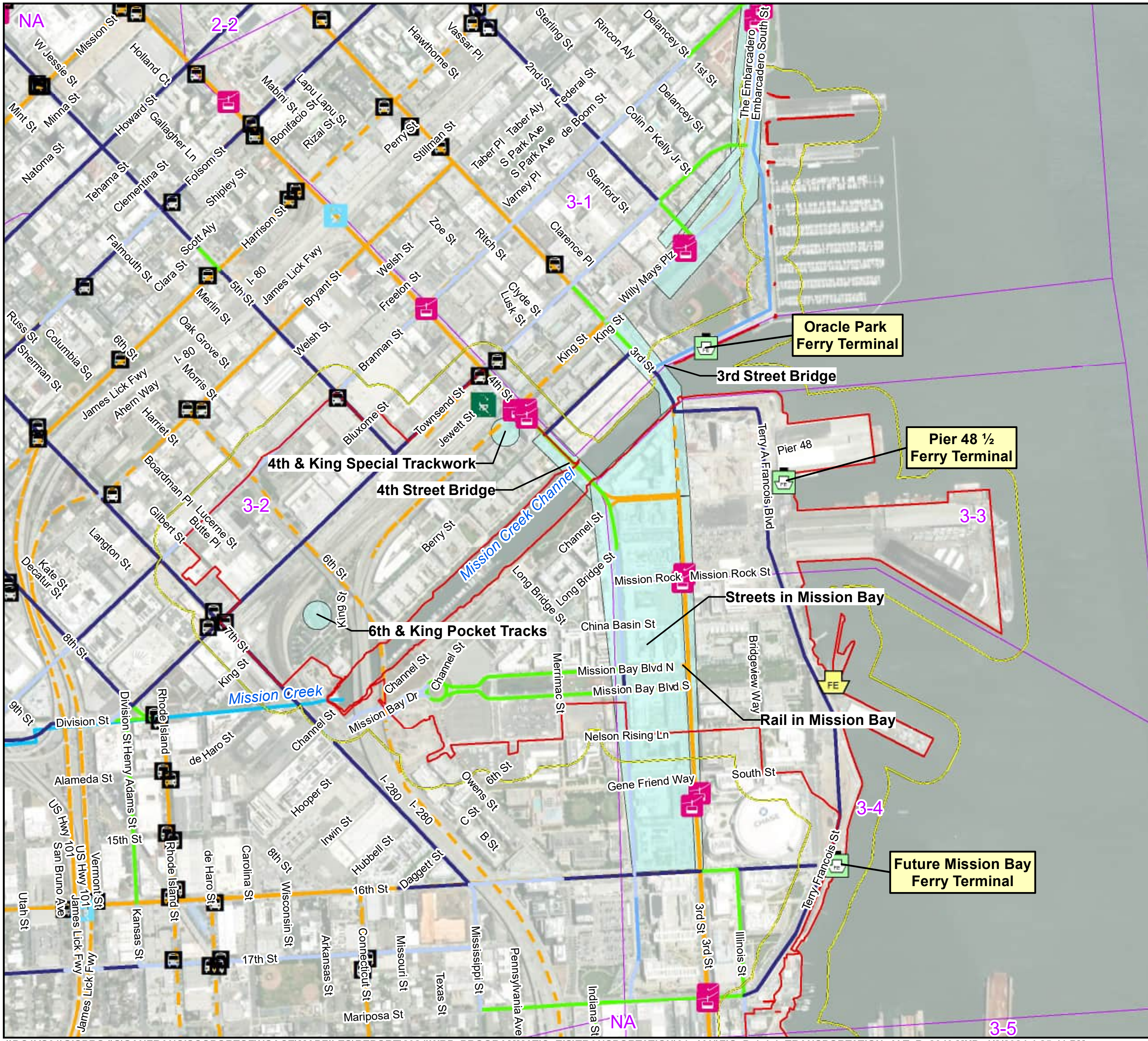
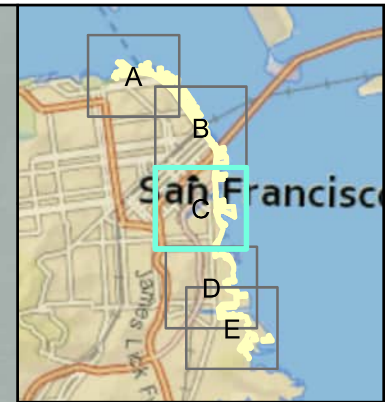


FIGURE D-1-4-1B TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California





LEGEND

Alternative B 2040

- Project Footprint
- 200 Foot buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Separated Bikeway
- BART Stop
- Bus Stop
- Ferry Stop
- Ferry Terminal
- Rail Stop
- Tram, Streetcar, Light Rail Stop

0 — 1,000 Feet

N

FIGURE D-1-4-1C TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

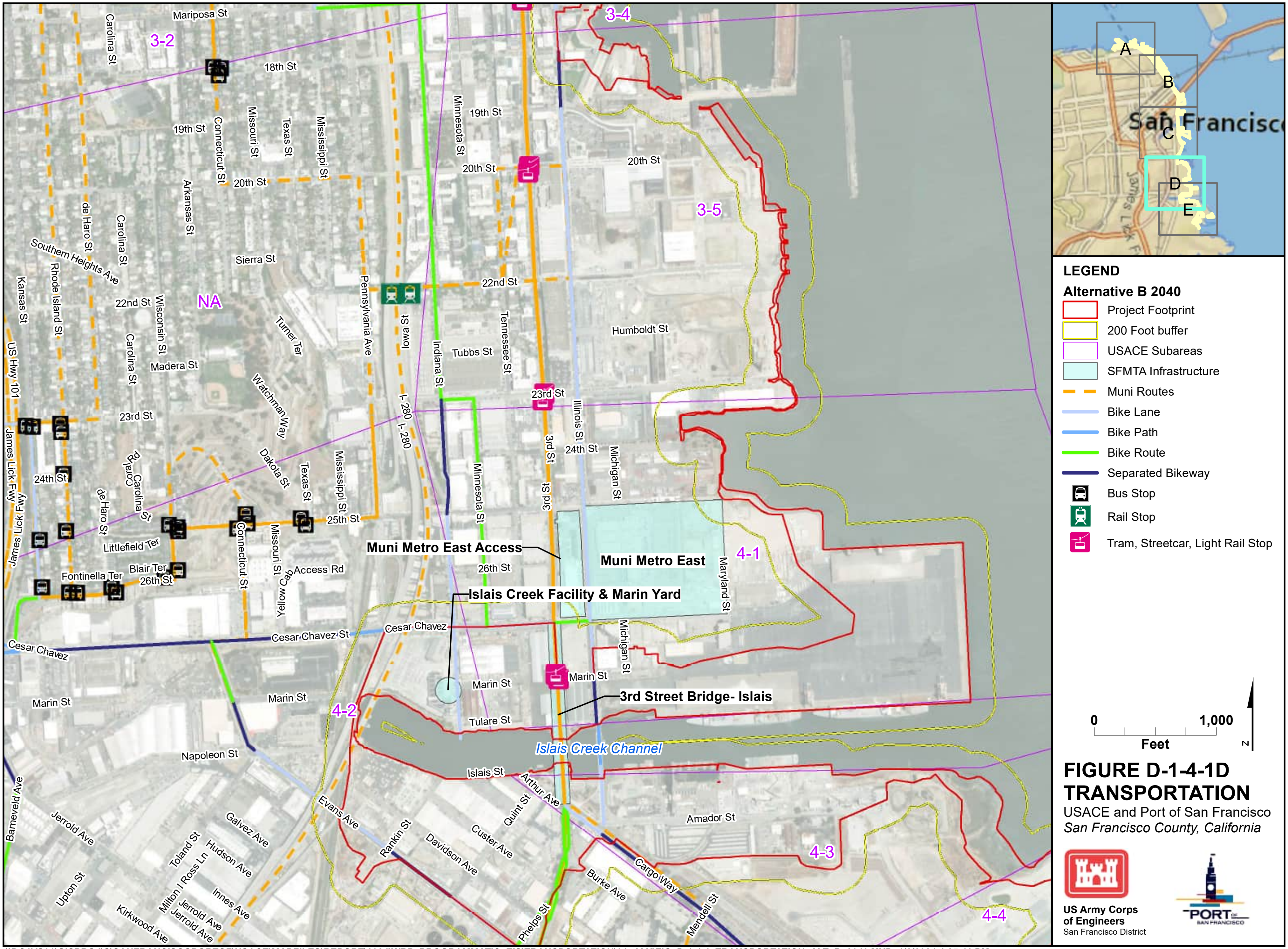


FIGURE D-1-4-1D
TRANSPORTATION

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-1_TRANSPORTATION_ALT_B_2040.MXD 1/2/2024 4:25:11 PM

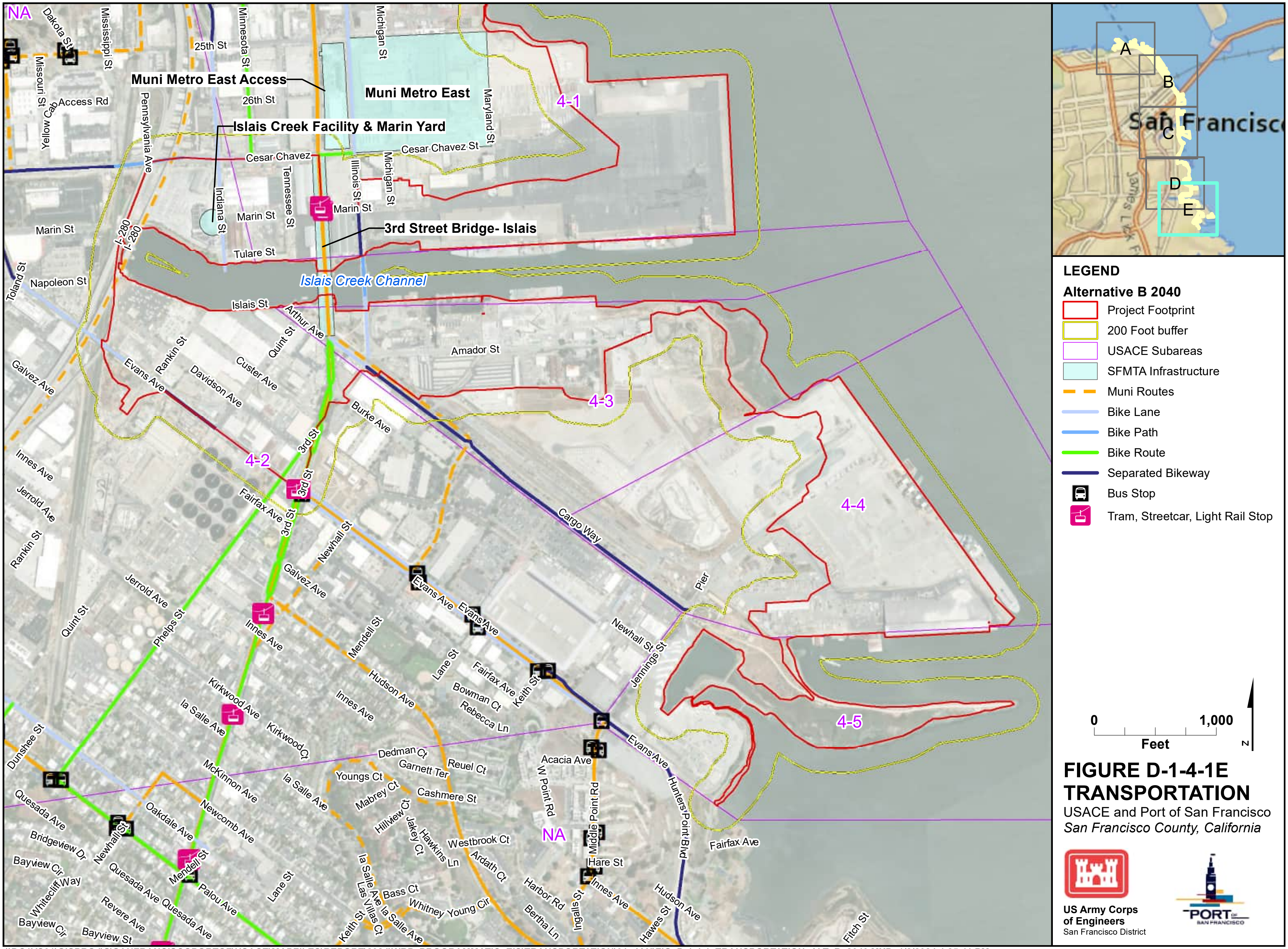
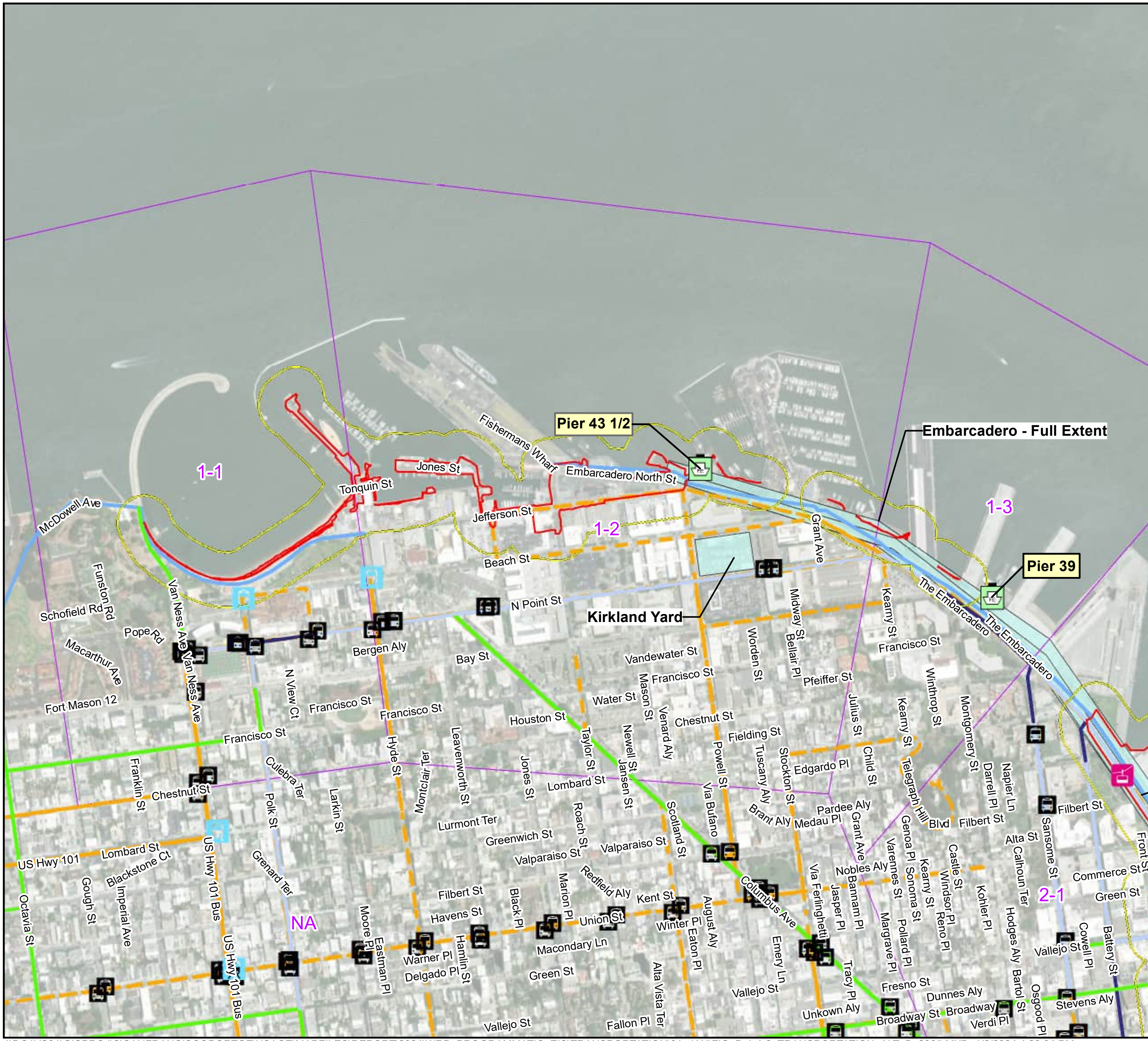
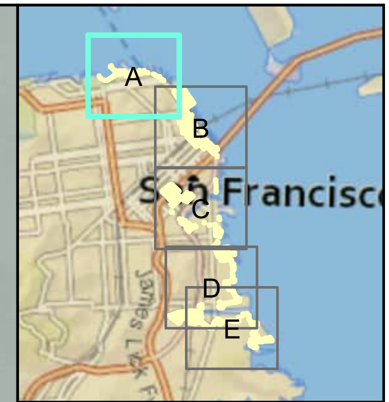


FIGURE D-1-4-1E
TRANSPORTATION
USACE and Port of San Francisco
San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-1_TRANSPORTATION_ALT_B_2040.MXD 1/2/2024 4:25:11 PM

Alternative B 2065





LEGEND

Alternative B 2065

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Separated Bikeway
- BART Stop
- Bus Stop
- Ferry Terminal
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet
N

FIGURE D-1-4-2A TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-2_TRANSPORTATION_ALT_B_2065.MXD 1/2/2024 4:28:04 PM

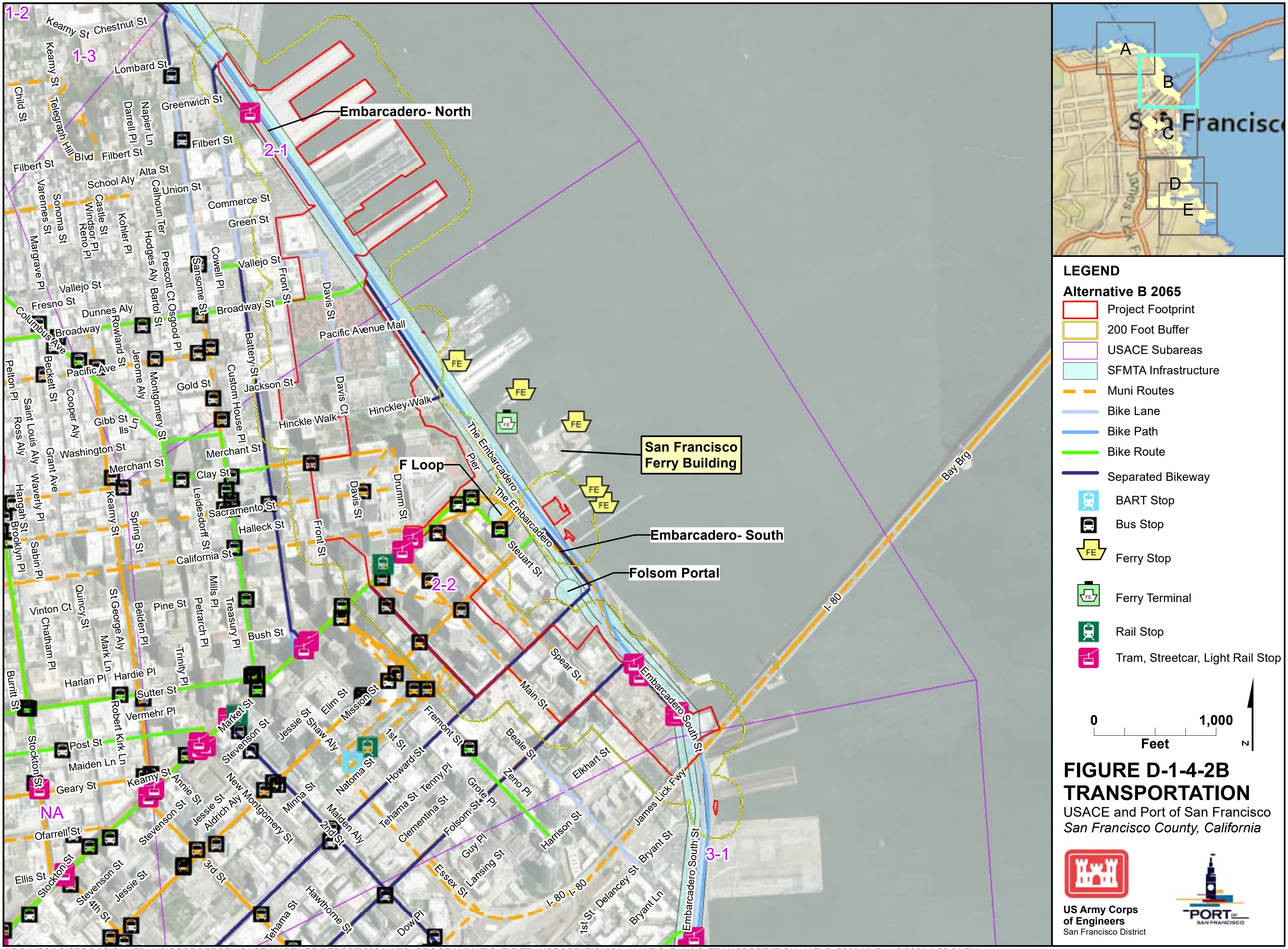


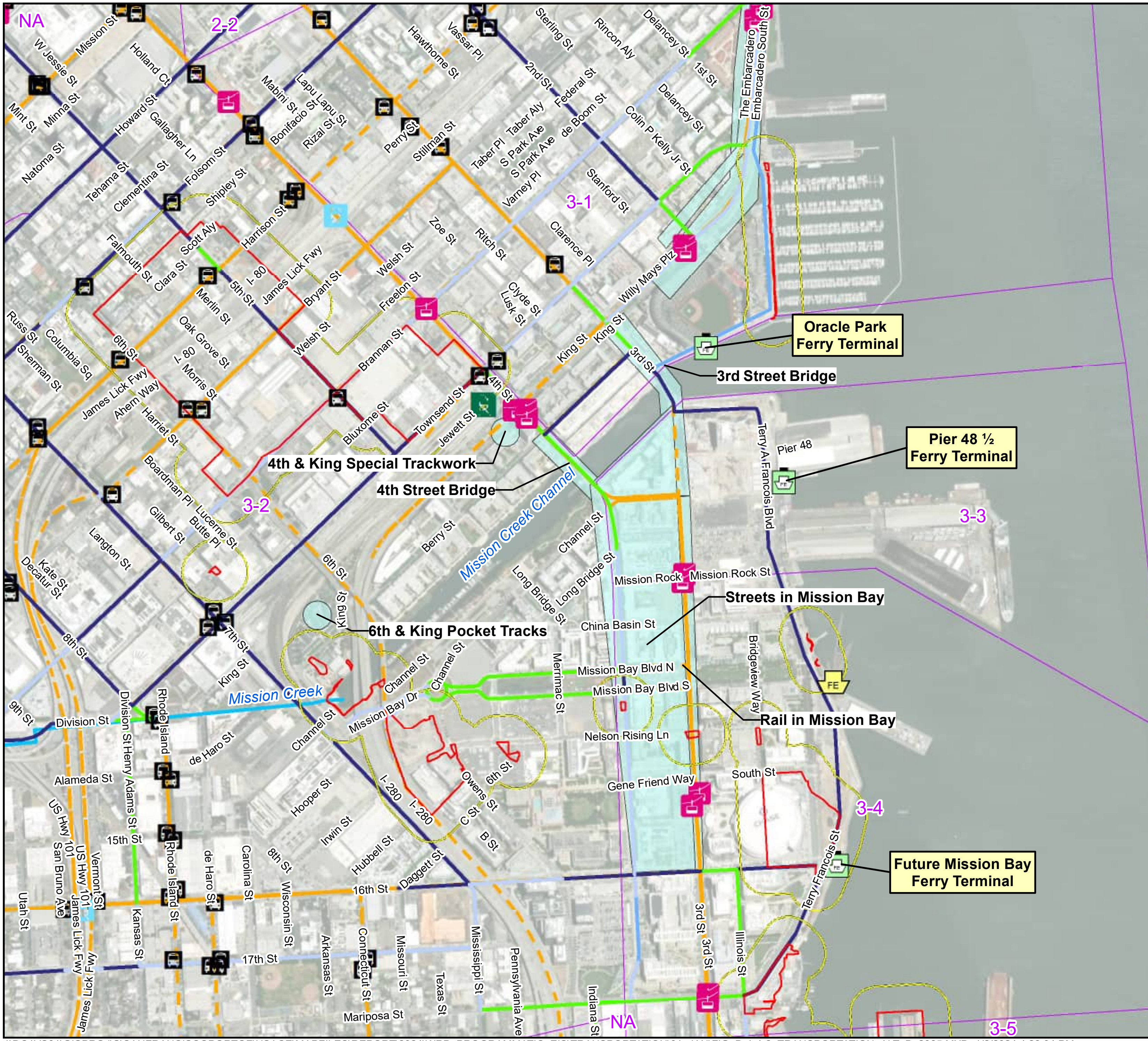
FIGURE D-1-4-2B TRANSPORTATION

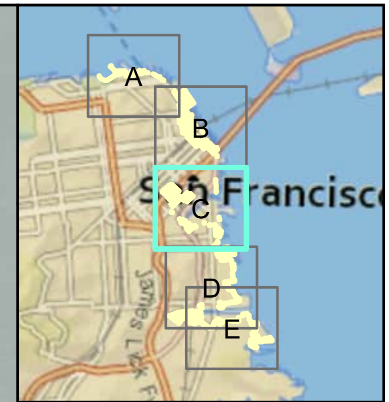
USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-2_TRANSPORTATION_ALT_B_2065.MXD 1/2/2024 4:28:04 PM





LEGEND

Alternative B 2065

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Separated Bikeway
- BART Stop
- Bus Stop
- Ferry Stop
- Ferry Terminal
- Rail Stop
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet

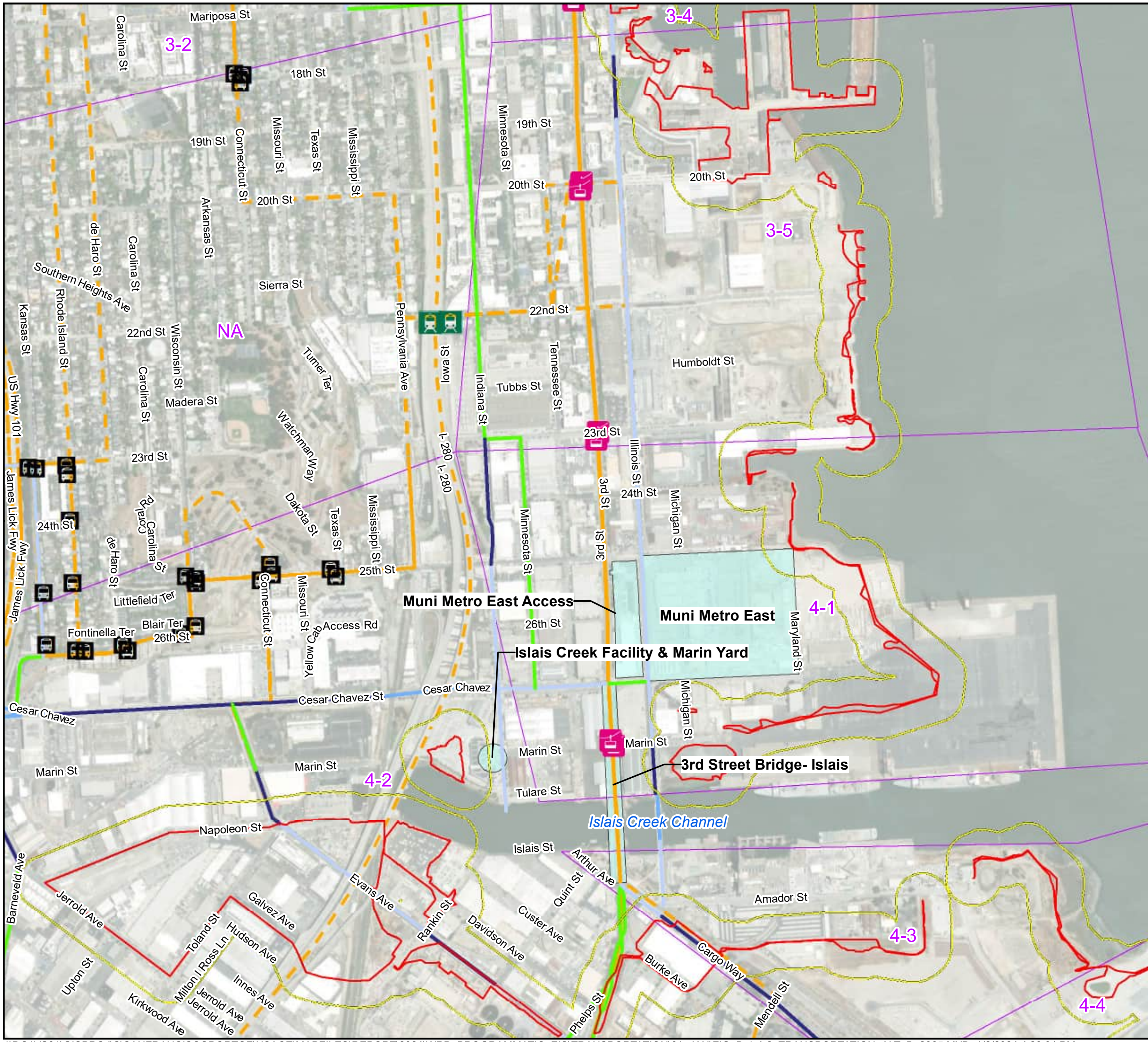
FIGURE D-1-4-2C TRANSPORTATION

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-2_TRANSPORTATION_ALT_B_2065.MXD 1/2/2024 4:28:04 PM



LEGEND

Alternative B 2065

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Separated Bikeway
- Bus Stop
- Rail Stop
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet

FIGURE D-1-4-2D TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-2_TRANSPORTATION_ALT_B_2065.MXD 1/2/2024 4:28:04 PM

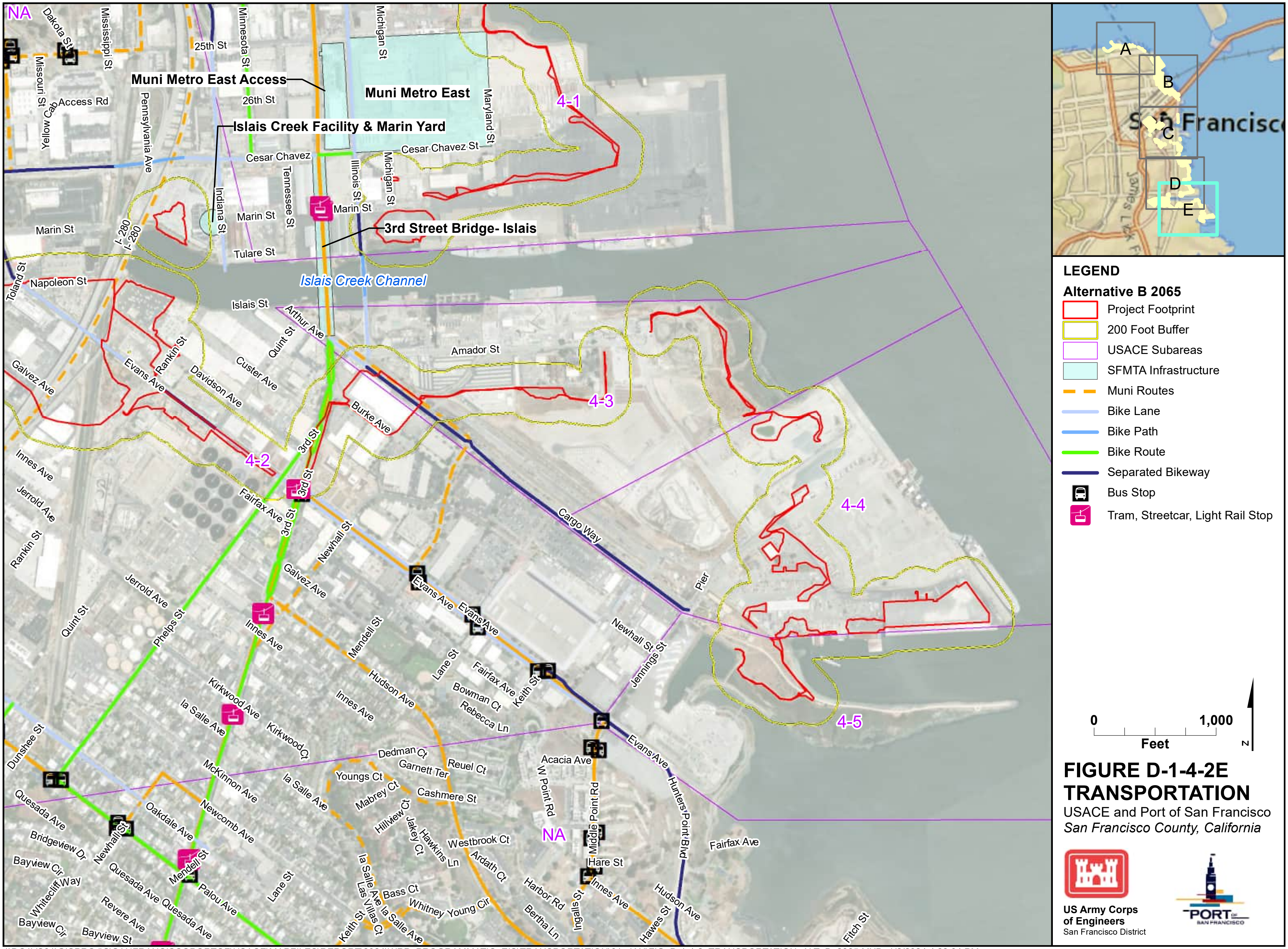


FIGURE D-1-4-2E
TRANSPORTATION
USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-2_TRANSPORTATION_ALT_B_2065.MXD 1/2/2024 4:28:04 PM

Alternative B 2090

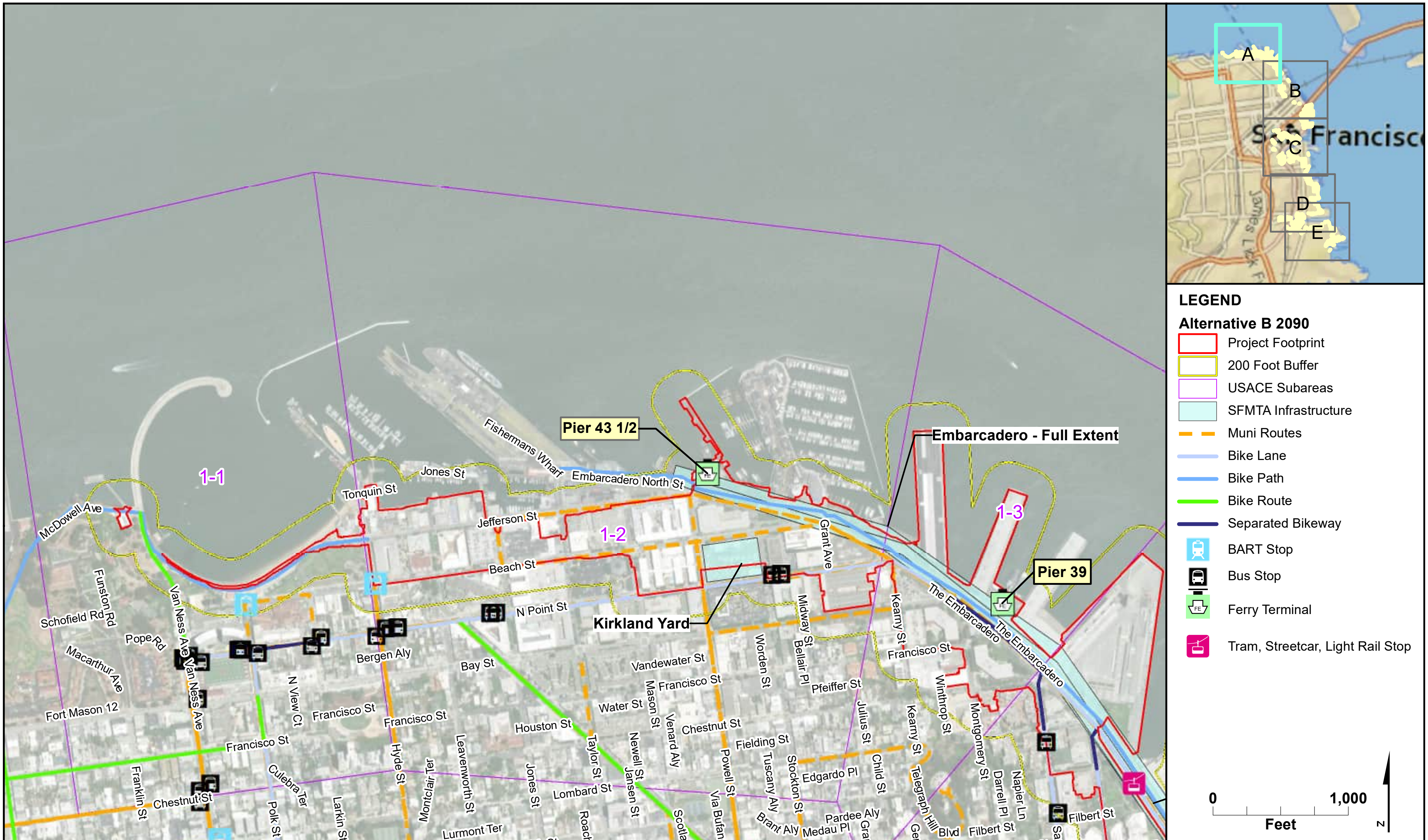


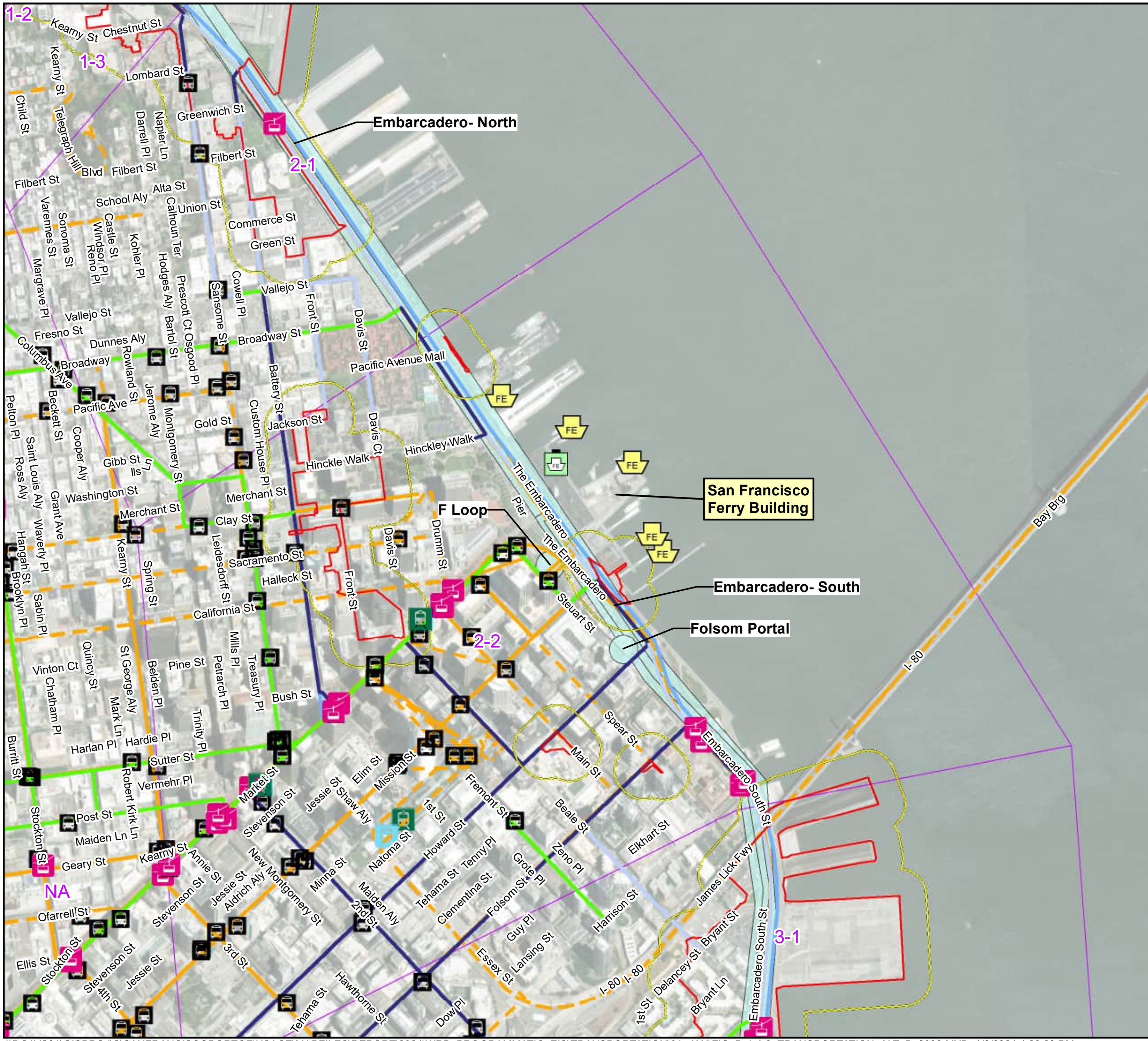
FIGURE D-1-4-3A
TRANSPORTATION

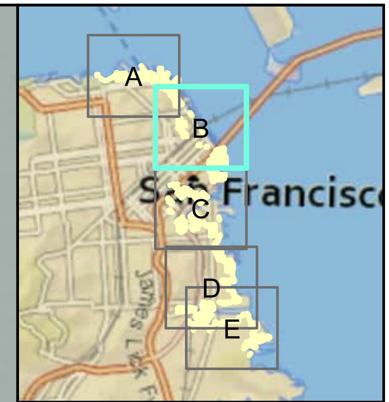
USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-3_TRANSPORTATION_ALT_B_2090.MXD 1/2/2024 4:28:29 PM





LEGEND

Alternative B 2090

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Separated Bikeway
- BART Stop
- Bus Stop
- Ferry Stop
- Ferry Terminal
- Rail Stop
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet

FIGURE D-1-4-3B TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-3_TRANSPORTATION_ALT_B_2090.MXD 1/2/2024 4:28:29 PM

FIGURE D-1-4-3C TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-3_TRANSPORTATION_ALT_B_2090.MXD 1/2/2024 4:28:29 PM

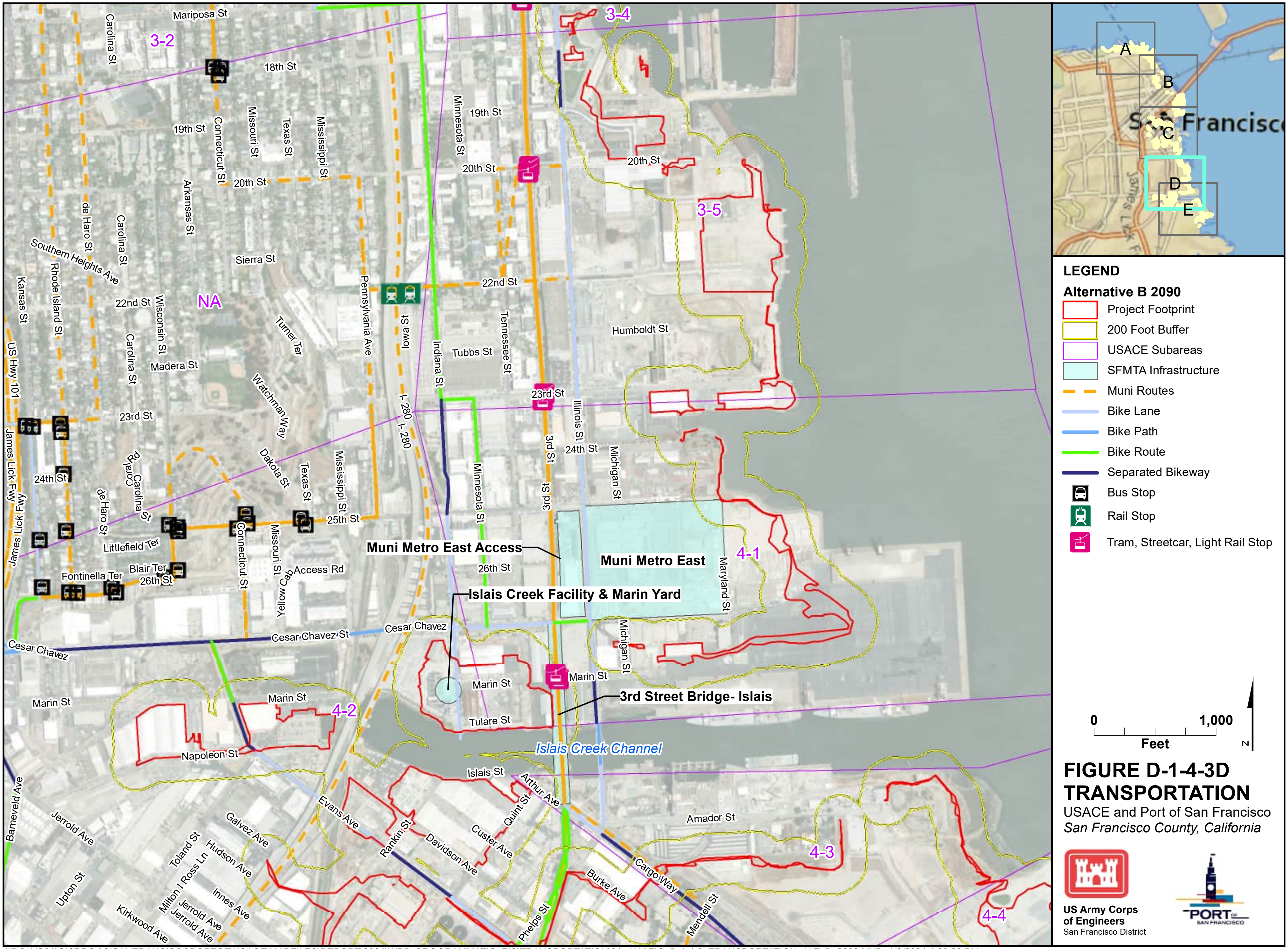
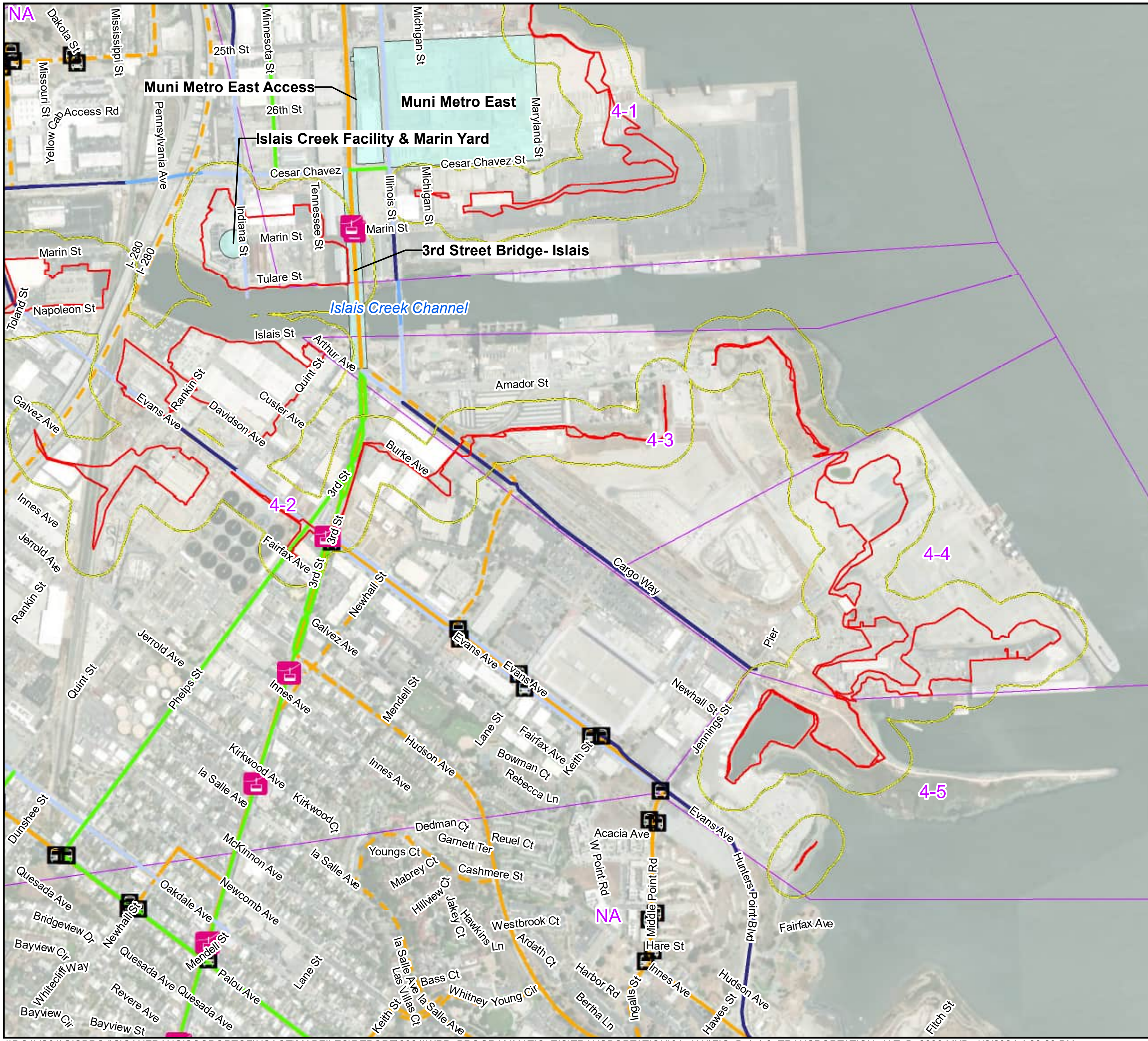


FIGURE D-1-4-3D TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-3_TRANSPORTATION_ALT_B_2090.MXD 1/2/2024 4:28:29 PM



LEGEND

Alternative B 2090

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Separated Bikeway
- Bus Stop
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet

FIGURE D-1-4-3E TRANSPORTATION

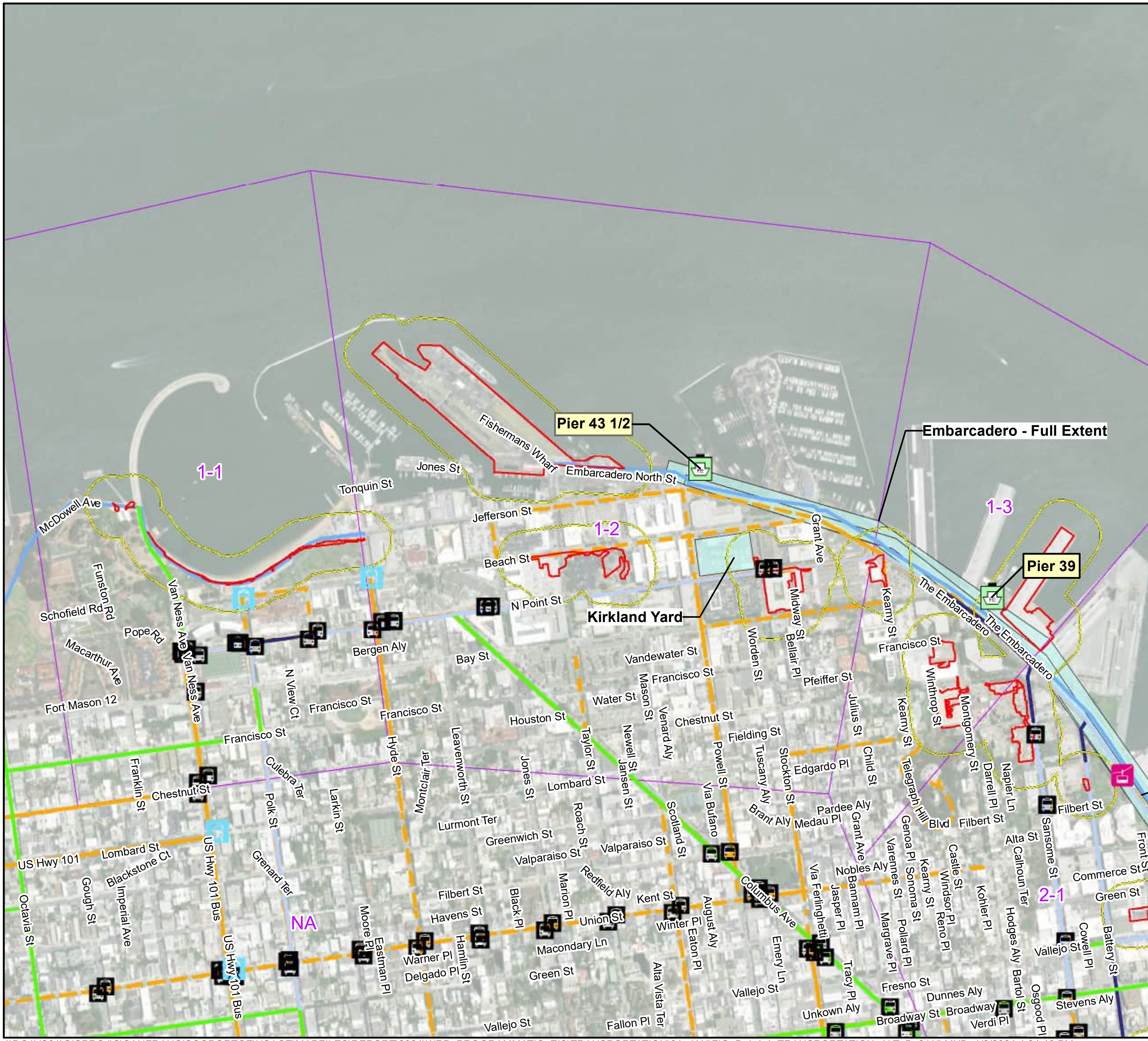
USACE and Port of San Francisco
San Francisco County, California

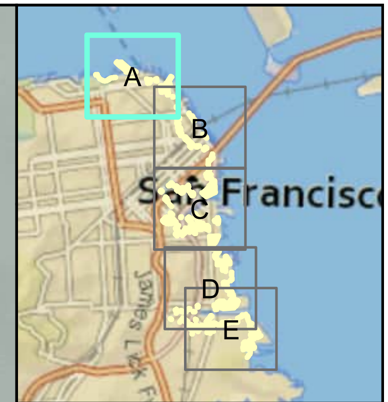
US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-3_TRANSPORTATION_ALT_B_2090.MXD 1/2/2024 4:28:29 PM

Alternative B 2115





LEGEND

Alternative B 2115

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Separated Bikeway
- BART Stop
- Bus Stop
- Ferry Terminal
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet
N

FIGURE D-1-4-4A TRANSPORTATION

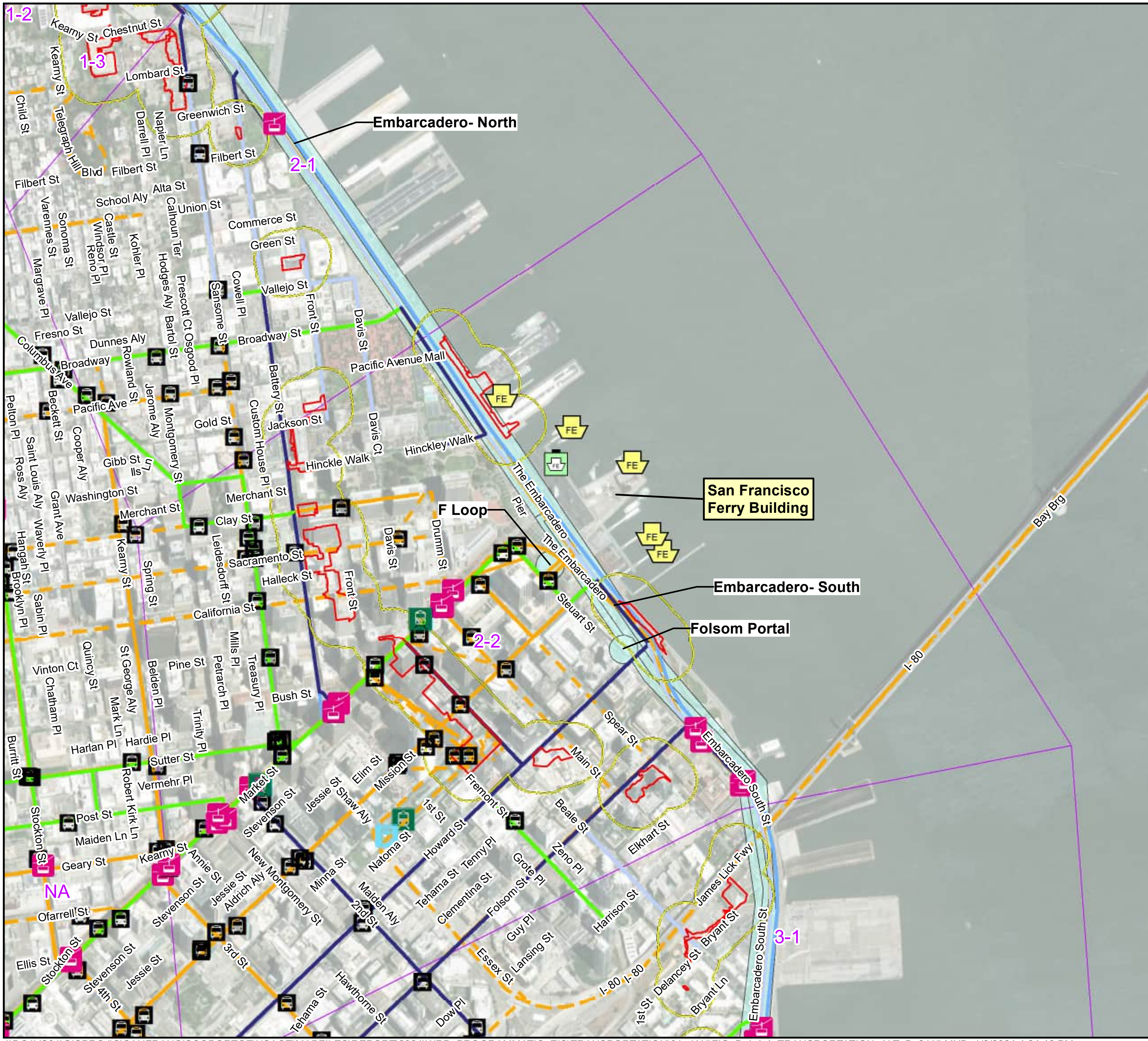
USACE and Port of San Francisco

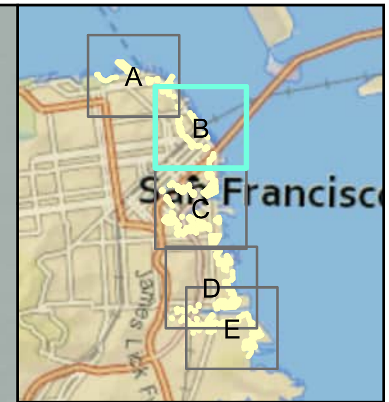
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-4_TRANSPORTATION_ALT_B_2115.MXD 1/2/2024 4:24:46 PM





LEGEND

Alternative B 2115

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Separated Bikeway
- BART Stop
- Bus Stop
- Ferry Stop
- Ferry Terminal
- Rail Stop
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet
N

FIGURE D-1-4-4B TRANSPORTATION

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-4_TRANSPORTATION_ALT_B_2115.MXD 1/2/2024 4:24:46 PM

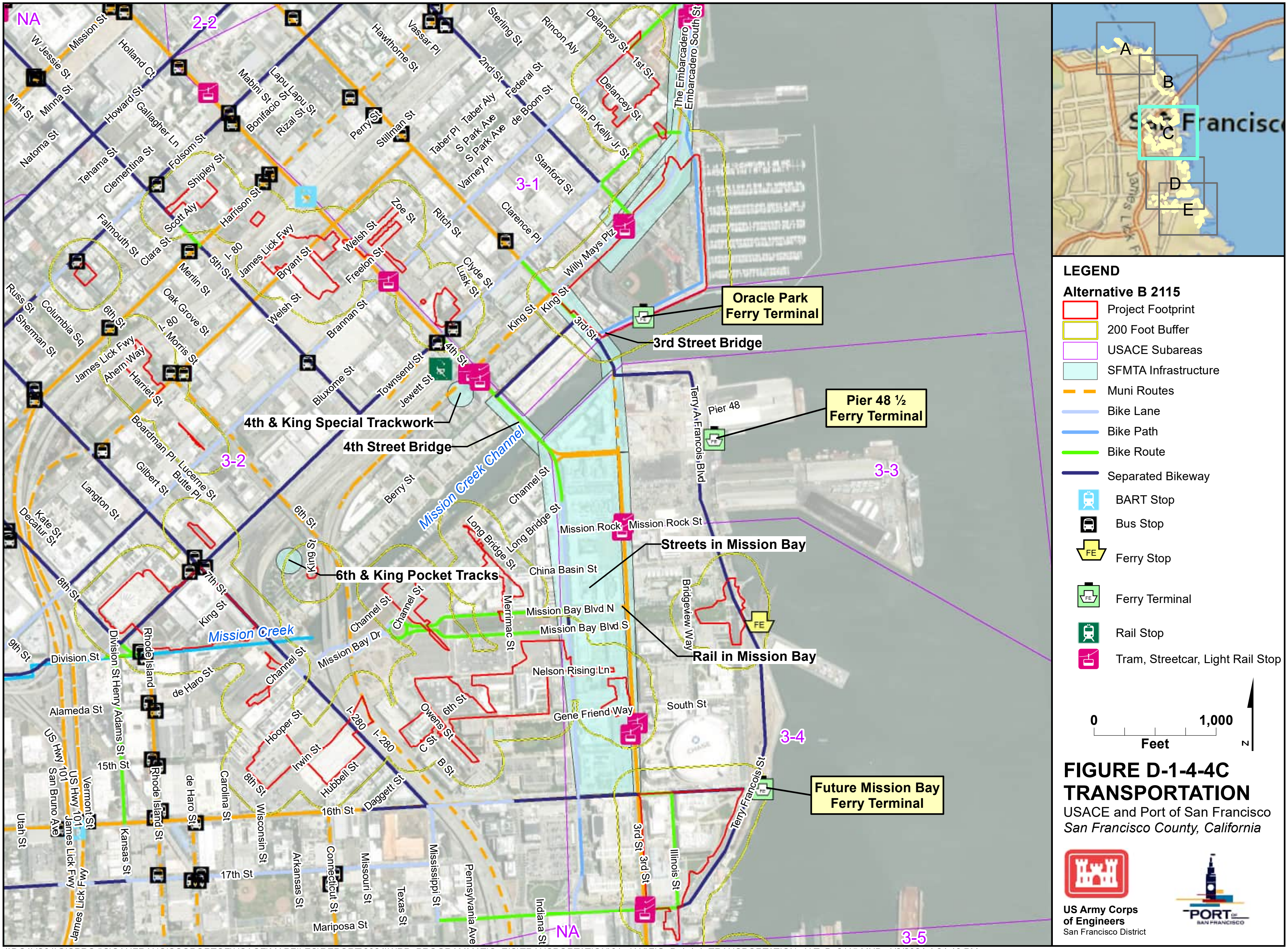


FIGURE D-1-4-4C TRANSPORTATION

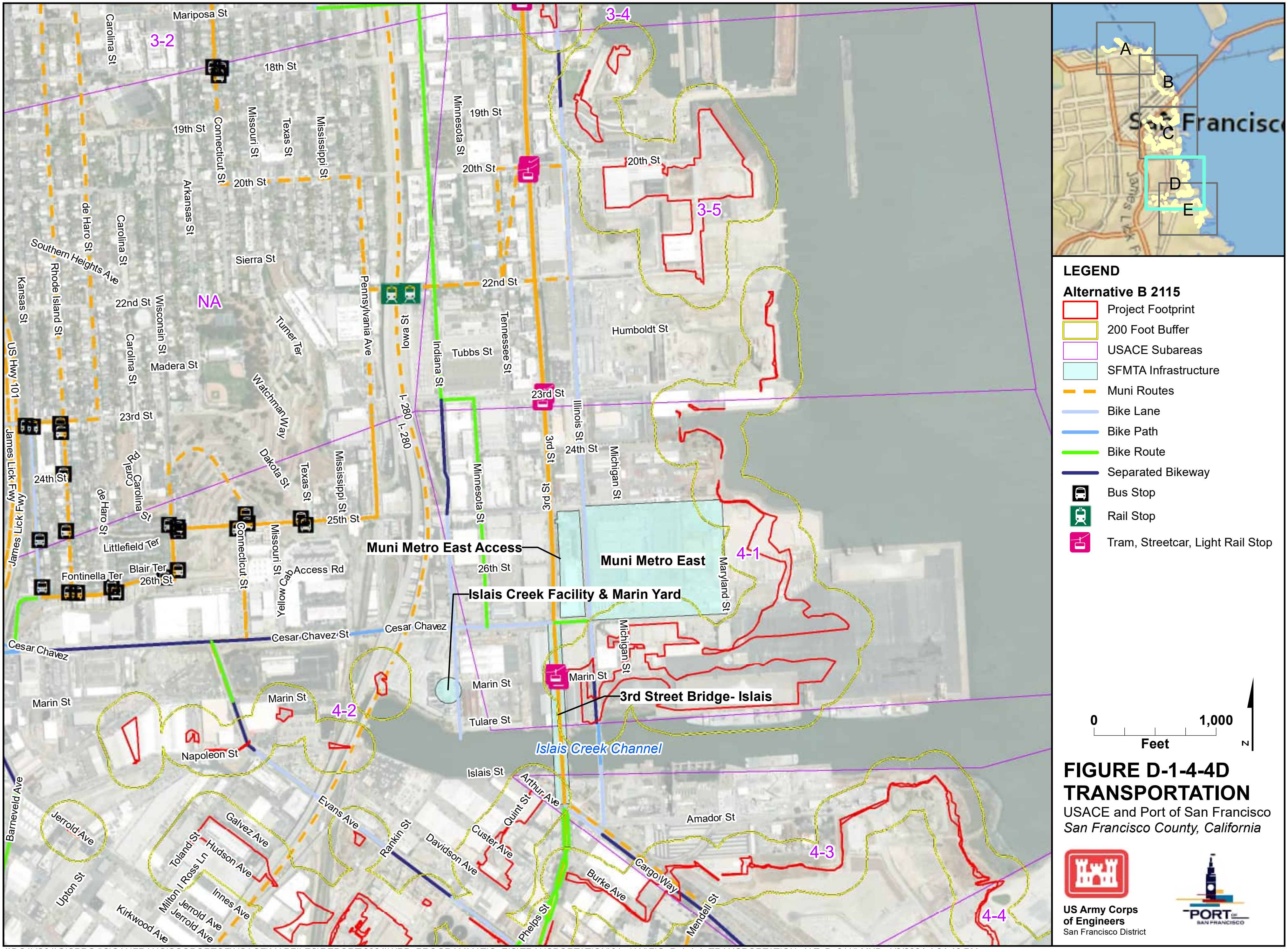
USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-4_TRANSPORTATION_ALT_B_2115.MXD 1/2/2024 4:24:46 PM



LEGEND

Alternative B 2115

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Separated Bikeway
- Bus Stop
- Rail Stop
- Tram, Streetcar, Light Rail Stop

0 1,000 Feet

N

FIGURE D-1-4-4D TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-4_TRANSPORTATION_ALT_B_2115.MXD 1/2/2024 4:24:46 PM

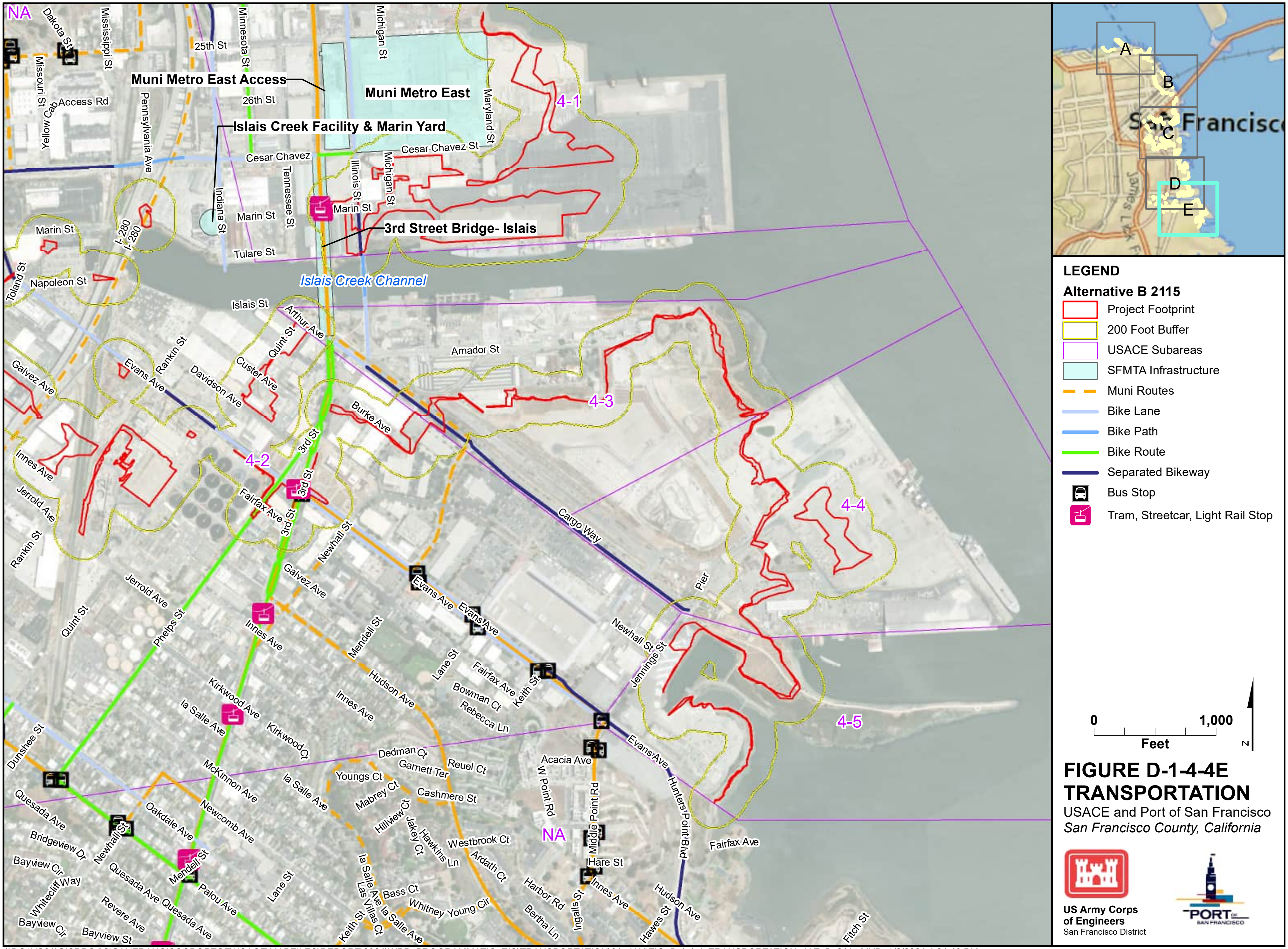


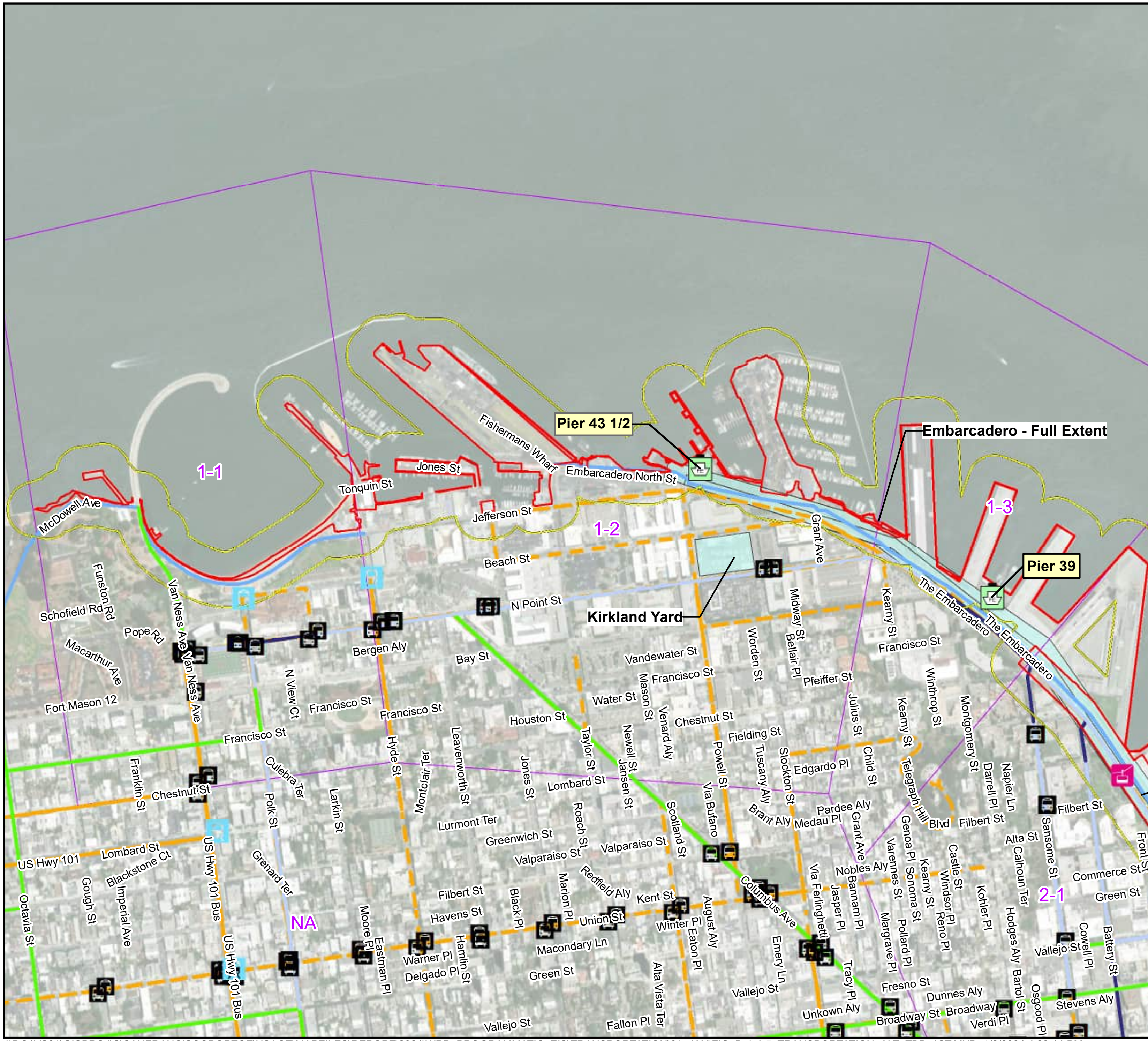
FIGURE D-1-4-4E
TRANSPORTATION
USACE and Port of San Francisco
San Francisco County, California

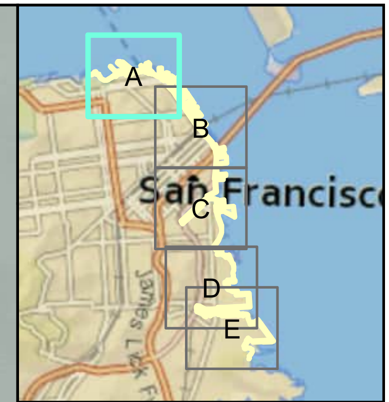
US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-4_TRANSPORTATION_ALT_B_2115.MXD 1/2/2024 4:24:46 PM

TNBP 1st Action





LEGEND

Alternative TNBP 1st Action

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Separated Bikeway
- BART Stop
- Bus Stop
- Ferry Terminal
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet

N

FIGURE D-1-4-5A TRANSPORTATION

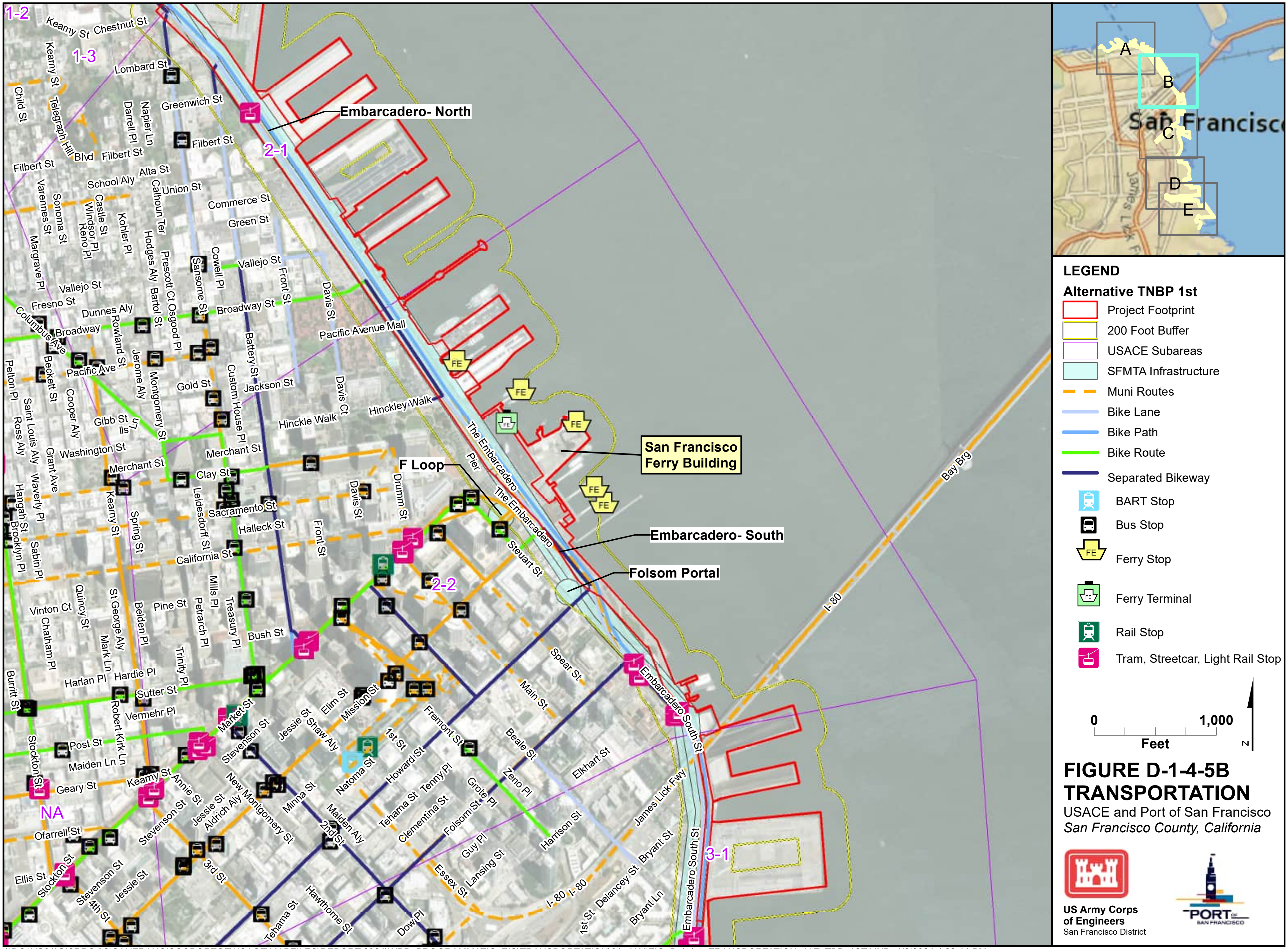
USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-5_TRANSPORTATION_ALT_TBP_1ST.MXD 1/2/2024 4:23:44 PM



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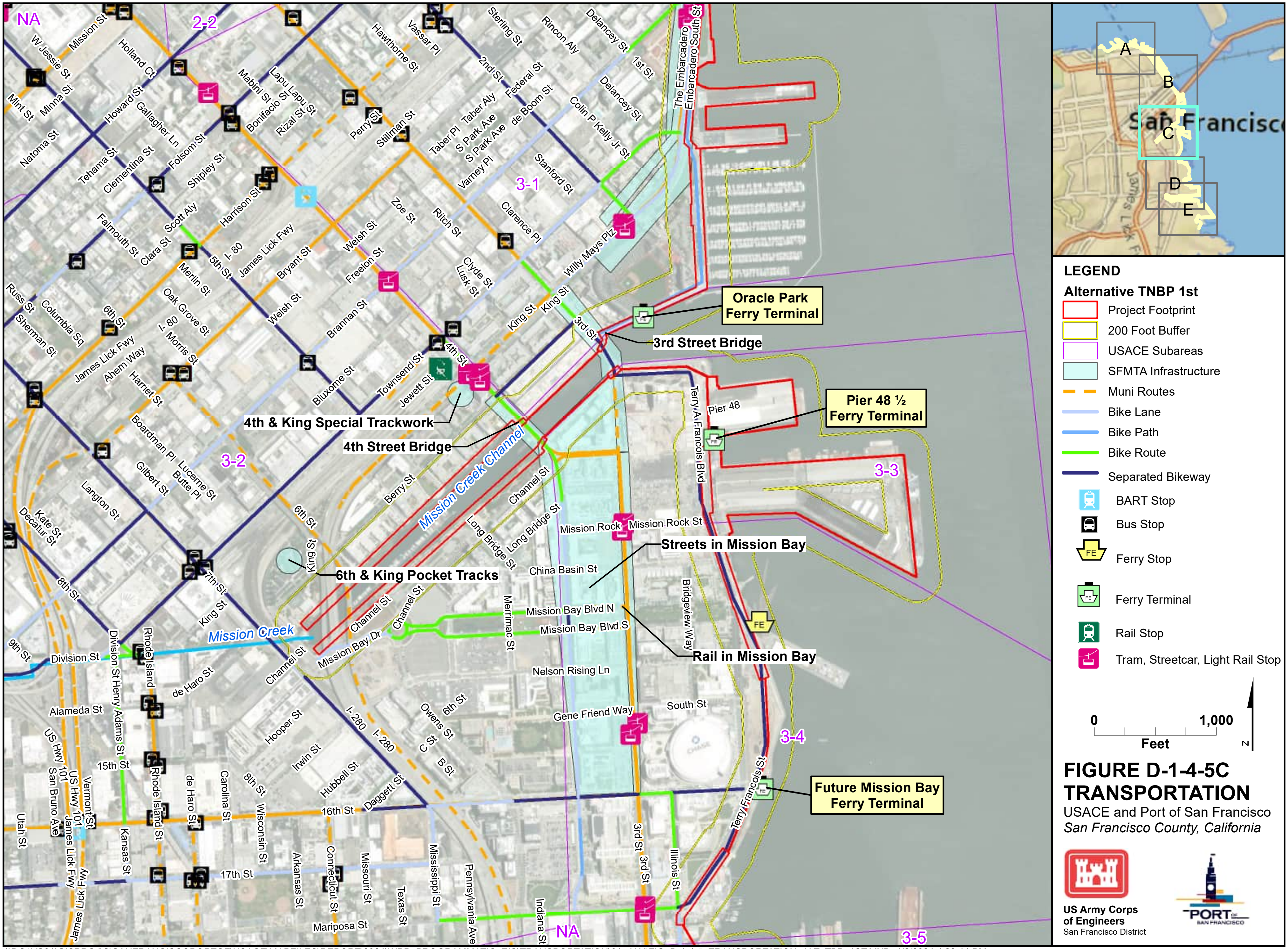


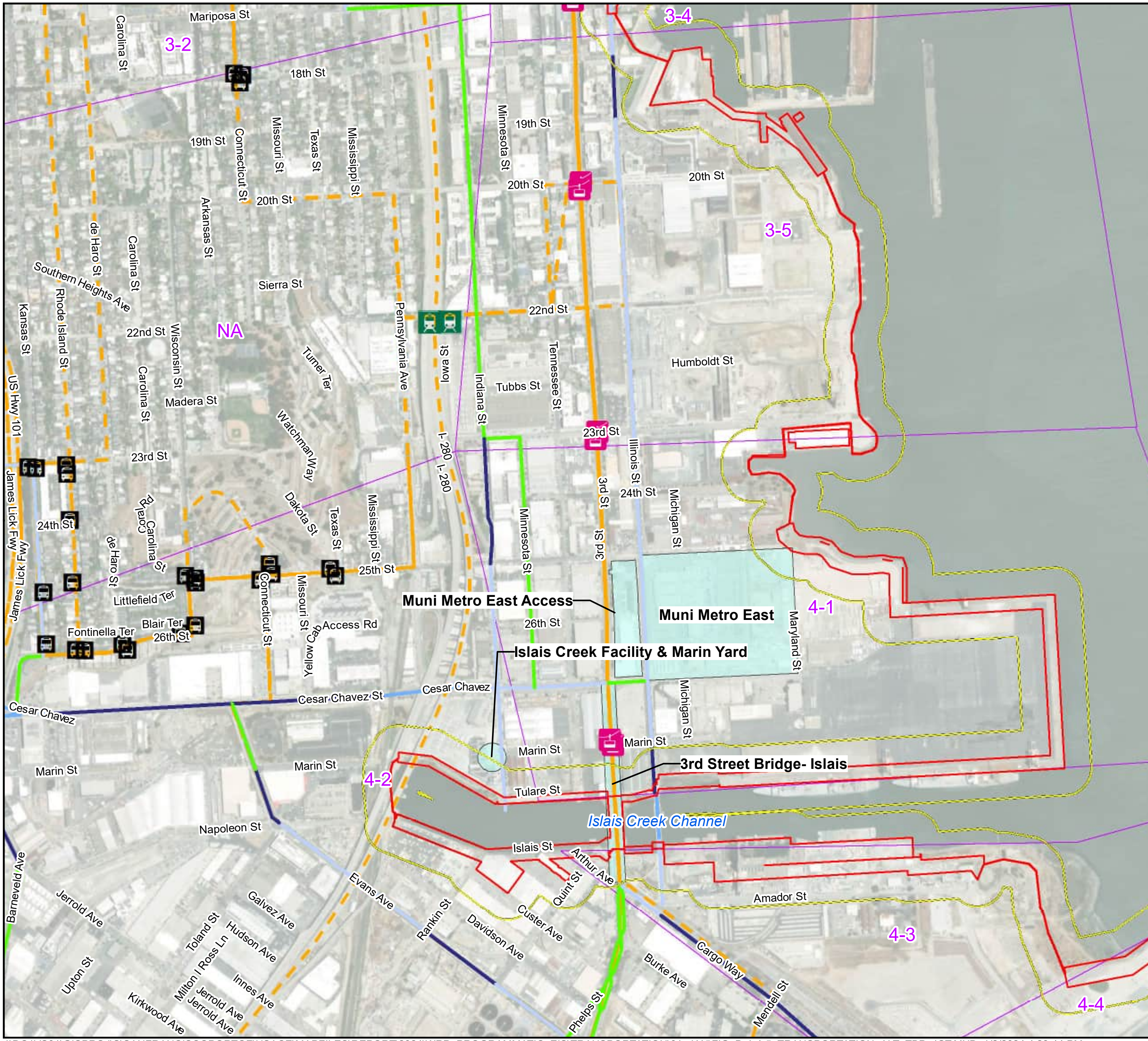
FIGURE D-1-4-5C
TRANSPORTATION

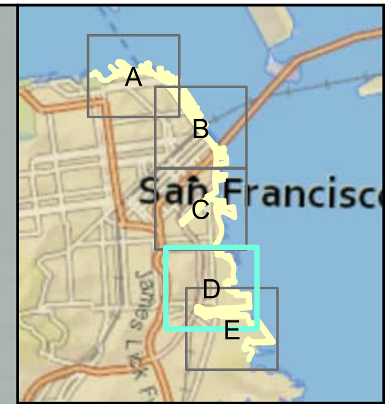
USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-5_TRANSPORTATION_ALT_TBP_1ST.MXD 1/2/2024 4:23:44 PM





LEGEND

Alternative TNBP 1st

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Seperated Bikeway\
- Bus Stop
- Rail Stop
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet
N

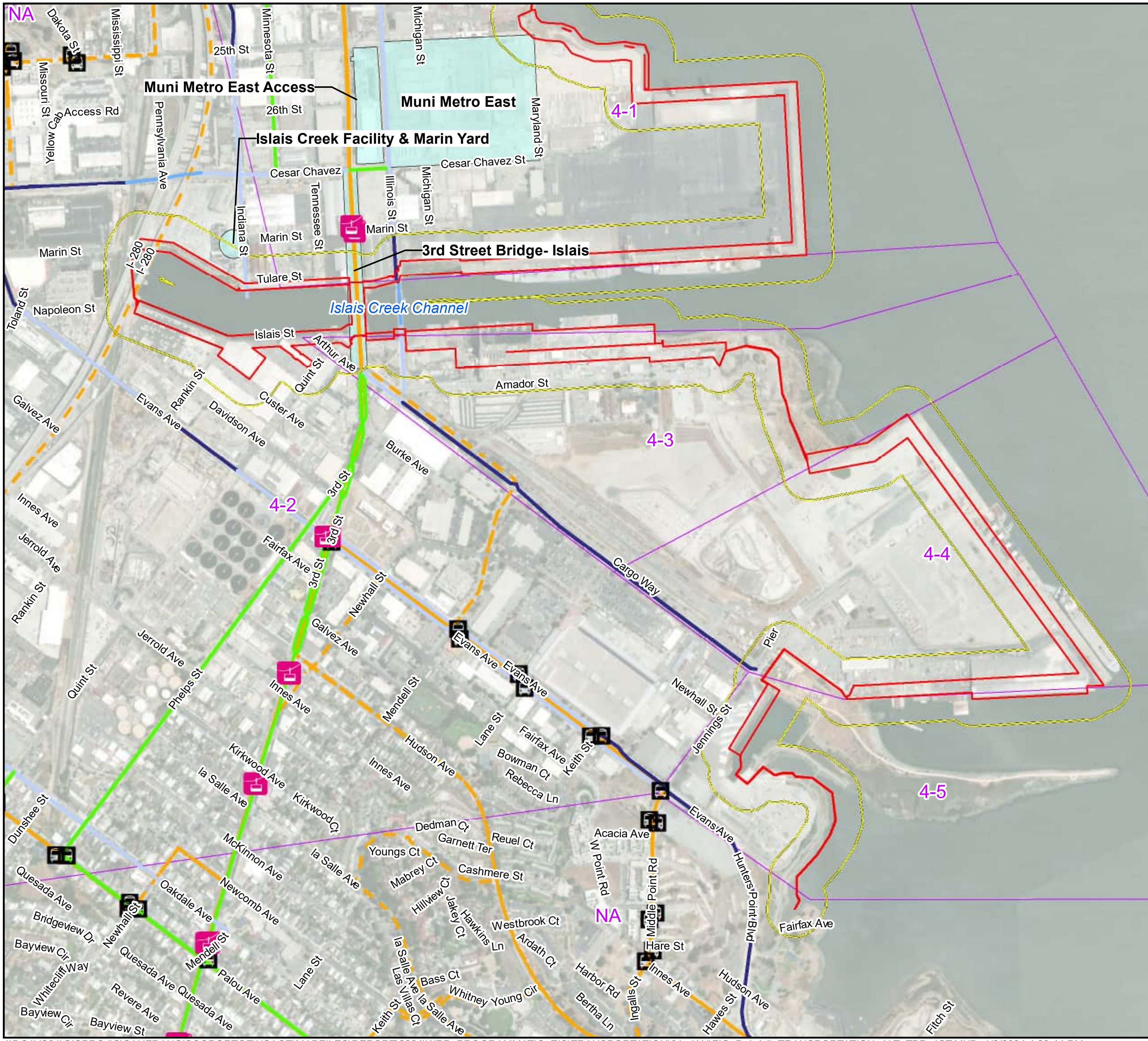
FIGURE D-1-4-5D TRANSPORTATION

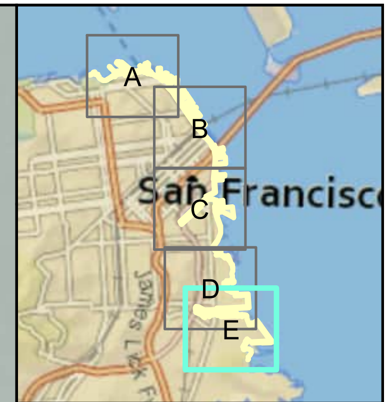
USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-5_TRANSPORTATION_ALT_TBP_1ST.MXD 1/2/2024 4:23:44 PM





LEGEND

Alternative TNBP 1st Action

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Seperated Bikeway\
- Bus Stop
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet

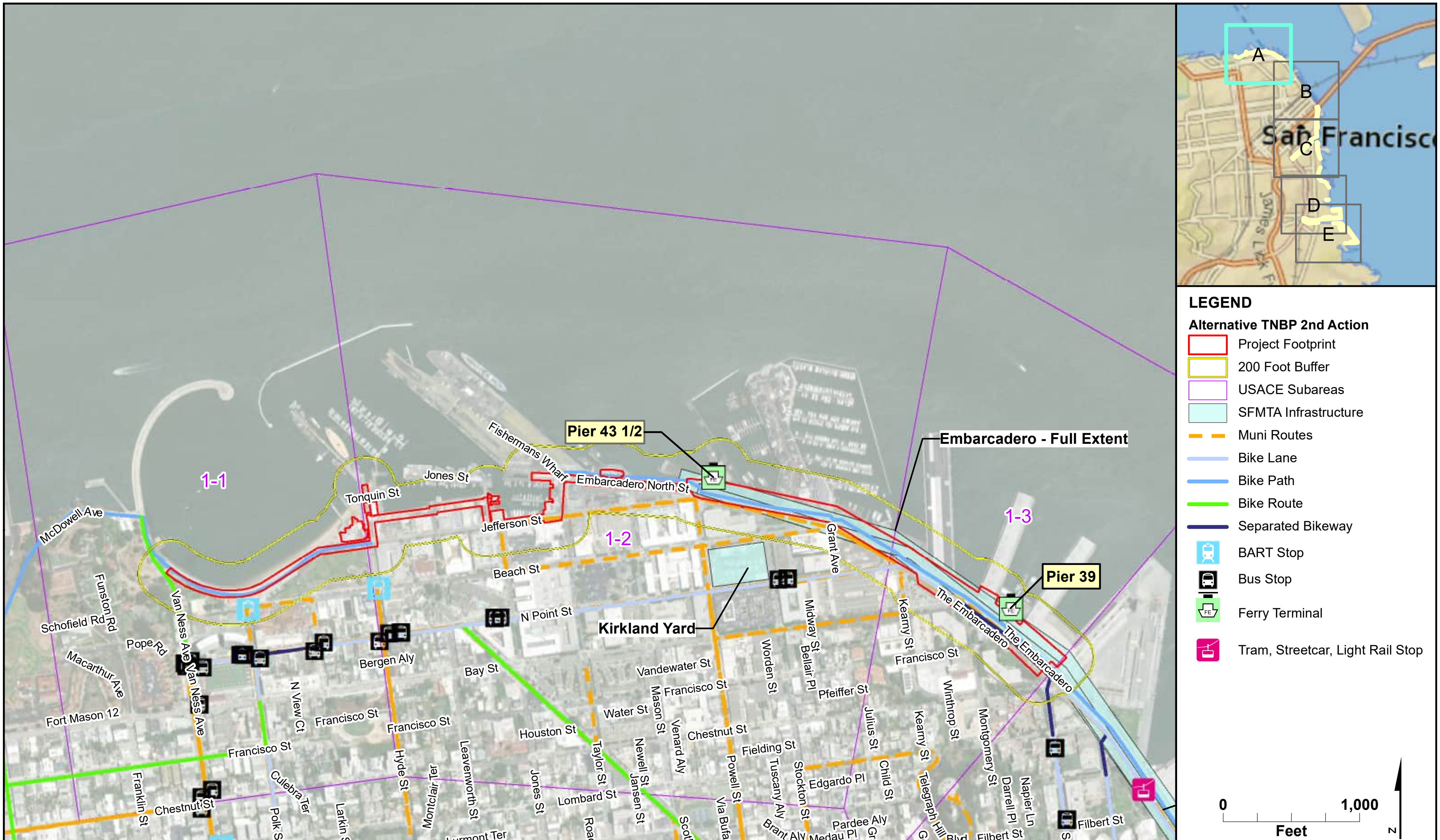
FIGURE D-1-4-5E TRANSPORTATION

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

TNBP 2nd Action



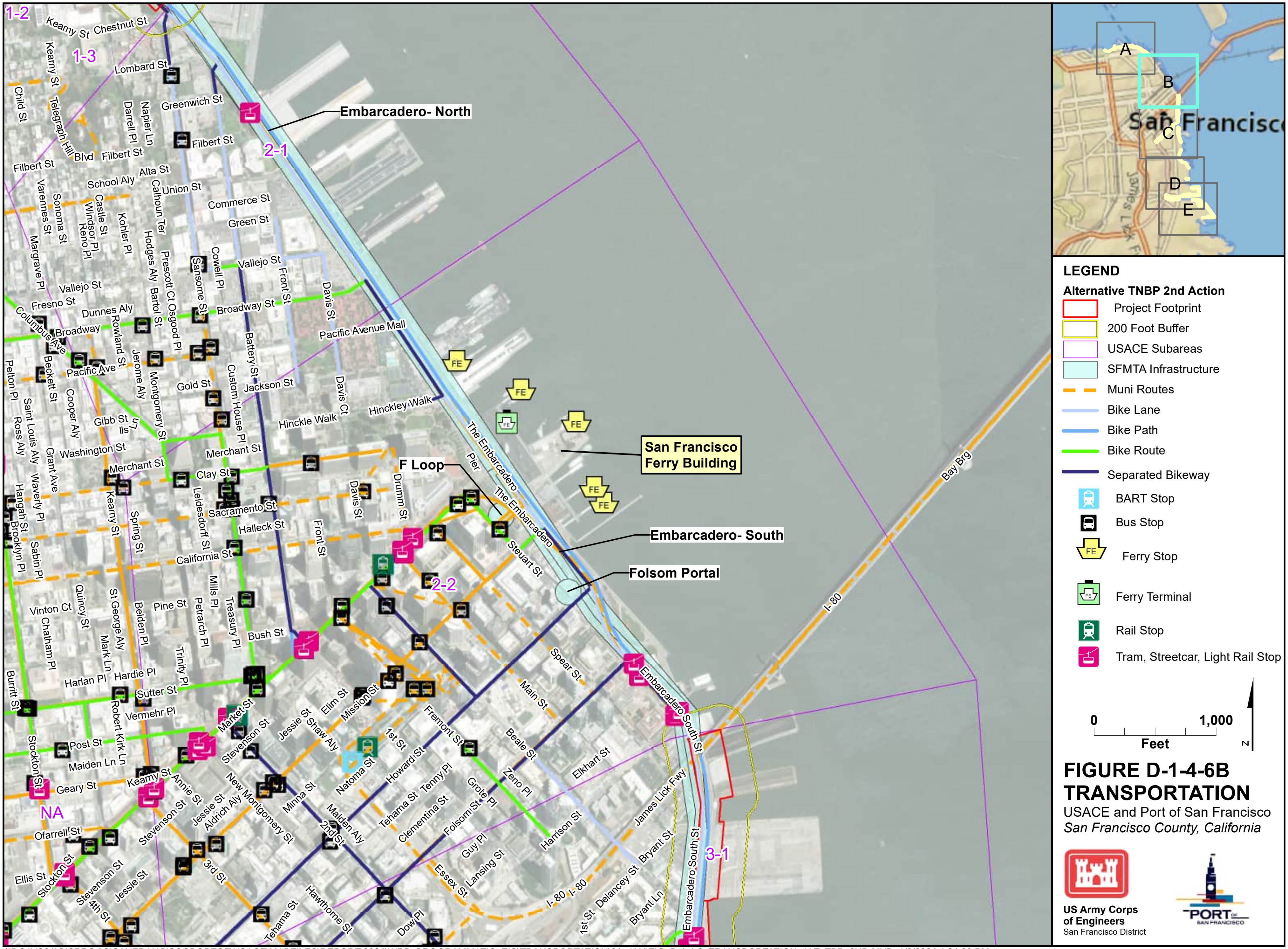
US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

FIGURE D-1-4-6A TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California



LEGEND

Alternative TNBP 2nd Action

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Separated Bikeway
- BART Stop
- Bus Stop
- Ferry Stop
- Ferry Terminal
- Rail Stop
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet

N

FIGURE D-1-4-6B TRANSPORTATION

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

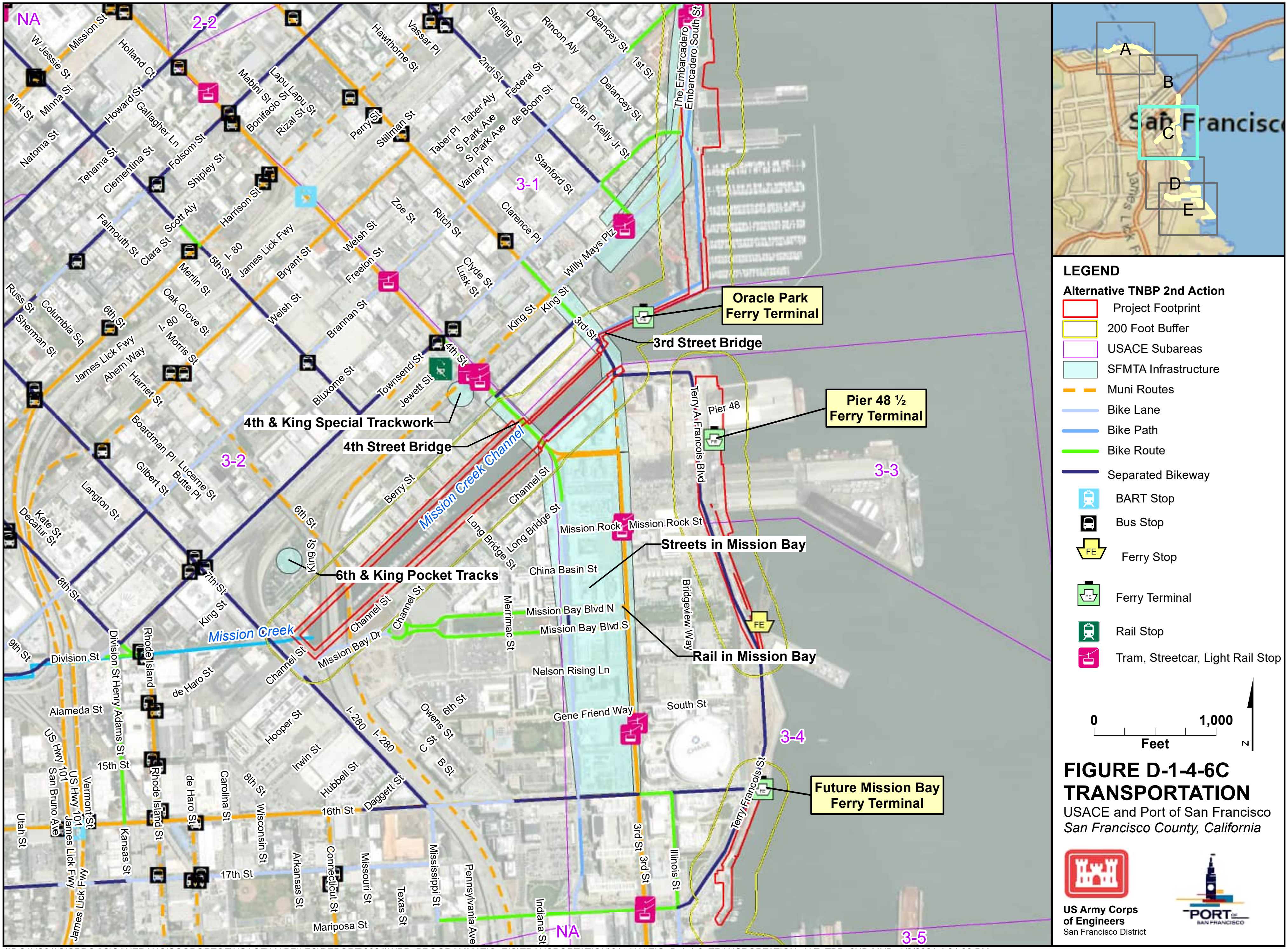


FIGURE D-1-4-6C TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

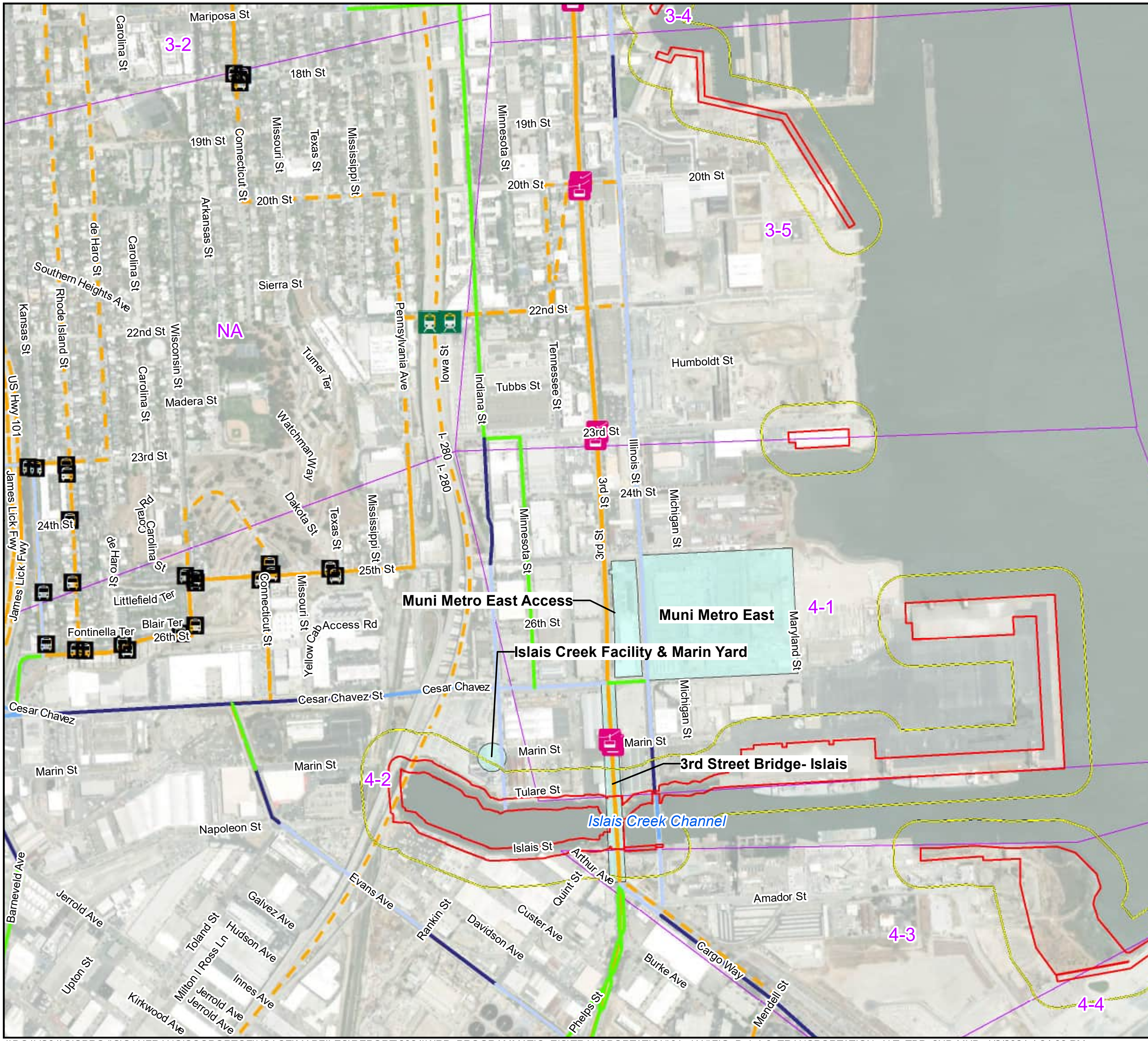


FIGURE D-1-4-6D TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-6_TRANSPORTATION_ALT_TBP_2ND.MXD 1/2/2024 4:24:08 PM

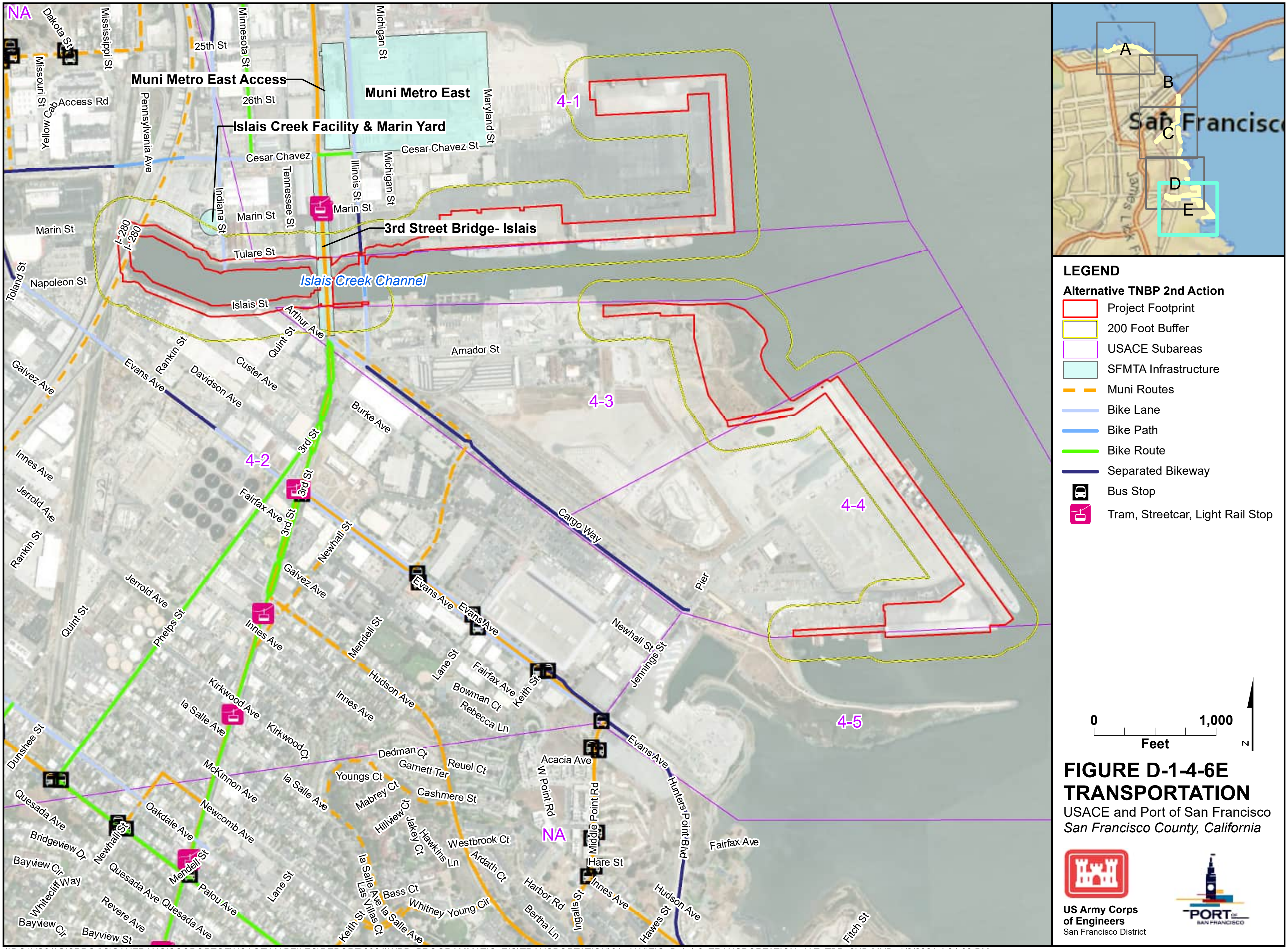


FIGURE D-1-4-6E TRANSPORTATION

USACE and Port of San Francisco

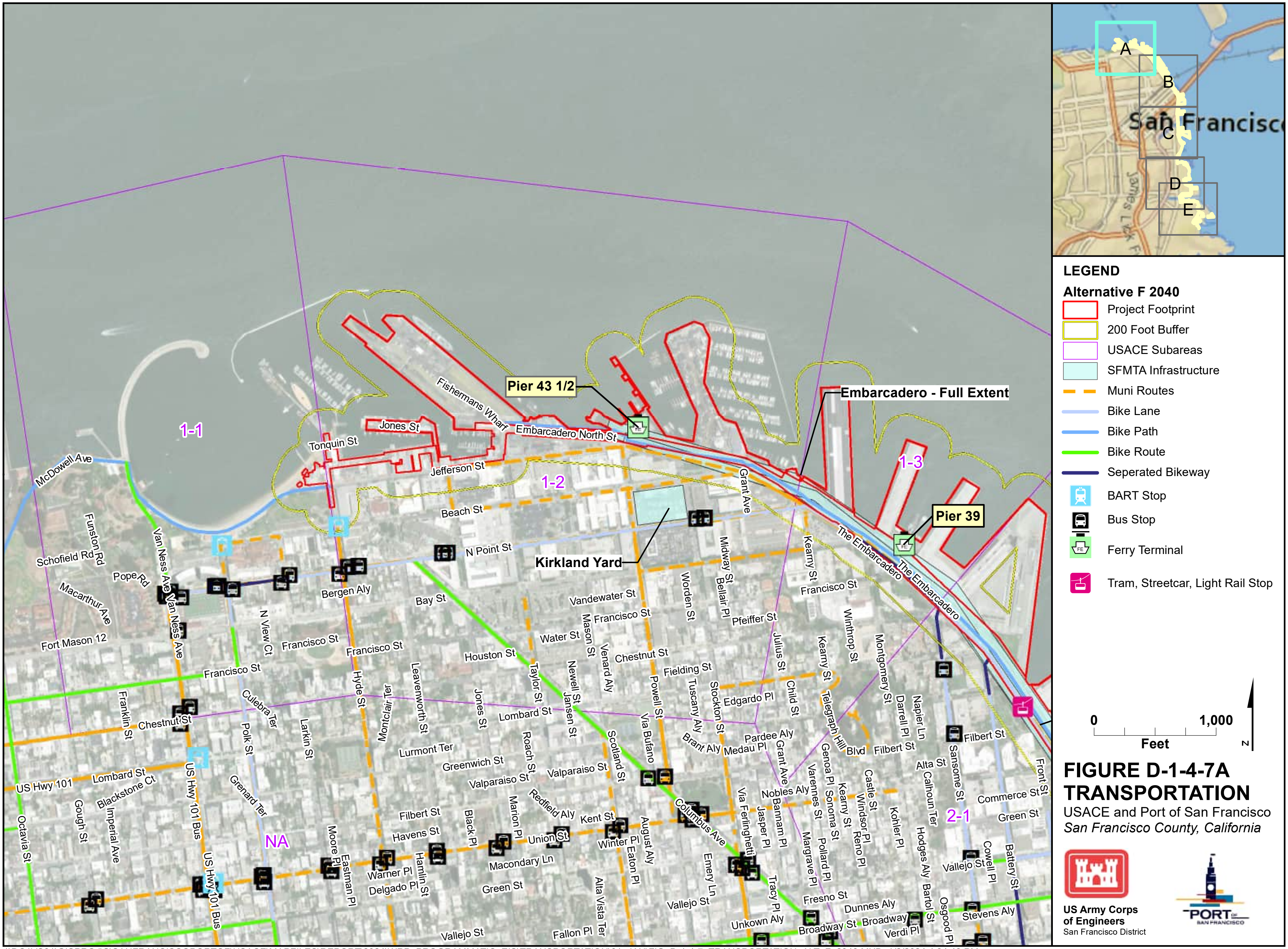
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-6_TRANSPORTATION_ALT_TBP_2ND.MXD 1/2/2024 4:24:08 PM

Alternative F 2040



LEGEND

Alternative F 2040

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Seperated Bikeway
- BART Stop
- Bus Stop
- Ferry Terminal
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet
N

FIGURE D-1-4-7A TRANSPORTATION

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-7_TRANSPORTATION_ALT_F_2040.MXD 1/2/2024 4:34:48 PM

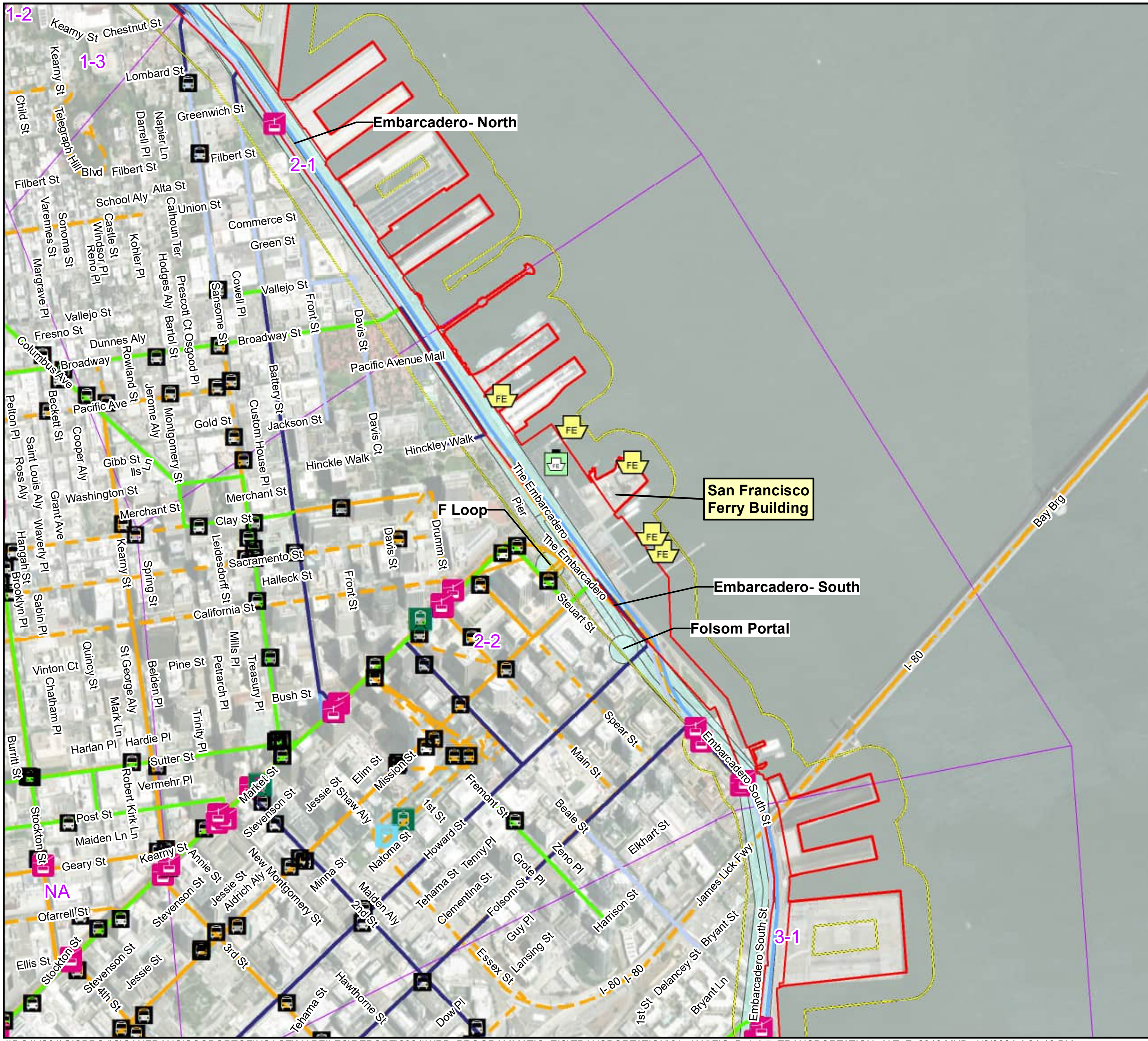


FIGURE D-1-4-7B TRANSPORTATION

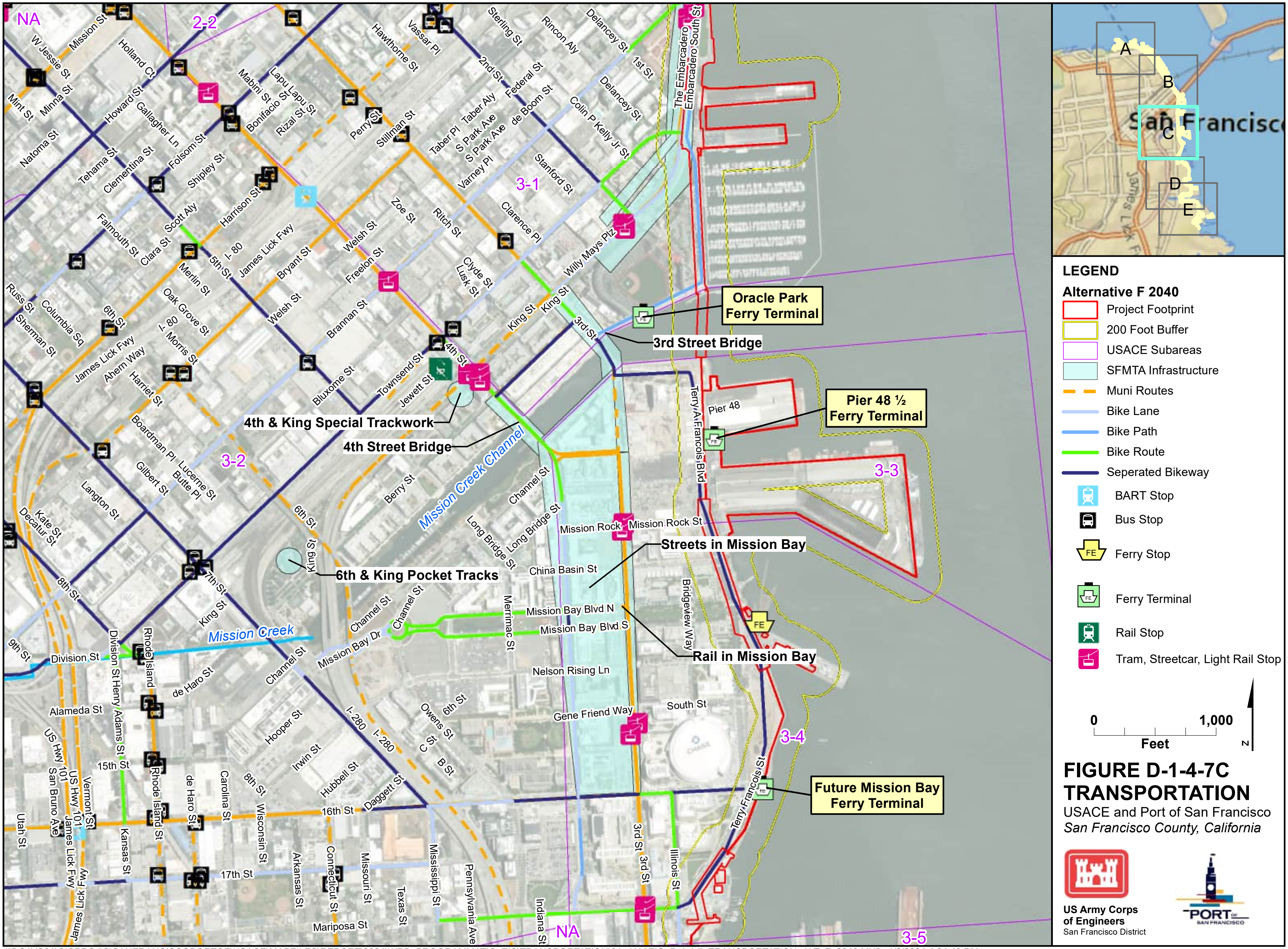
USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-7_TRANSPORTATION_ALT_F_2040.MXD 1/2/2024 4:34:48 PM



LEGEND

Alternative F 2040

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Seperated Bikeway
- BART Stop
- Bus Stop
- Ferry Stop
- Ferry Terminal
- Rail Stop
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet

N

FIGURE D-1-4-7C TRANSPORTATION

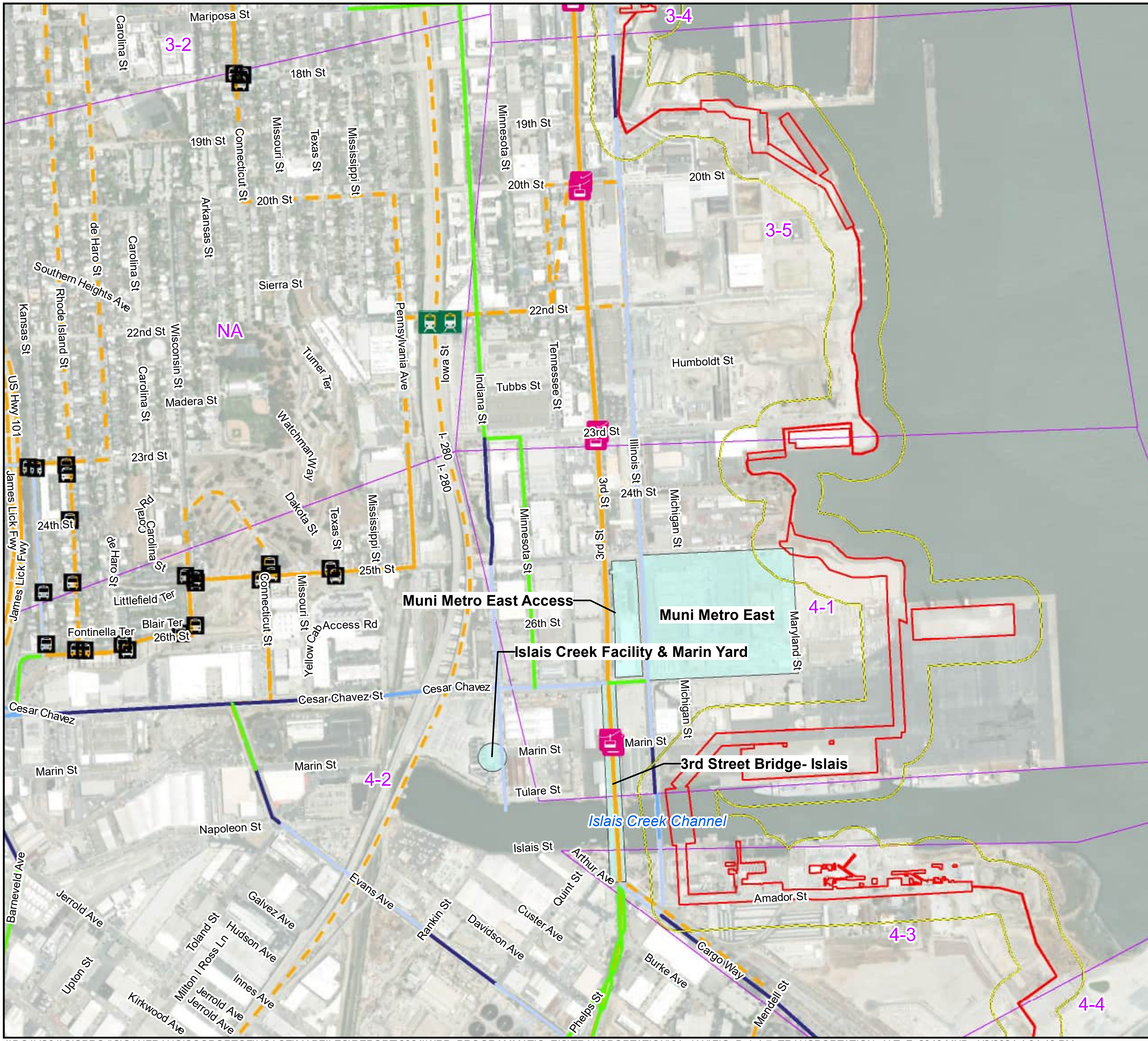
USACE and Port of San Francisco

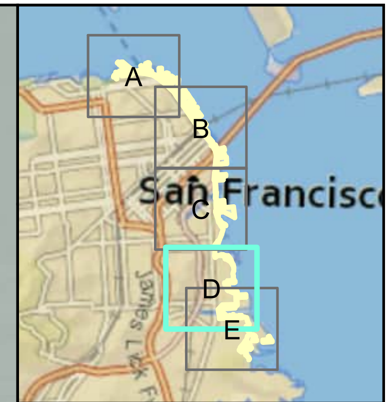
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-7_TRANSPORTATION_ALT_F_2040.MXD 1/2/2024 4:34:48 PM





LEGEND

Alternative F 2040

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Seperated Bikeway
- Bus Stop
- Rail Stop
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet

N

FIGURE D-1-4-7D TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-7_TRANSPORTATION_ALT_F_2040.MXD 1/2/2024 4:34:48 PM

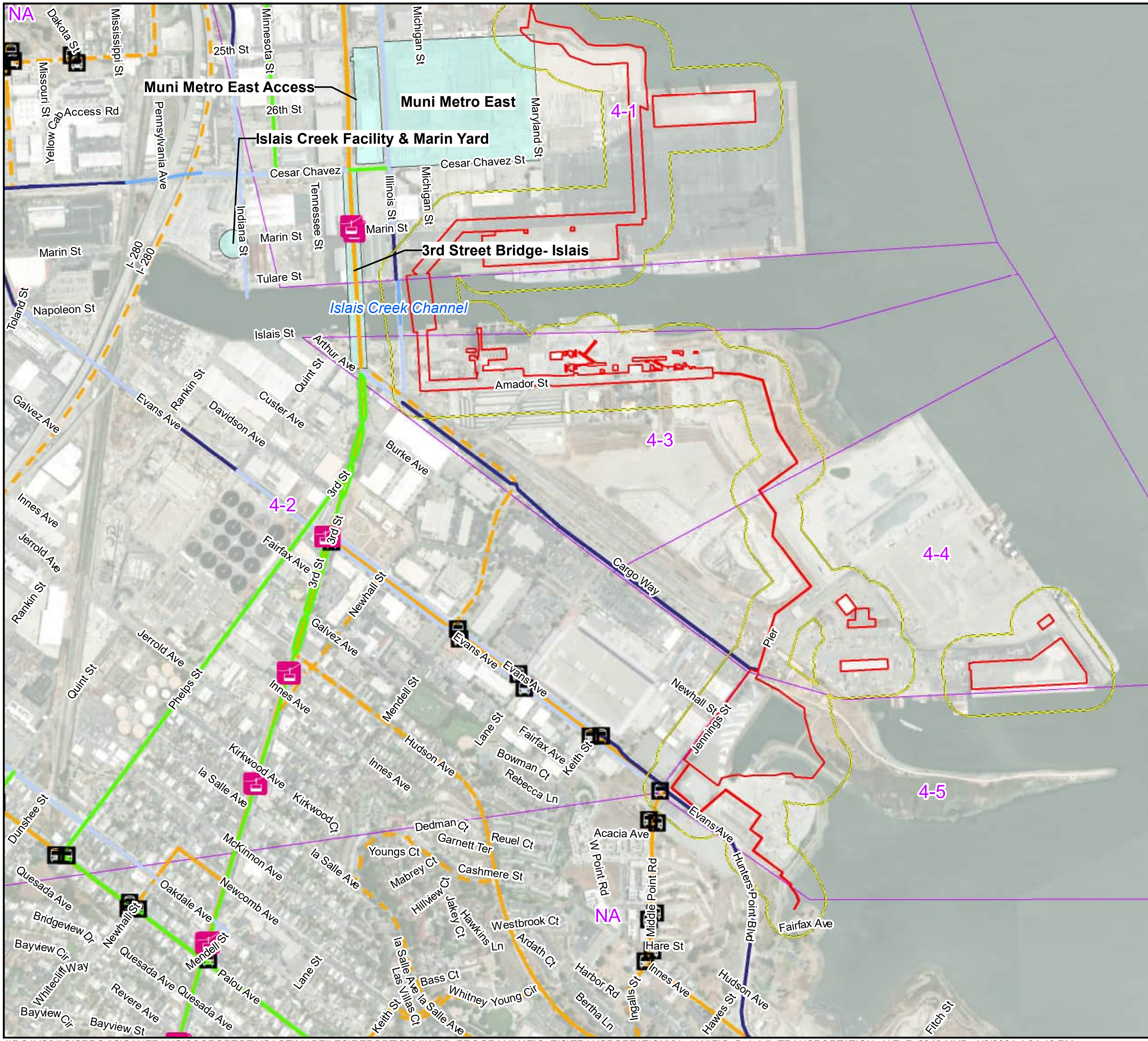


FIGURE D-1-4-7E TRANSPORTATION

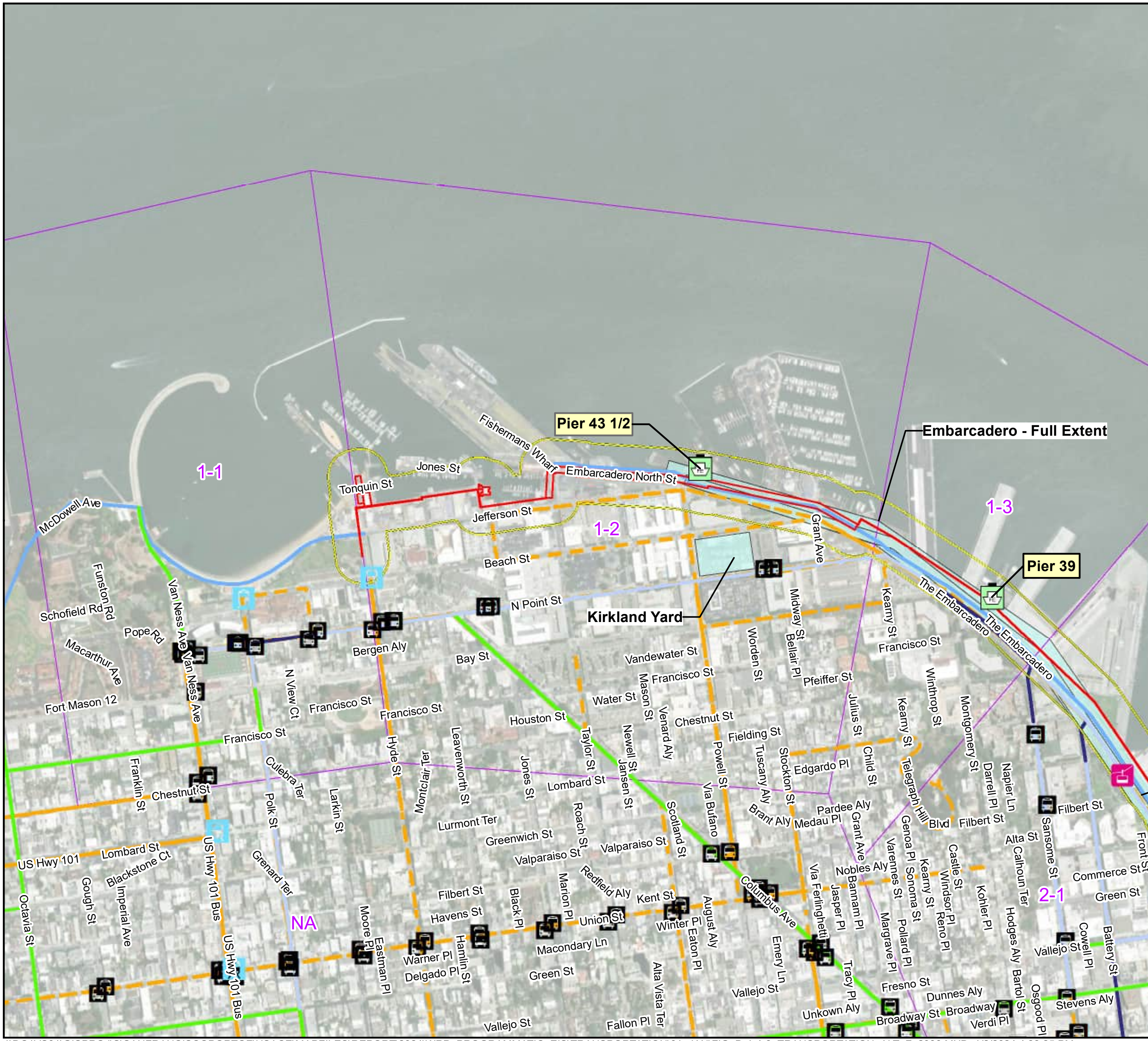
USACE and Port of San Francisco

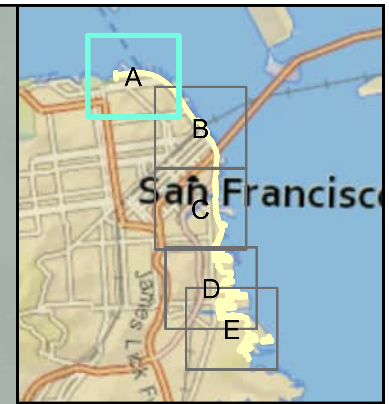
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

Alternative F 2090





LEGEND

Alternative F 2090

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Seperated Bikeway
- BART Stop
- Bus Stop
- Ferry Terminal
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet
N

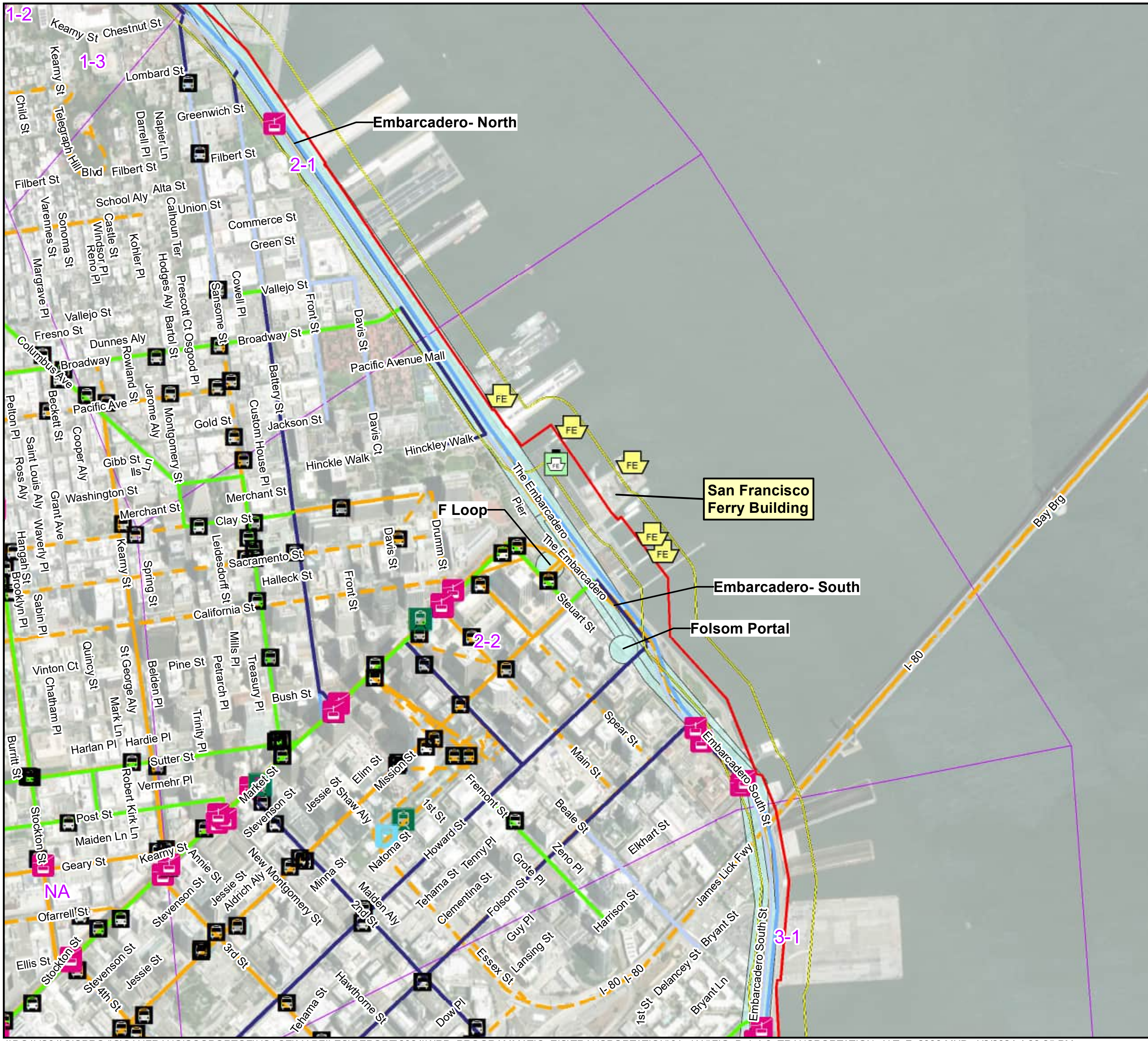
FIGURE D-1-4-8A TRANSPORTATION

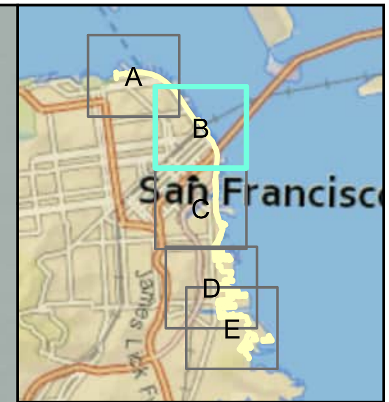
USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-8_TRANSPORTATION_ALT_F_2090.MXD 1/2/2024 4:38:25 PM





LEGEND

Alternative F 2090

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Seperated Bikeway
- BART Stop
- Bus Stop
- Ferry Stop
- Ferry Terminal
- Rail Stop
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet
N

FIGURE D-1-4-8B TRANSPORTATION

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-8_TRANSPORTATION_ALT_F_2090.MXD 1/2/2024 4:38:25 PM

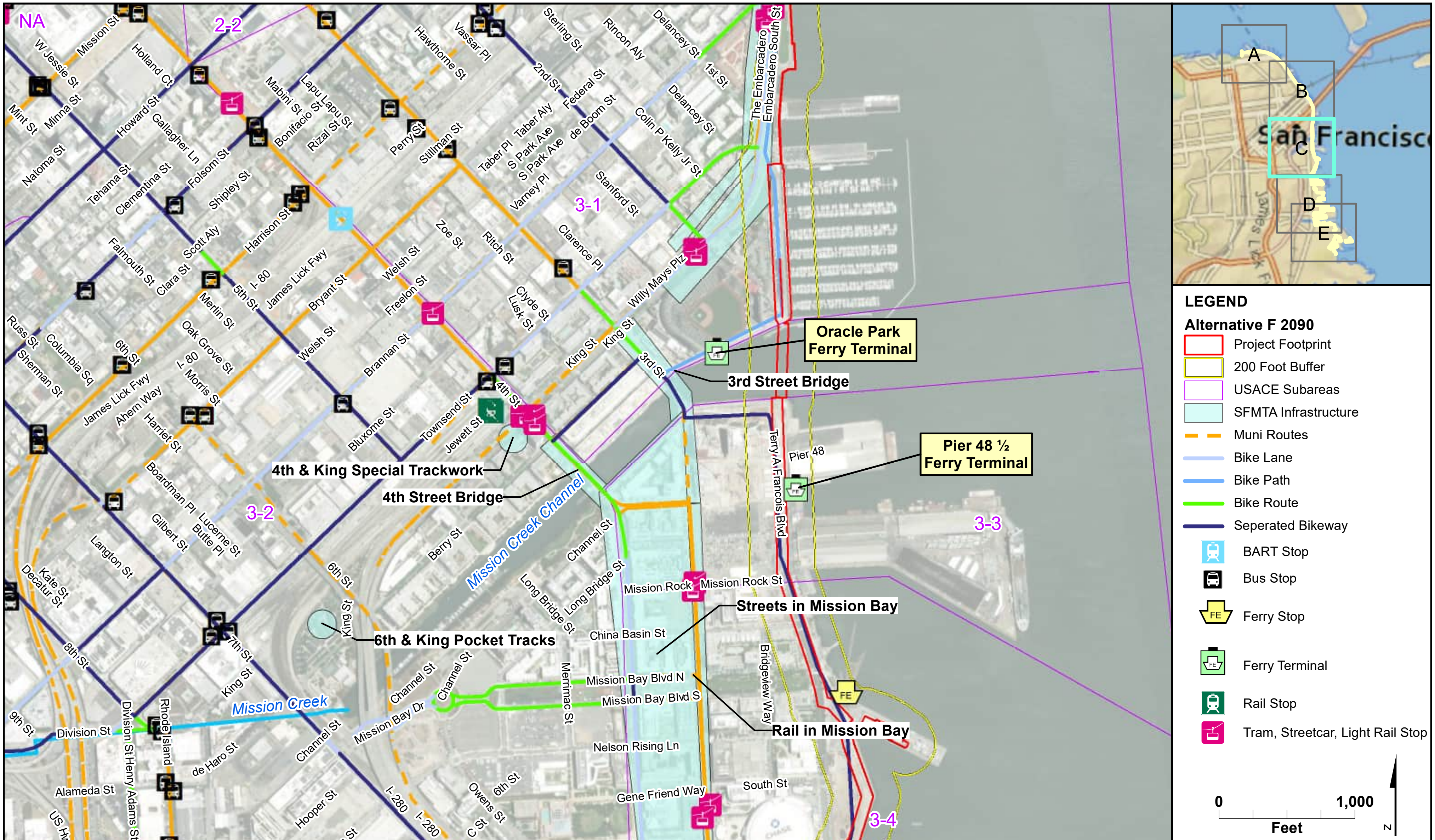


FIGURE D-1-4-8C TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-8_TRANSPORTATION_ALT_F_2090.MXD 1/2/2024 4:38:25 PM

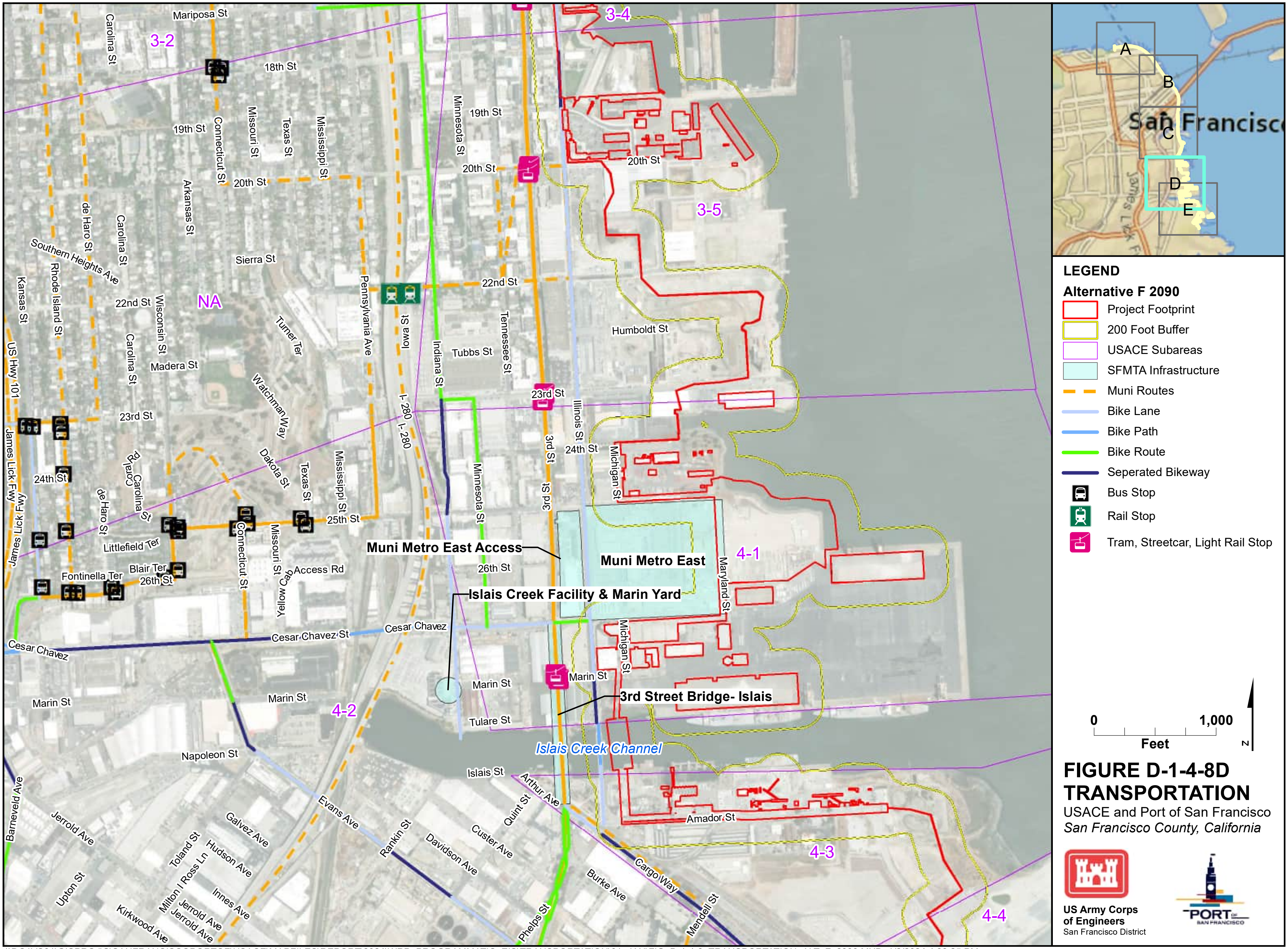


FIGURE D-1-4-8D TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-8_TRANSPORTATION_ALT_F_2090.MXD 1/2/2024 4:38:25 PM

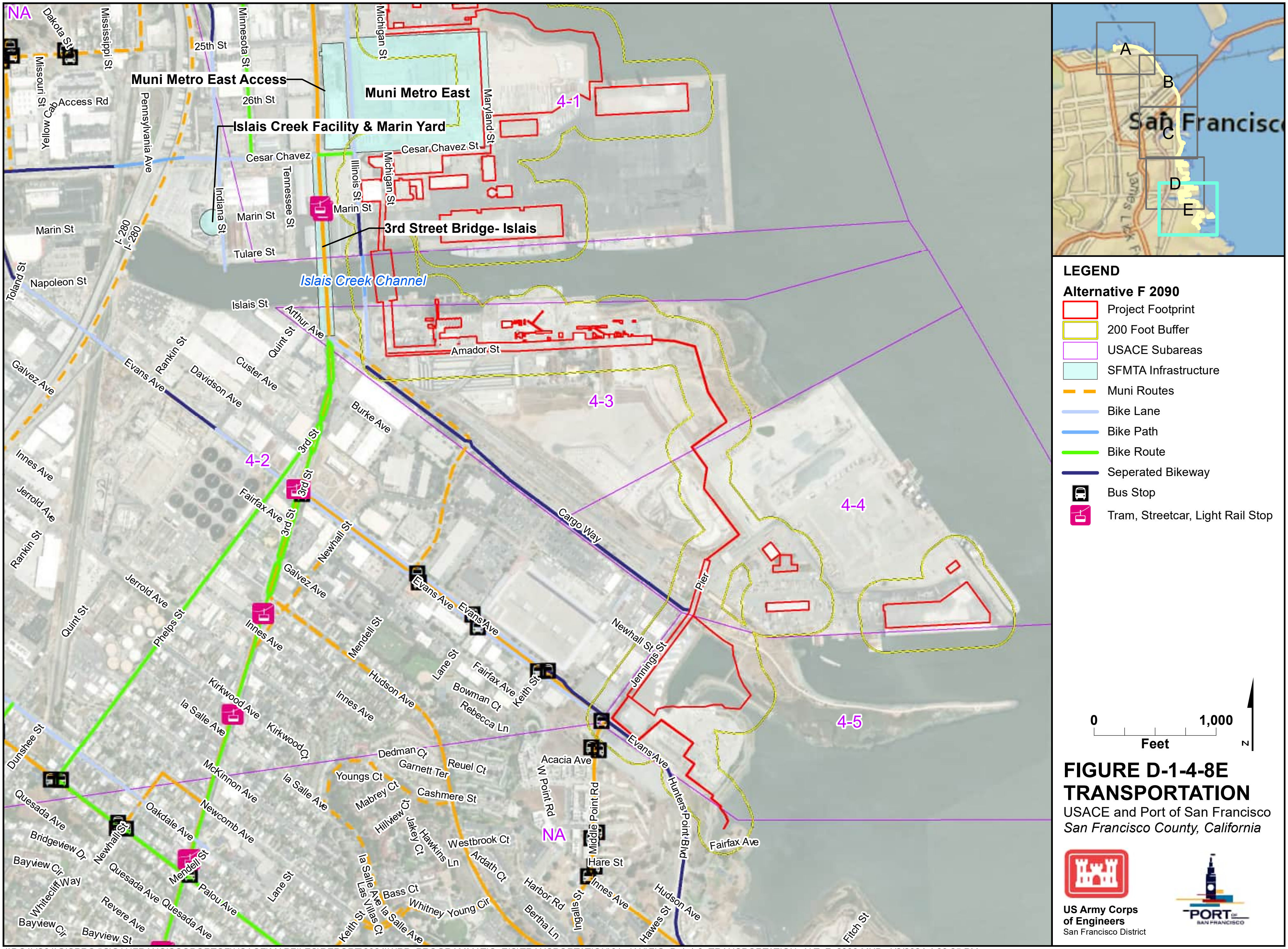
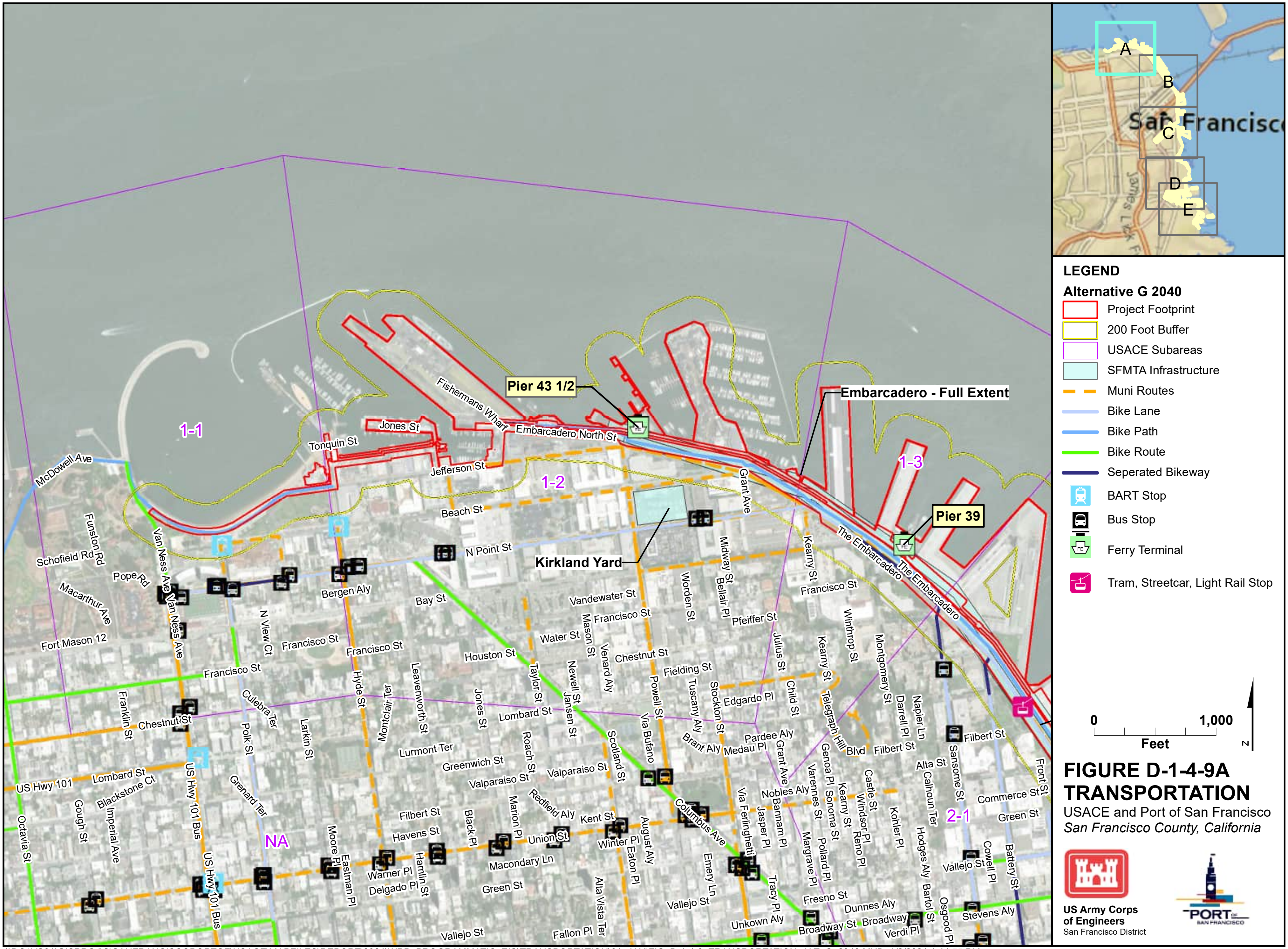


FIGURE D-1-4-8E
TRANSPORTATION
USACE and Port of San Francisco
San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-8_TRANSPORTATION_ALT_F_2090.MXD 1/2/2024 4:38:25 PM

Alternative G 2040



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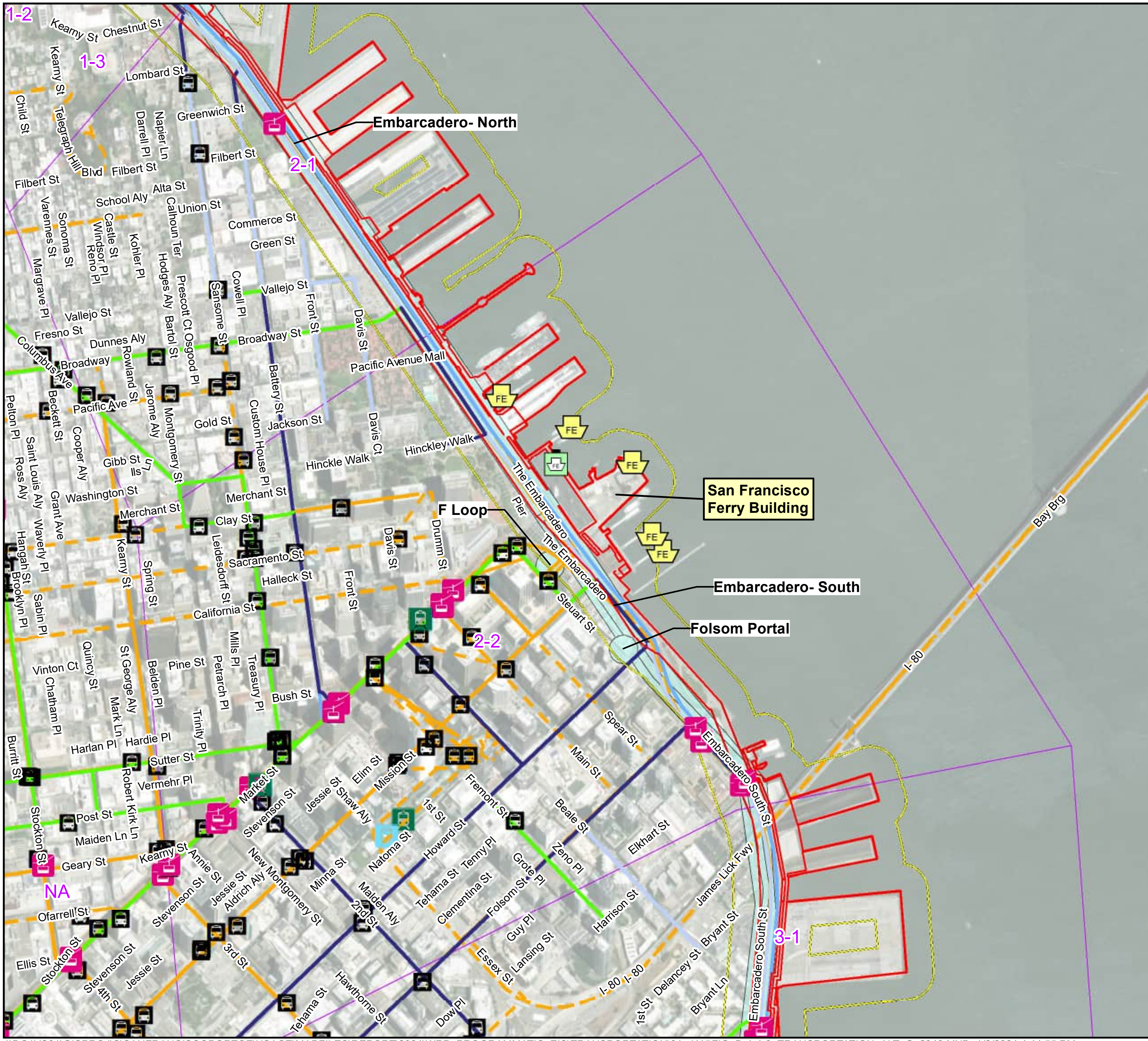

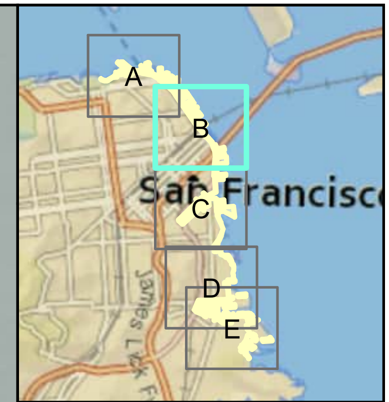

LEGEND

Alternative G 2040

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Seperated Bikeway
- BART Stop
- Bus Stop
- Ferry Stop
- Ferry Terminal
- Rail Stop
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet
N

FIGURE D-1-4-9B TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-9_TRANSPORTATION_ALT_G_2040.MXD 1/2/2024 4:44:55 PM

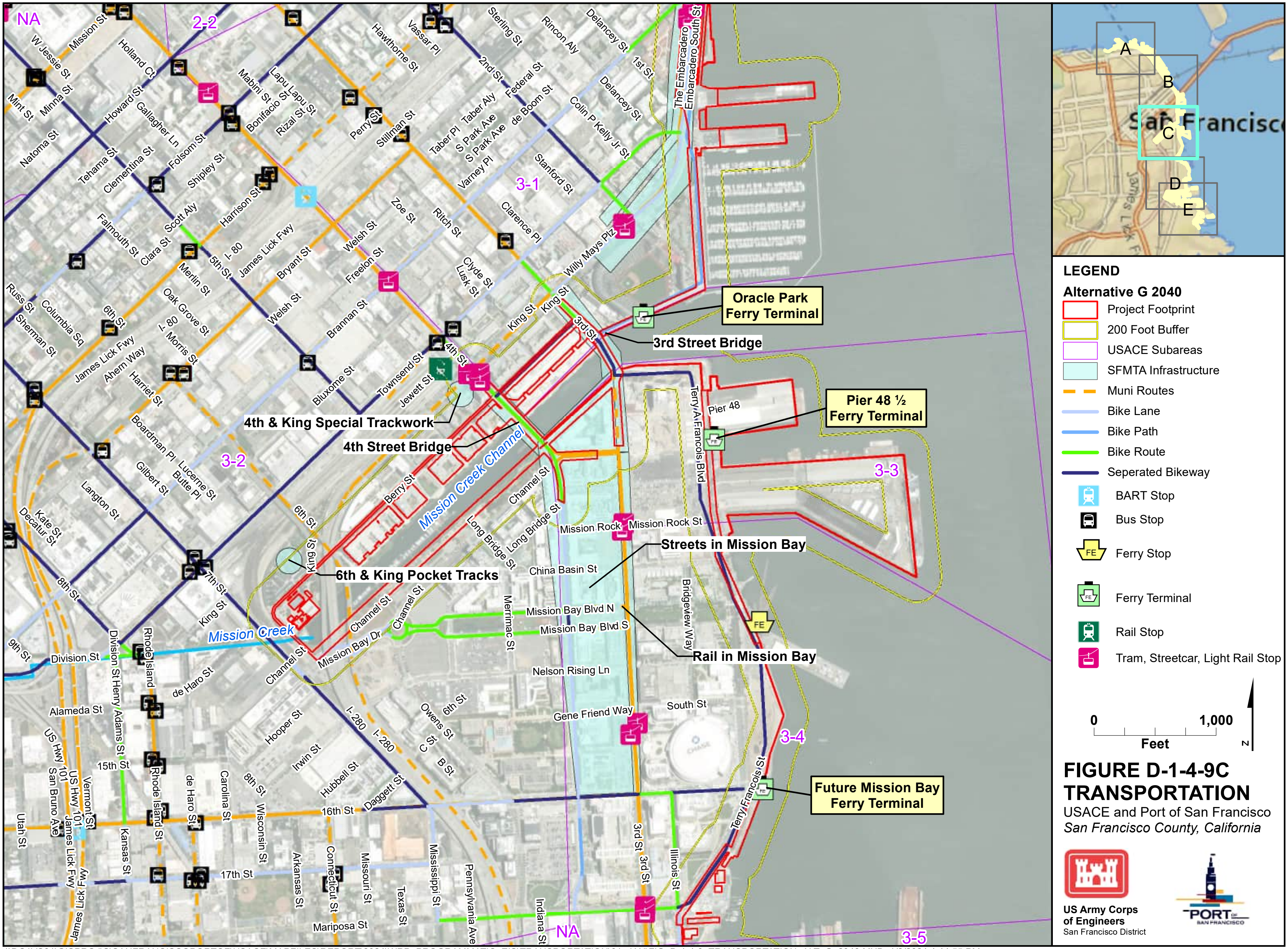

FIGURE D-1-4-9C
TRANSPORTATION
USACE and Port of San Francisco
San Francisco County, California

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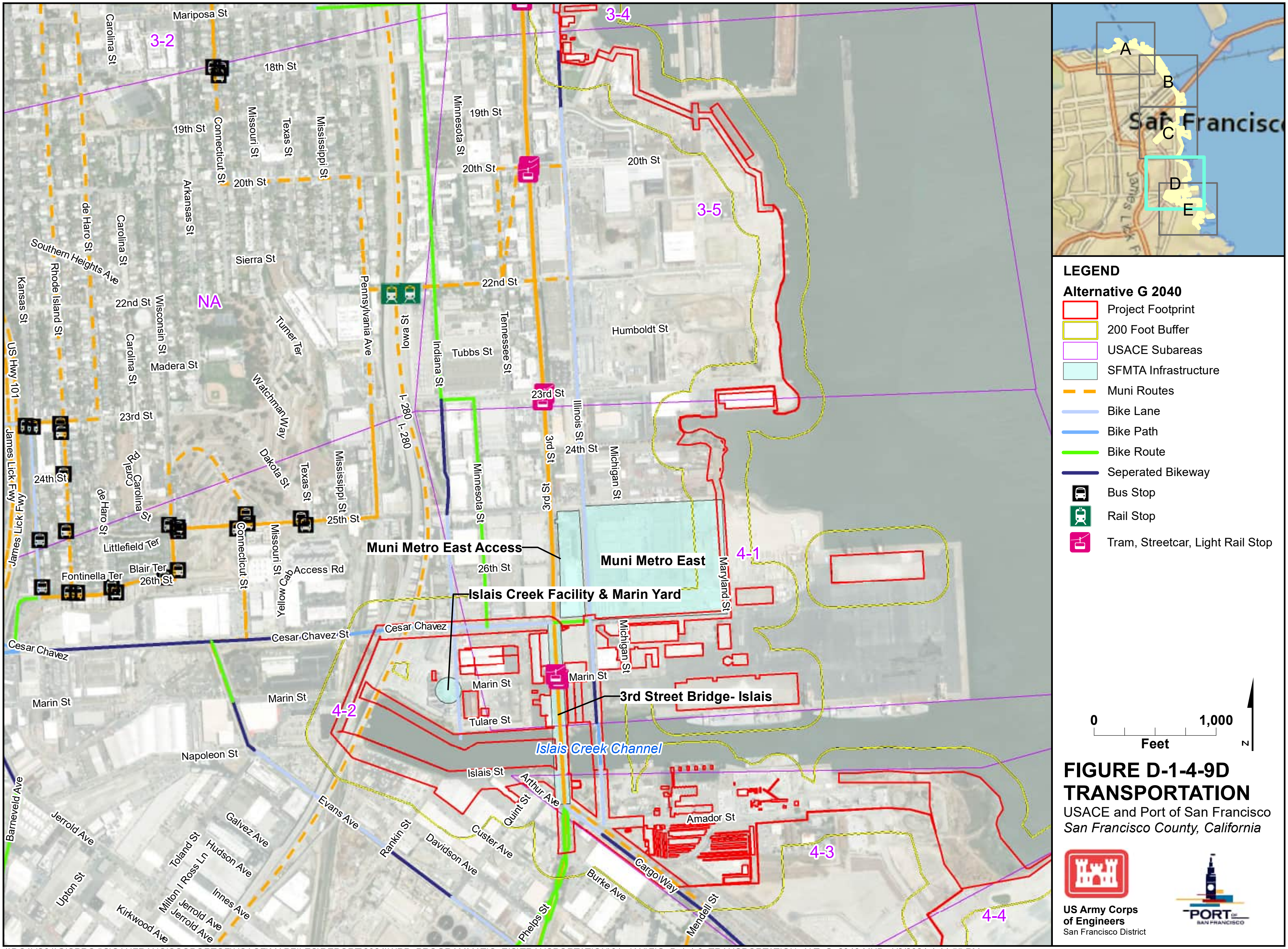

FIGURE D-1-4-9D
TRANSPORTATION
USACE and Port of San Francisco
San Francisco County, California

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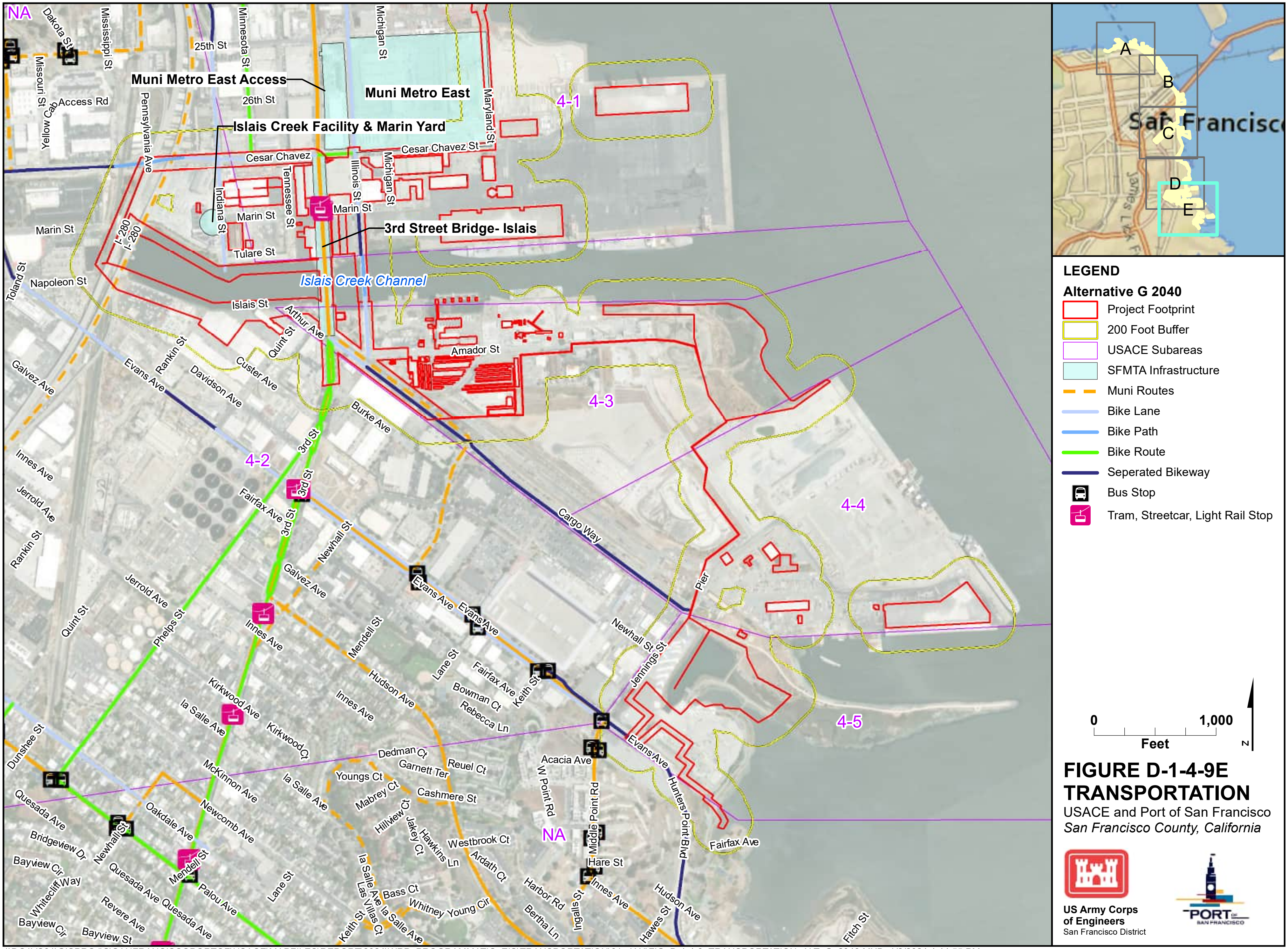

FIGURE D-1-4-9E TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

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Alternative G 2090

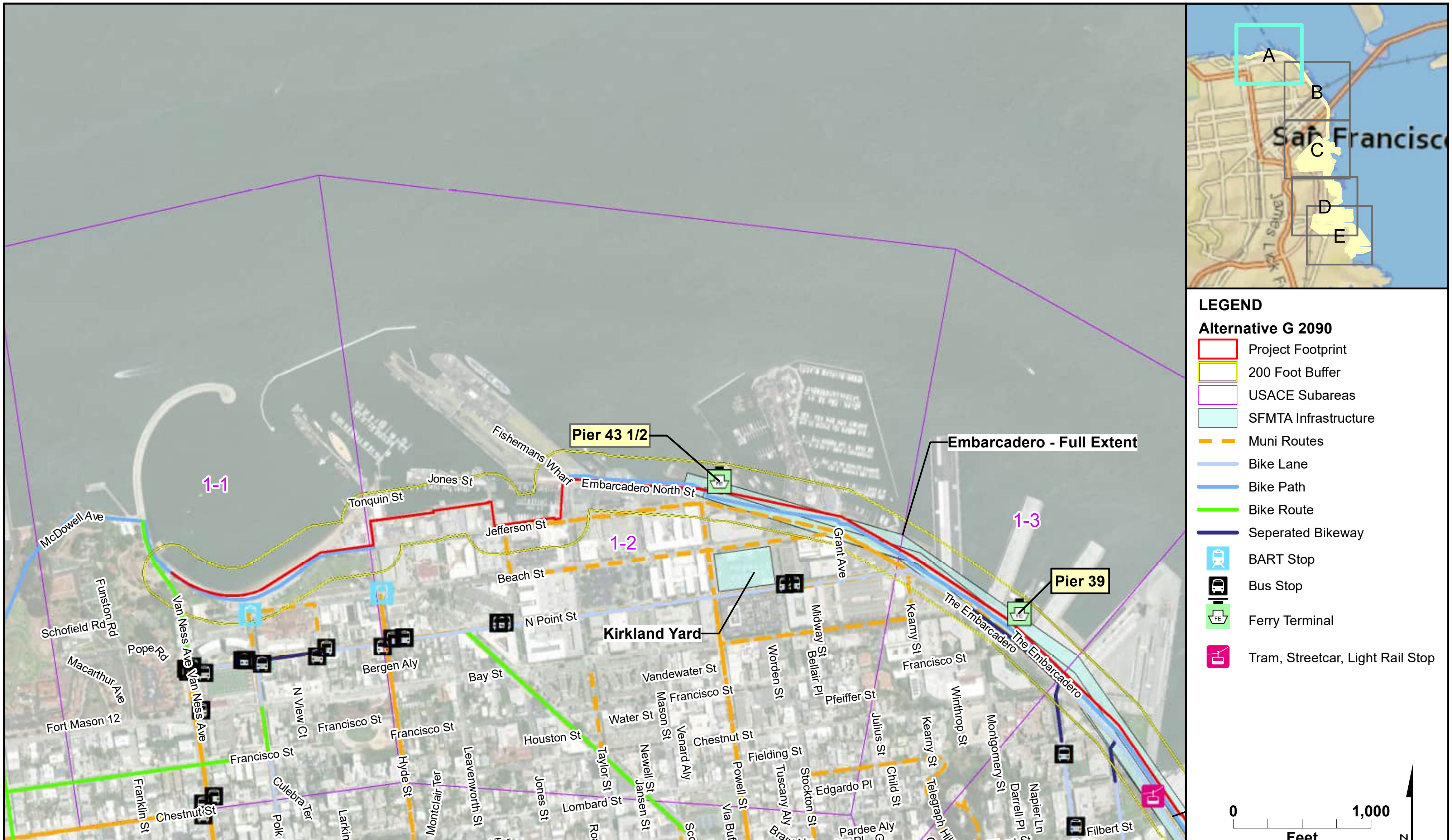


FIGURE D-1-4-10A TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-10_TRANSPORTATION_ALT_G_2090.MXD 1/2/2024 4:46:10 PM

FIGURE D-1-4-10B
TRANSPORTATION

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-10_TRANSPORTATION_ALT_G_2090.MXD 1/2/2024 4:46:10 PM

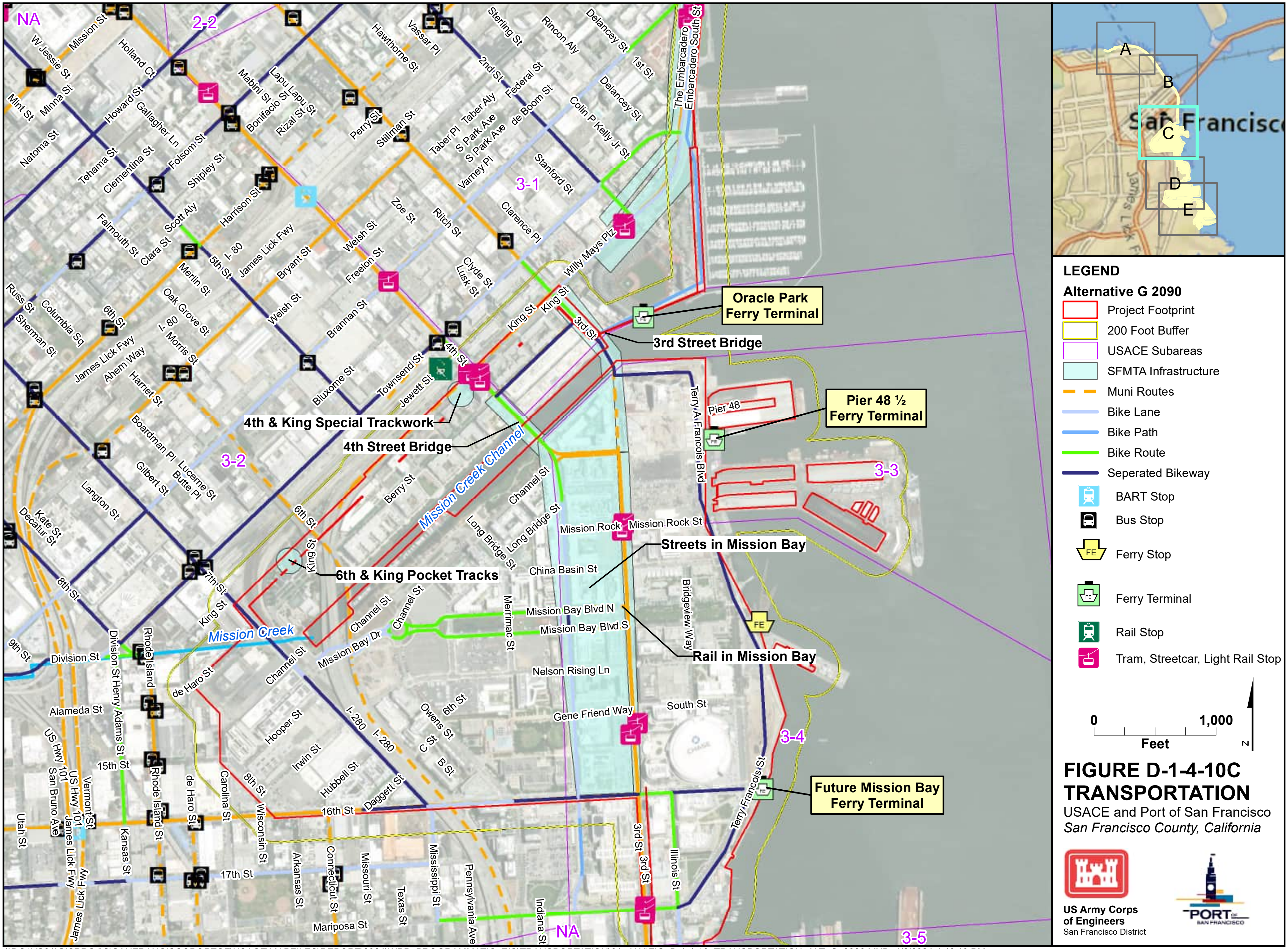


FIGURE D-1-4-10C TRANSPORTATION

USACE and Port of San Francisco

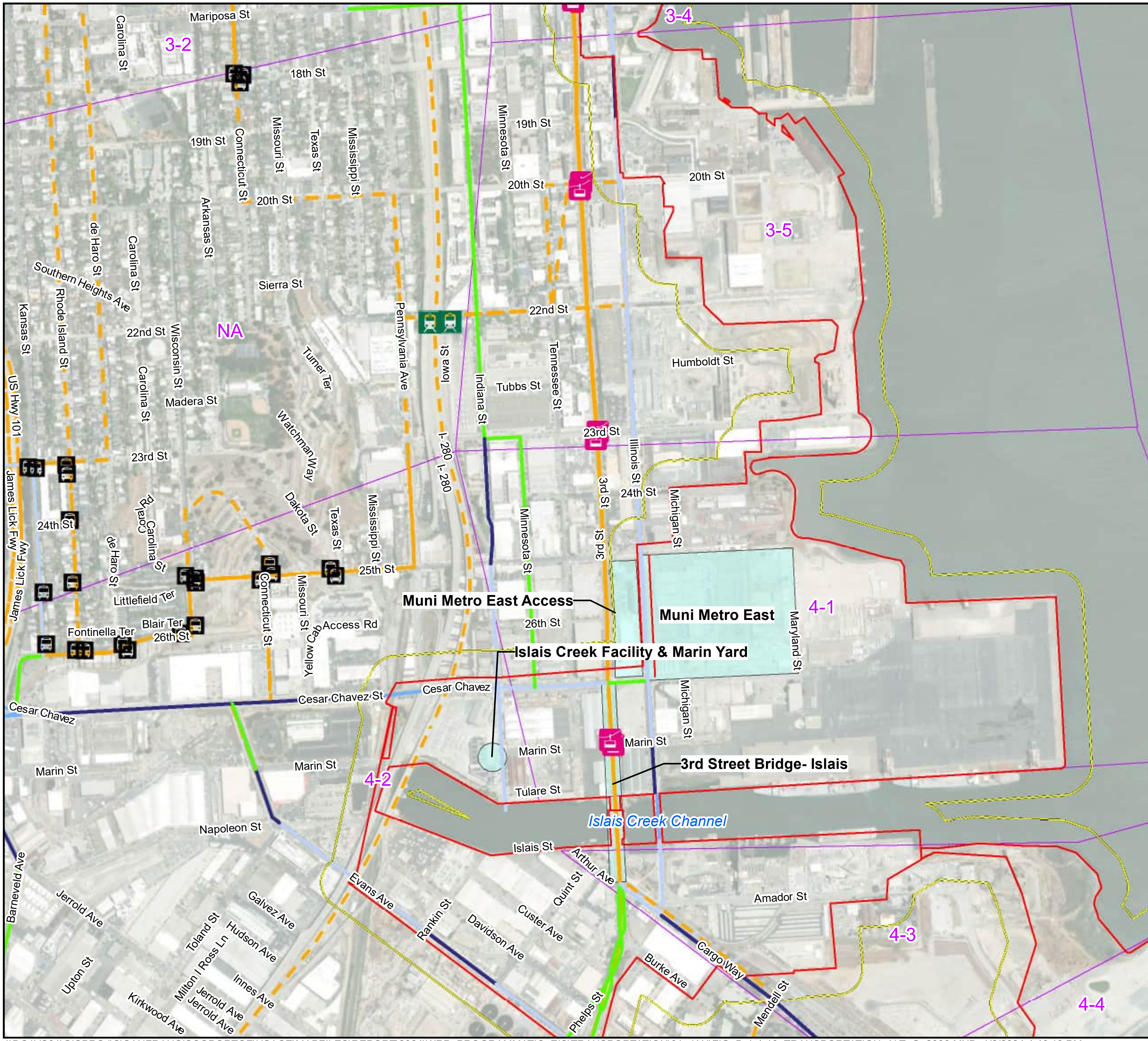
San Francisco County, California

US Army Corps of Engineers

San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-10_TRANSPORTATION_ALT_G_2090.MXD 1/2/2024 4:46:10 PM



LEGEND

Alternative G 2090

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Seperated Bikeway
- Bus Stop
- Rail Stop
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet

N

FIGURE D-1-4-10D TRANSPORTATION

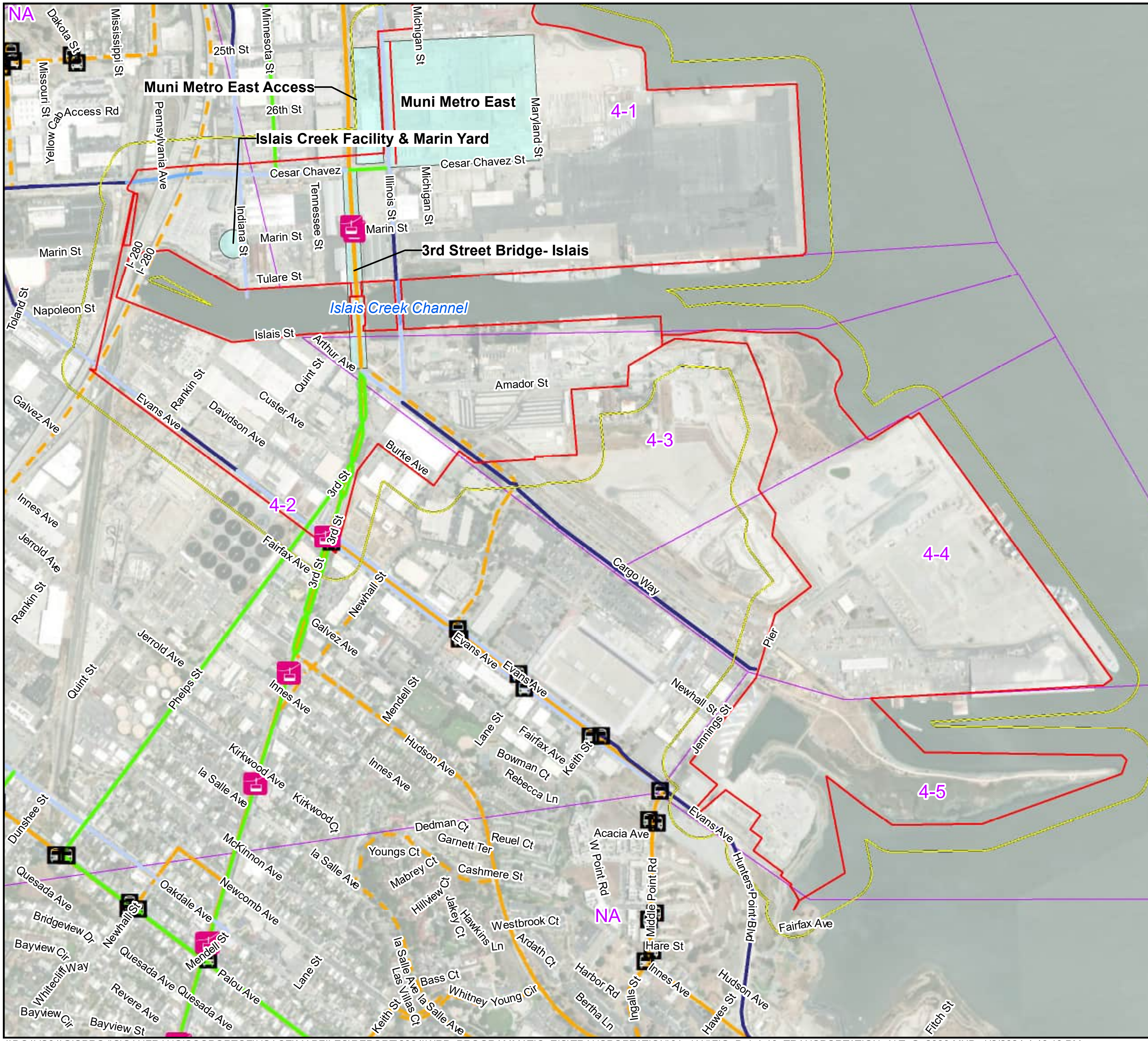
USACE and Port of San Francisco

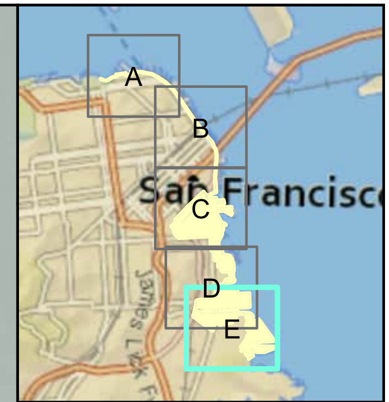
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-10_TRANSPORTATION_ALT_G_2090.MXD 1/2/2024 4:46:10 PM





LEGEND

Alternative G 2090

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Seperated Bikeway
- Bus Stop
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet

N

FIGURE D-1-4-10E TRANSPORTATION

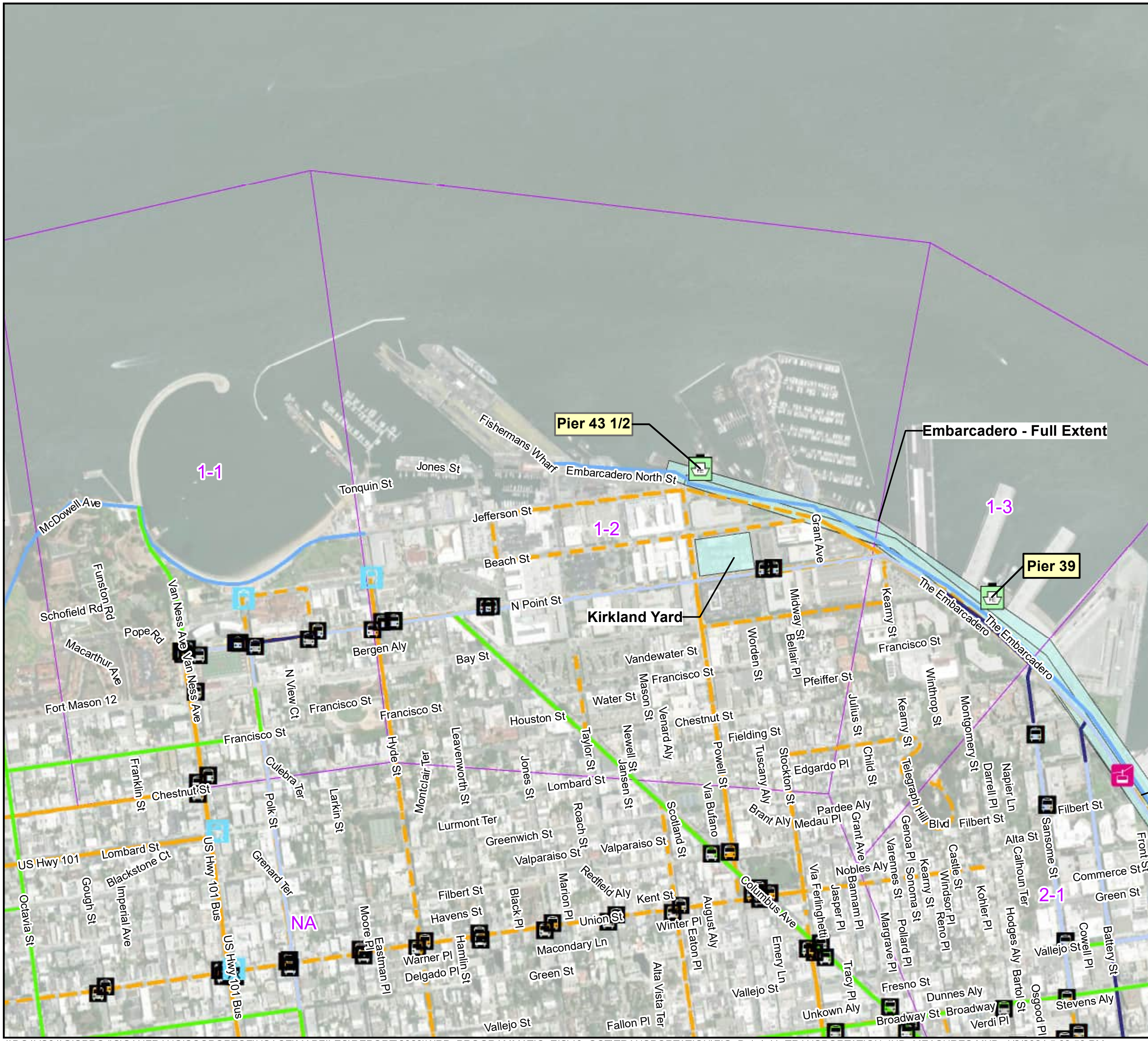
USACE and Port of San Francisco
San Francisco County, California

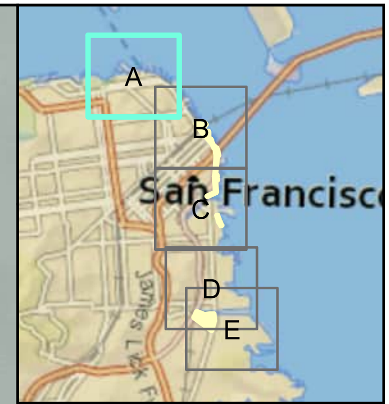
US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2024\WRP_PROGRAMMATIC_EIS\TRANSPORTATION\01_JAN\FIG_D-1-4-10_TRANSPORTATION_ALT_G_2090.MXD 1/2/2024 4:46:10 PM

Independent Measures





LEGEND

- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Seperated Bikeway
- BART Stop
- Bus Stop
- Ferry Terminal
- Tram, Streetcar, Light Rail Stop

0 1,000
Feet

N

FIGURE D-1-4-11A TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\TRANSPORTATION\FIG_D-1-4-11_TRANSPORTATION_IND_MEASURES.MXD 1/2/2024 5:03:59 PM

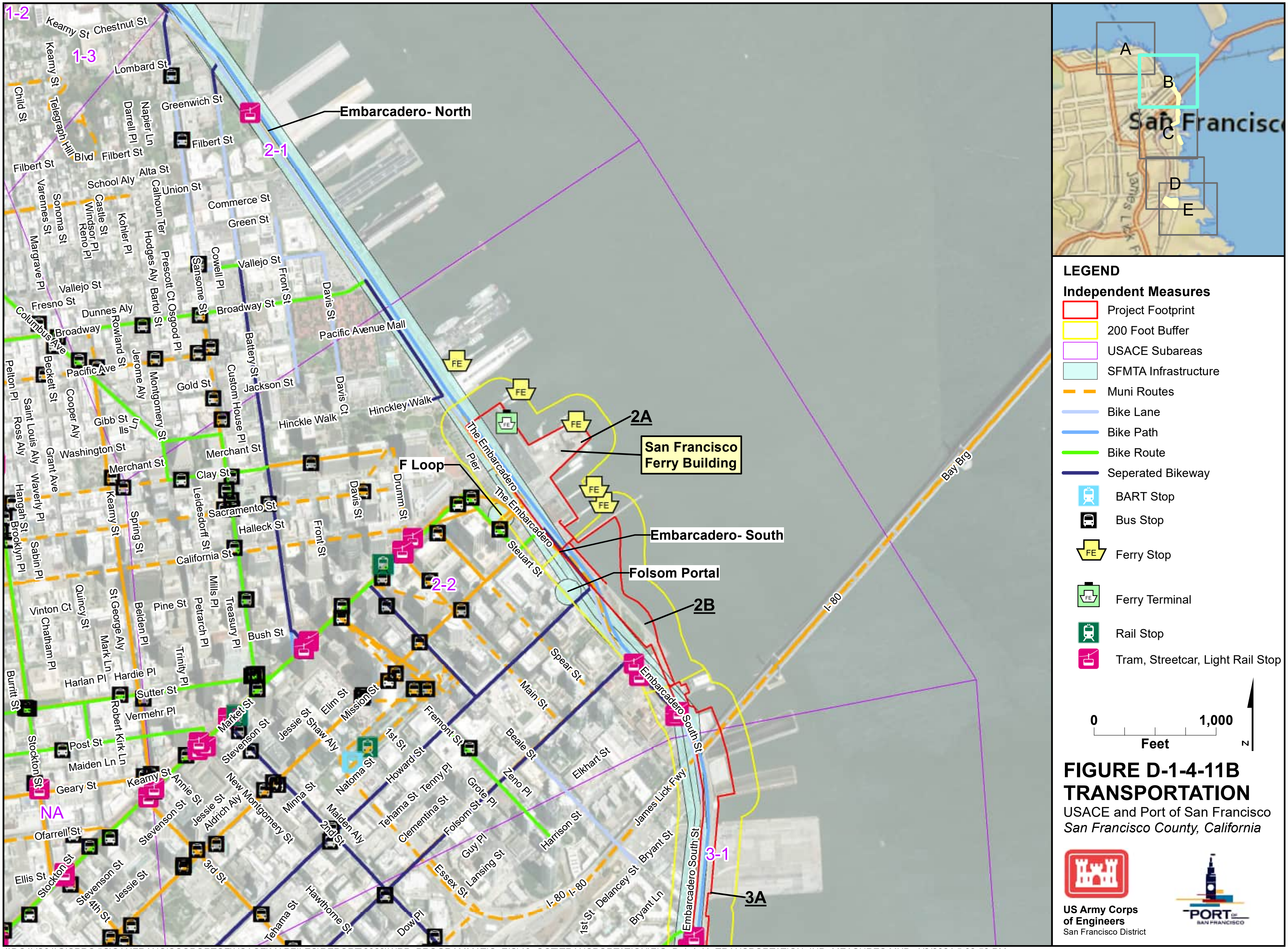


FIGURE D-1-4-11B
TRANSPORTATION
USACE and Port of San Francisco
San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\TRANSPORTATION\FIG_D-1-4-11_TRANSPORTATION_IND_MEASURES.MXD 1/2/2024 5:03:59 PM

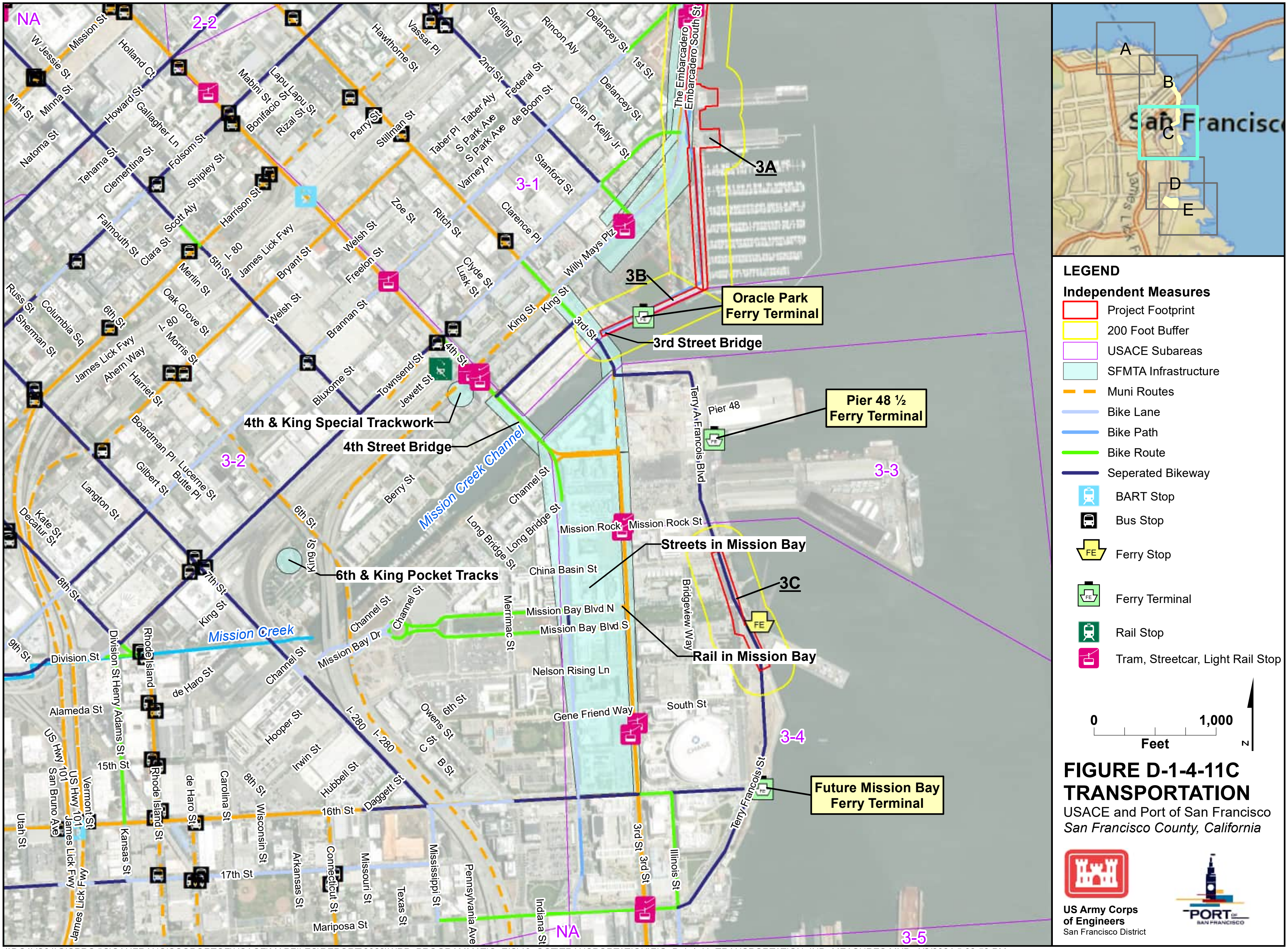


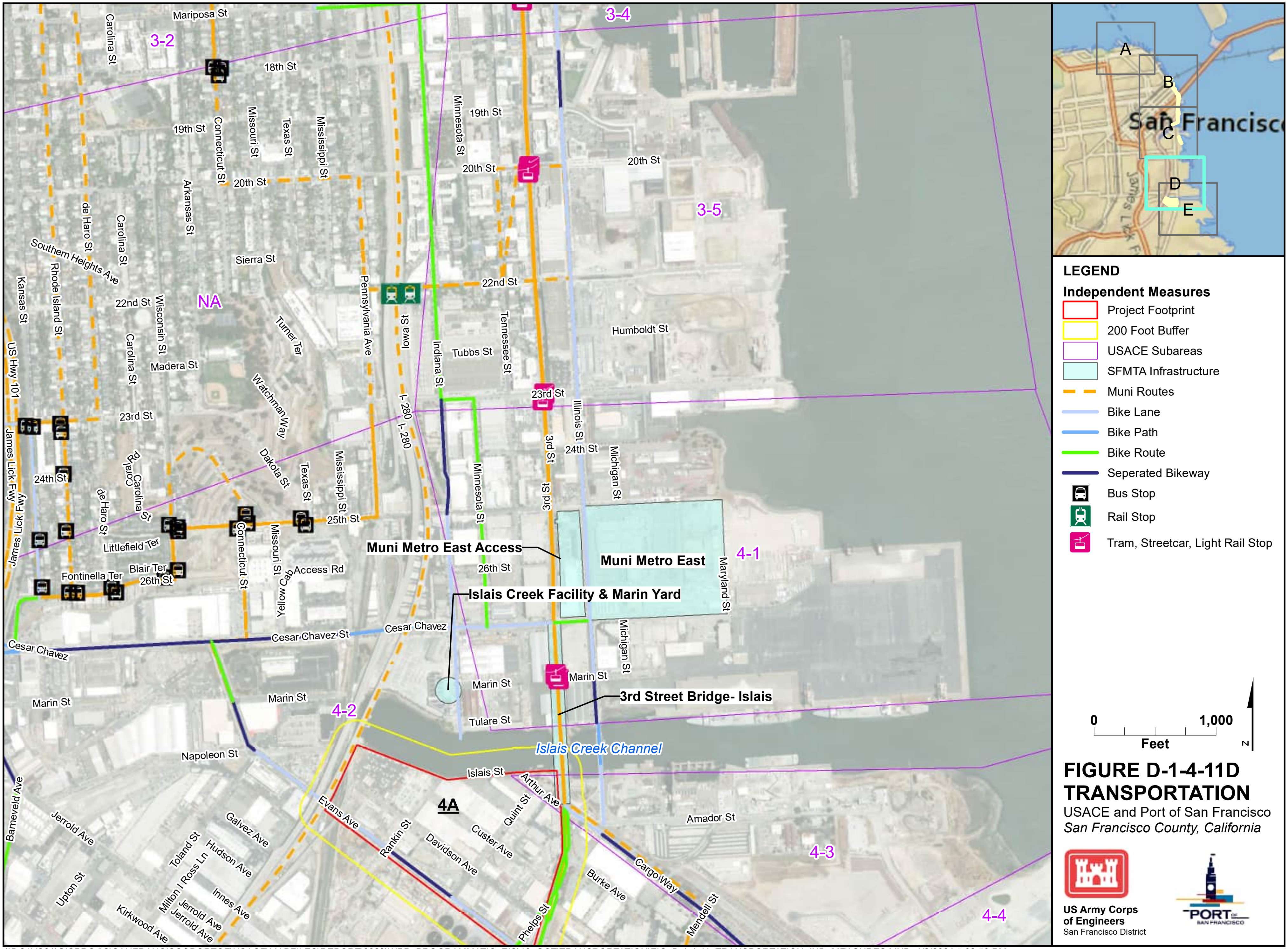
FIGURE D-1-4-11C
TRANSPORTATION

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\TRANSPORTATION\FIG_D-1-4-11_TRANSPORTATION_IND_MEASURES.MXD 1/2/2024 5:03:59 PM



LEGEND

Independent Measures

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- SFMTA Infrastructure
- Muni Routes
- Bike Lane
- Bike Path
- Bike Route
- Seperated Bikeway
- Bus Stop
- Rail Stop
- Tram, Streetcar, Light Rail Stop

FIGURE D-1-4-11D TRANSPORTATION

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

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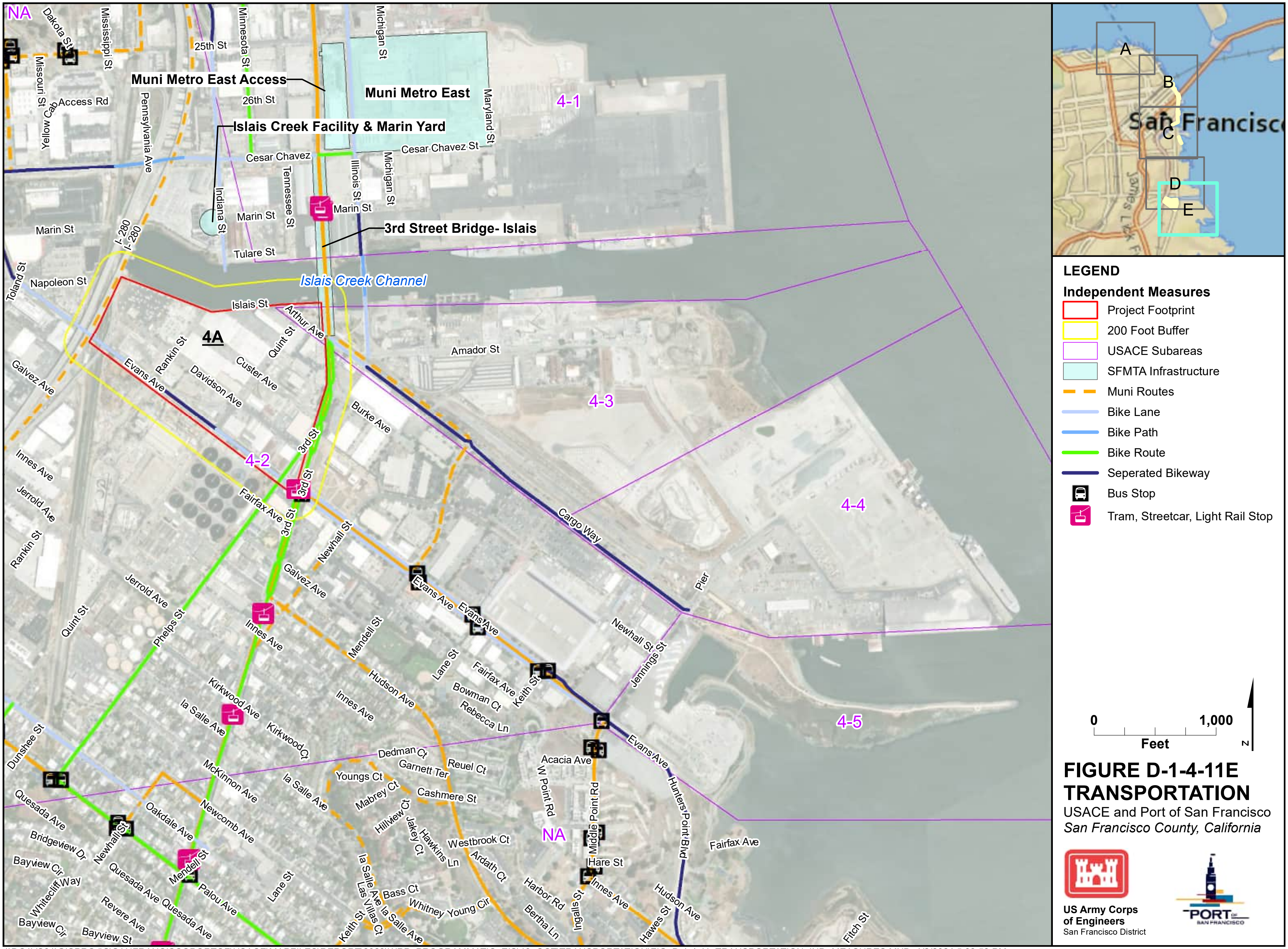

FIGURE D-1-4-11E
TRANSPORTATION
USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

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Transportation Table D-1-4-18

Roadway Class within Project Footprints

Table D-1-4-18 – Class of Roadways within Project Footprint and Construction Buffer Impacts in feet

Alternative	Action and Area	**Class 1** Freeway	**Class 3** Arterial Street	**Class 4** Collector Street	**Class 5** Residential Street	**Class 6** Freeway Ramp	**Class 0** Other (private streets, etc.)
TBP	First Action Footprint	631	14,038	197	2,695	377	15,016
TBP	First Action Construction Buffer	4,807	11,367	2,697	28,530	1,400	31,092
TBP	Second Action Footprint	1,389	5,873	932	4,106	258	8,208
TBP	Second Action Construction Buffer	3,599	6,672	1,156	22,384	1,492	16,980
Alternative B	2040 Footprint	5,008	14,675	10,222	45,919	2,954	37,273
Alternative B	2040 Construction Buffer	4,934	20,393	9,304	32,943	1,104	34,117
Alternative B	2065 Footprint	5,902	13,039	9,110	39,953	1,698	12,872
Alternative B	2065 Construction Buffer	8,001	16,605	13,314	51,870	2,772	30,236
Alternative B	2090 Footprint	2,467	17,601	7,693	43,443	1,110	14,630
Alternative B	2090 Construction Buffer	8,274	21,091	14,474	63,783	4,206	39,842
Alternative B	2115 Footprint	753	4,922	3,167	17,972	597	9,291
Alternative B	2115 Construction Buffer	9,971	25,409	19,635	76,515	3,586	31,980
Alternative F	2040 Footprint	324	10,562	652	5,085	-	13,576
Alternative F	2040 Construction Buffer	1,591	13,351	2,813	22,498	-	17,132
Alternative F	2090 Footprint	13	-	-	4,979	-	10,400
Alternative F	2090 Construction Buffer	977	18,292	2,067	31,056	-	21,068
Alternative G	2040 Footprint	1,626	24,493	1,130	16,498	259	23,227
Alternative G	2040 Construction Buffer	5,934	9,998	2,687	35,120	2,480	28,070
Alternative G	2090 Footprint	7,061	17,022	6,754	69,479	3,395	53,619
Alternative G	2090 Construction Buffer	4,259	27,625	3,338	26,257	1,240	32,483

Table D-1-4-18 – Class of Roadways within Project Footprint and Construction Buffer Impacts in feet

Alternative	Action and Area	**Class 1** Freeway	**Class 3** Arterial Street	**Class 4** Collector Street	**Class 5** Residential Street	**Class 6** Freeway Ramp	**Class 0** Other (private streets, etc.)
Independent Measures							
Measure 2A	Footprint	-	1,319	10	-	-	17
Measure 2A	Construction Buffer	-	1,681	201	-	-	1,380
Measure 2B	Footprint	-	602	-	-	-	1,958
Measure 2B	Construction Buffer	-	1,849	206	-	-	595
Measure 3A	Footprint	580	2,909	-	-	-	1,087
Measure 3A	Construction Buffer	958	5,054	130	630	-	1,149
Measure 3B	Footprint	-	-	-	-	-	-
Measure 3B	Construction Buffer	-	419	-	-	-	53
Measure 3C	Footprint	-	-	-	811	-	993
Measure 3C	Construction Buffer	-	-	-	1,218	-	484
Measure 4A	Footprint	-	-	2,073	6,389	-	812
Measure 4A	Construction Buffer	1,890	3,774	588	2,022	-	2,366

Source: USACE Alternatives GIS files with analysis conducted by Jacobs on roadway impacts.

Note: No impacts were identified for Class 2 roadways, major street or highway, and, therefore, this column was not included.

Transportation Table D-1-4-19

Parking Facilities

Table D-1-4-19- Parking Facilities within Project Footprint

Name	Reach	Number of Parking Spots
Hyde Street Harbor	1	13
Capurro's	1	25
Taylor/Little Embarcadero	1	53
Pier 45 - Shed C	1	37
Seawall Lot 301	1	125
Pier 39 Garage	1	1110
Seawall Lot 314	1	106
Pier 29 1/2 Shed	1	68
Pier 27 - Lot #81	2	122
Pier 19 1/2 Shed	2	77
Seawall Lot 321/Big Triangle	2	192
Kron 4 Parking	2	45
Pier 9	2	31
Seawall Lot 323-324/Aqua Lot	2	200
Washington Parking Lot	2	80
Pier 3 Hornblower Landing	2	112
Seawall Lot 328 - Gap	2	30
Pier 26 - Lot #65	2	42
Bayside Lot - Lot #26	3	160
Pier 30 - Lot #30	3	1130
Pier 40	3	40
South Beach Harbor	3	167
Oracle Park	3	34
Pier 50/401 TFB	3	29
Pier 50	3	60
Pier 52 Boat Launch	3	60
Pier 54	3	23
The Ramp	3	14
Crane Cover Lot #149	3	171
590 Georgia Street	3	37
Seawall Lot 349	3	234

Table D-1-4-19- Parking Facilities within Project Footprint

Pier 70 - Lot #118	3	207
Pier 70 - Parcel K	3	107
Pier 80 Admin. Building	4	104
Pier 80 - Gear and Maintenance Shed	4	15
Pier 80	4	6806
Pier 90 West	4	23
Pier 90	4	38
Pier 94	4	60
San Francisco Bay Railway	4	18
Pier 96/ SFCC POL/ HSA	4	200
Heron's Head Park	4	25
Recycle Central	4	76

SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY, CA

DRAFT APPENDIX D-1-5 HABITAT MODELING

JANUARY 2024

USACE TULSA DISTRICT | THE PORT OF SAN FRANCISCO

US Army Corps of Engineers

PORT OF SAN FRANCISCO

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Attachment 2: HEA Output Files

Acronyms and Abbreviations

Acronym	**Definition**
AAA	Acronyms and Abbreviations
DSAY	discounted-service-acre-year
DSUY	discounted-service-unit-year
HEA	Habitat Equivalency Analysis
LF	Linear Feet
SFWCFS	San Francisco Waterfront Coastal Flood Study, CA
SQ FT	Square Feet
TNBP	Total Net Benefits Plan
TSP	Tentatively Selected Plan

1.0 Introduction

This appendix provides documentation of the habitat evaluation and quantification process that was conducted to evaluate potential adverse and beneficial impacts to various habitat types if the recommended plan of the San Francisco Waterfront Coastal Flood Study, CA (SFWCFS) is implemented. Quantification is needed in the project planning process to evaluate benefits or impacts of project features because traditional benefit/cost evaluation is not applicable when valuing habitat.

1.1 Study Area

The study area extends approximately 7.5 miles from Aquatic Park in the northeast to just past Heron's Head Park in the south. The study area is divided into four reaches for evaluating environmental impacts (Figure 1-1). These reaches were chosen based on hydrologic separability, identifiable geographic references, specific wave action within each reach, and major differences in physical structure inventory. These reaches also provide a neighborhood-scale approach to communicate risks, impacts, and alternatives. Reach delineations included:

- **Reach 1:** Covers Aquatic Park, Fisherman's Wharf, Pier 31 to Pier 35, and the North Beach neighborhood.
- **Reach 2:** Includes the Northeast Waterfront and Financial District. This area comprises a significant portion of the Embarcadero Historic District and includes popular sites such as the Exploratorium, Embarcadero Promenade, and the San Francisco Ferry Building.
- **Reach 3:** Contains South Beach, Mission Creek, Mission Rock, Mission Bay and Pier 70, and includes the South Beach, SoMa, and Mission Bay neighborhoods. This area is known for the Giants' baseball stadium, Chase Center, and access to Mission Creek and the Bay. It is one of the densest residential areas within the study area.
- **Reach 4:** Encompasses Pier 80, Islais Creek, Cargo Way, Pier 96, and Heron's Head Park. This area is comprised of industrial uses along the waterfront and provides critical industrial, maritime, and commercial Port functions.

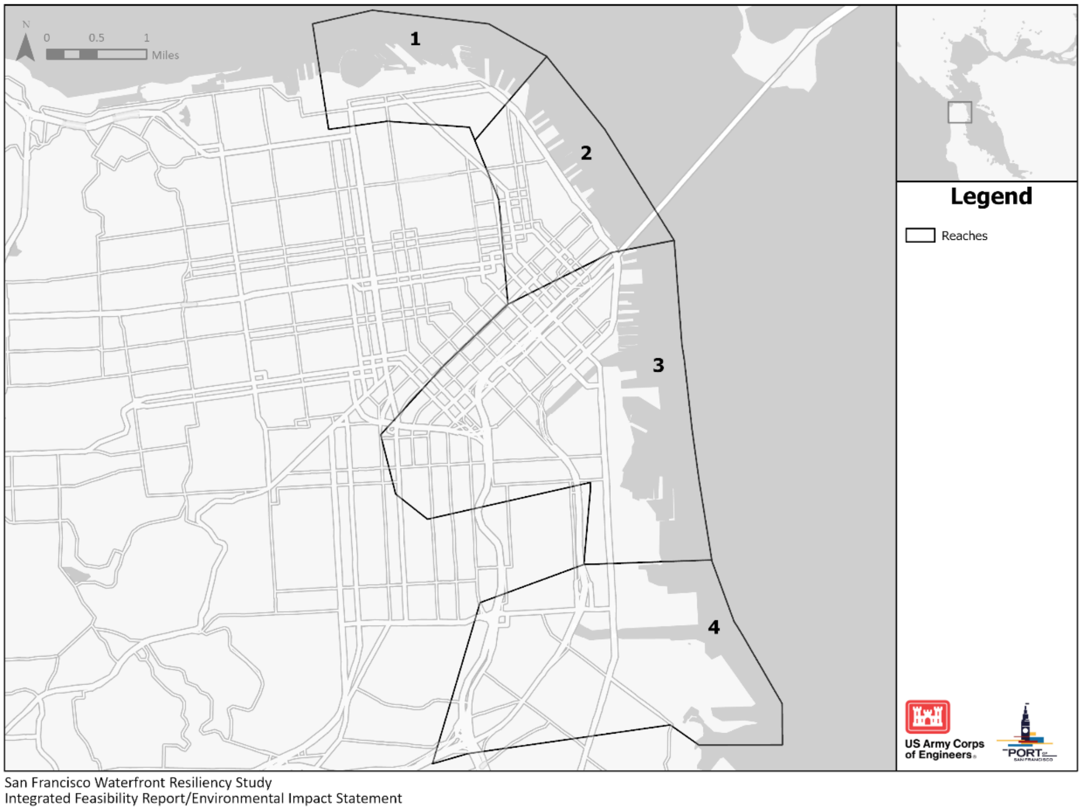


Figure 1-1. Project location in San Francisco, CA outlining the four reaches of the study area.

Much of the northern shoreline (i.e., north of the San Francisco Giants ballpark) is engineered with bulkhead wharves and finger piers, while the southern shoreline includes two inlets (Mission Creek and Islais Creek), working piers (Piers 80 – 96), and areas with sensitive habitat such as the Pier 94 wetlands and Heron's Head Park (Figure 1-2). Much of the areas inland from the shoreline are built on reclaimed land that was filled over time (bay fill) to support the construction of the historic Embarcadero seawall in the late 1800s, and the ship building industries that supported the World Wars in the early 1900s (Figure 1-3). This man-made shoreline is relatively flat, with a mean elevation of approximately 11.8 feet North American Vertical Datum of 1988 (NAVD88). The areas inland of the shoreline are high-density urban and industrial areas.

Figure 1-2. Land Use in the Study Area

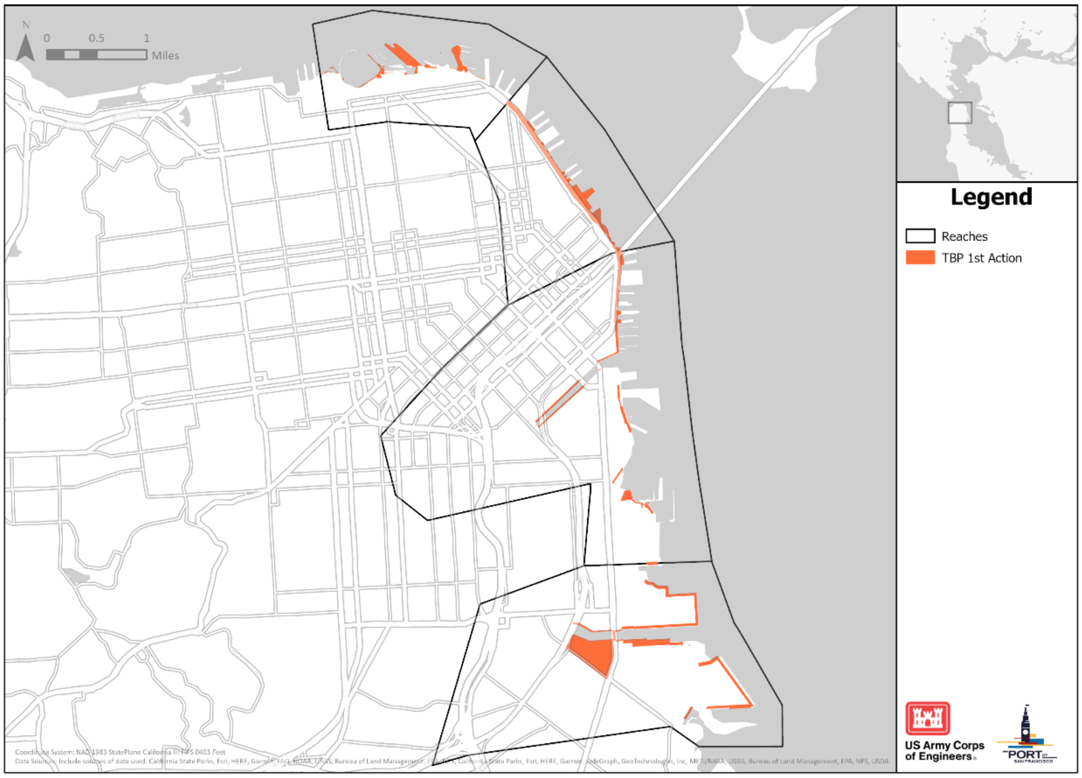
Source: (SF Planning 2019)

Figure 1-3. Historic Shoreline and Areas of Reclaimed Land Built on Bay Fill

Source: (SFEI 1998)

1.2 Total Net Benefit Plan

The Tentatively Selected Plan is the Total Net Benefits Plan (TNBP). The TNBP includes a combination of the following measures: floodproofing methods (i.e., elevate or demolition buildings), berms, sea wall/ bulkhead walls, raising and rebuilding wharves, deployable flood gates, seismic ground improvement, and Engineering with Nature (EWN) features. The project map provides an overview of where proposed features would occur along the San Francisco waterfront, simplified to polygons of the construction footprint (Figure 1-4). Detailed maps are provided in Attachment 1 that define the measures occurring in each reach, with anticipated construction footprint, and include a description of how measures are assumed to be constructed.



San Francisco Waterfront Resiliency Study
Integrated Feasibility Report/Environmental Impact Statement

Figure 1-4. Footprint for measures proposed for construction in the first action of the Total Net Benefits Plan.

A description of the construction activities for the proposed action are provided in the following sections below. Approximate spatial extent (e.g., linear feet, acres) for the construction footprint of measures are provided in Table 1. A general description of the construction methods and equipment, as well as anticipated duration for construction is provided below.

Table 1-1. Total Net Benefits Plan construction footprint quantities.

Measure	Quantities
Bay Fill (ACRES)	9
Levee (LF; ACRES)	17,960; 20+
Bridge Raise/Replacement (LF)	-
Building Demolition (SQFT)	578,500
Building Relocation (SQFT)	641,400
Bulkhead wall/Seawall (LF)	14,105
Deployable Flood Gate (LF)	1,600
Floodproofing (SQFT)	558,905

Roadway Impact (ACRES)	34
Seismic Ground Improvements (ACRES)	90
Sheetpile Wall (LF)	2,165
T-wall (LF)	7,735
Vertical wall (LF)	68,795
Wharf (LF; ACRES)	n/a; 24
EWN* (ACRES)	60
Vertical Shoreline* (LF)	12,100

**Note: acres are rounded to the nearest whole number. LF & SQFT are rounded to the nearest 5. A dash (-) indicates the measure is not included. A "n/a" indicates the value was not available. Levee acreage is denoted with a plus "+" sign because engineering drawings for 3,250 LF of levee did not include the acreage estimate.*

1.2.1 Avoidance and Minimization Measures Incorporated into the Designs

The TNBP avoids a significant amount of unavoidable adverse impacts to ecological habitats by placing the line of defense at or landward of the existing shoreline and designing the project to avoid bay fill to the greatest extent practicable and integrating engineering with nature where feasible. The following is a brief assessment of the avoidance and minimization measures by reach and action.

1.2.1.1 Reach 1

1.2.1.1.1 First Action

All measures are considered nonstructural, meaning the measure attempts to reduce the flood risk and the damages associated with flooding rather than focusing on reducing or modifying how the water moves through the area. By design, the nonstructural measures realize impacts at the immediate site of the measure which is often isolated to the structure itself (e.g. floodproofing, building demolition) and do not involve disturbance of ecological habitats. Construction of the 2-foot wall around the piers involves minimal construction efforts that would be completed from the pier and would not involve any in-water work which avoids impacts to any aquatic habitats.

Three of the five measures in this reach would provide long-term ecological benefits. Approximately 1.7 acres of land would be allowed to flood and be overtaken by RSLC from implementation of the retreat measure (1.6 acres) and building demolition (0.1 acres). In these locations, it is anticipated that intertidal habitat would be naturally created. Additionally, demolition of two piers would remove approximately 1.0 acre of piles, bay fill, and decking and allow the area to restore to higher quality open water and subtidal habitat.

1.2.1.1.2 Second Action

For the second action measures, the seawall alignment and associated seismic ground improvements are landward of the existing shoreline and behind the existing seawall where one currently exists. This design would not require any bayfill or in-water work to construct the features. To maintain the aesthetic quality and accessibility of the waterfront, a gradual slope has been incorporated into the design that will promote unity throughout waterfront that would generally be unnoticeable to the average visitor when the pre-construction and post-construction conditions are compared. The design allows accessibility to all (i.e. fewer steps and gentle slopes) and incorporates and maintains the historic features unique to the waterfront buy ensuring the architectural design and materials are consistent with the surrounding environment. This design creates more transportation impacts to achieve the target slope and seawall elevation but fully avoids any impact to aquatic habitats.

With the increase in ground elevation, approximately 3.25 acres of existing wharf would need to be rebuilt to the higher elevation resulting in temporary localized impacts to the aquatic environment during construction. Because of the design, there would be no increase in the footprint of the wharf, all existing wharf material would need to be removed and replaced with new, more eco-friendly materials, and fewer piles would be necessary per square foot than currently exists. Overall long-term benefits to the aquatic environment are expected from the net decrease in bay fill and removal of old materials (e.g. creosote piles) that contribute to poor water quality.

Other adaptive measures are nonstructural and would not impact any location except at the immediate structure. An additional 1.0 acre of building demolition would be completed that would result in similar beneficial impacts to the those described for the first action.

1.2.1.2 Reach 2

1.2.1.2.1 First Action

Similar to the second action in Reach 1, the first action in reach 2 involves constructing a seawall landward of the existing seawall and rebuilding approximately 6.3 acres of wharf. The design and construction methodology would be identical to Reach 1 second action and all the same avoidance and minimization efforts and long-term benefits described above would be applicable here. The difference here is that the action would be completed as a first action and not a second action.

1.2.1.2.2 Second Action

The TNBP does not include a second action in this reach since the first action is being constructed at a higher initial scale, unlike the other three reaches. By completing the 3.5-foot target elevation in the first action, the significant disturbance to the

Embarcadero including transportation, recreation and cultural resource impacts and costs associated with reworking the same area twice are avoided.

1.2.1.3 Reach 3

1.2.1.3.1 First Action

In reach 3, all measures are constructed landward of the existing shoreline and would not require any in-water work, thus avoiding the need for bay fill and adverse impacts to aquatic habitats. Additionally, all impacts from construction have been avoided on approximately 7,500 linear feet of shoreline because the design was aligned to take advantage of existing high ground to avoid unnecessary construction of additional features. Instead of raising the bridges, deployables are proposed which avoids a significant amount of in-water work and disturbance associated with replacing two bridges.

1.2.1.3.2 Second Action

The first action measures have each been designed to be adaptable to future design modifications to address SLC conditions. Based on the designs at this time, the second action would not abandoned the first action structures and thereby avoids the need for construction or conversion of lands to impervious surfaces outside the first action construction footprint. As with the other measures, the designs and construction methodology avoid all aquatic impacts.

1.2.1.4 Reach 4

1.2.1.4.1 First Action

Like the other reaches, all measures are constructed landward of the existing shoreline and would not require any in-water work, thus avoiding the need for bay fill and adverse impacts to aquatic habitats. Additionally, all impacts from construction have been avoided on approximately 6,500 linear feet of shoreline because the design was aligned to take advantage of existing high ground to avoid unnecessary construction of additional features. Similar to reach 3, the impacts of raising of existing bridges would be avoided by relying on deployables for flood defense. Similar to reach 1 first action, approximately 0.75 acres of building demolition would occur allowing these areas to convert to intertidal or sub-tidal habitat, while an additional 2.0 acres of building demolition would occur and be converted to open space.

1.2.1.4.2 Second Action

The second action avoidance and minimization measures described for reach 3 also apply in reach 4. Additionally, NNBF features have been incorporated into the designs that allow for ecological enhancements while supporting and enhancing the performance of the flood defense structures.

1.2.1.5 Independent Measures for Consideration

All NNBFs (living seawalls, 2B, and 3C) minimize the long-term adverse impacts of the engineered structure despite some temporary aquatic impacts during construction. By incorporating NNBF into the design, natural processes and materials are used to reduce wave hazards, support nearshore ecology, and provide public water access in lieu of more traditional engineered designs and materials such as concrete, rip rap, or monoculture turf grass, which do not provide any long-term ecological or recreational benefits and are generally less visually desirable. Additionally, implementation of the NNBF avoids conversion of existing habitats into impervious surfaces.

For 3A, similar to other shoreline raises, this measure would be constructed entirely landward of the existing shoreline and avoids any impacts to aquatic habitats. Approximately 4.5 acres of wharf would also need to be rebuilt which would involve some temporary impacts, but overall result in long-term benefits from removal of old construction materials and a reduction in bay fill as described for reach 1 second action. The footprint would not be increased and therefore long-term changes from a footprint increase have been avoided. As well, the modified design in this location avoids disruptions and reconfiguration of the light rail system.

For 3B, this modification aligns the flood defense with the current shoreline edge on the north side of McCovey Cove (along the ballpark) and avoids needing to add fill or extend the shoreline into the creek, thus avoiding any aquatic impacts.

For 4A, the modification incorporates a small area of gradual retreat along the creek, resulting in long-term ecological benefits and avoidance of engineered structures and permanent impacts at or near the existing shoreline. These areas would be allowed flood and be overtaken by RSLC, which is expected to convert to marsh, intertidal or sub-tidal habitat. Long-term conversion of existing habitats into impervious surfaces would be avoided. As well, this conversion of some industrial lands and public facilities would provide public water access and additional open space.

2.0 Identification of Impacted Habitats

Since site-specific habitat surveys were not completed during the feasibility phase, habitats in the study area were identified using primarily the California Aquatic Resources Inventory (CARI) version 2.2 (last updated December 23, 2023) (SFEI 2022) Geographic Information System (GIS) dataset of aquatic habitats that maps subtidal, beaches, wetlands, streams, and riparian areas. This information was supplemented by Google Earth aerial imagery, site visits, published literature, and other GIS datasets where necessary. CARI is a compilation of local, regional, and statewide aquatic resource GIS datasets into a standardized, seamless, statewide coverage of aquatic resources employing a common wetland classification system.

2.1 Habitats in the Study Area

A total of six CARI mapped ecological habitat types are located within the project footprint including: subtidal, beach, pond and associated vegetation, tidal flat and marsh panne, tidal marsh, and eelgrass (Figure 2-1). Only subtidal habitat and tidal flat and marsh panne are expected to have unavoidable adverse impacts as a result of implementing the Independent Measures, while implementation of the TNBP, alone, would have no unavoidable adverse impacts.

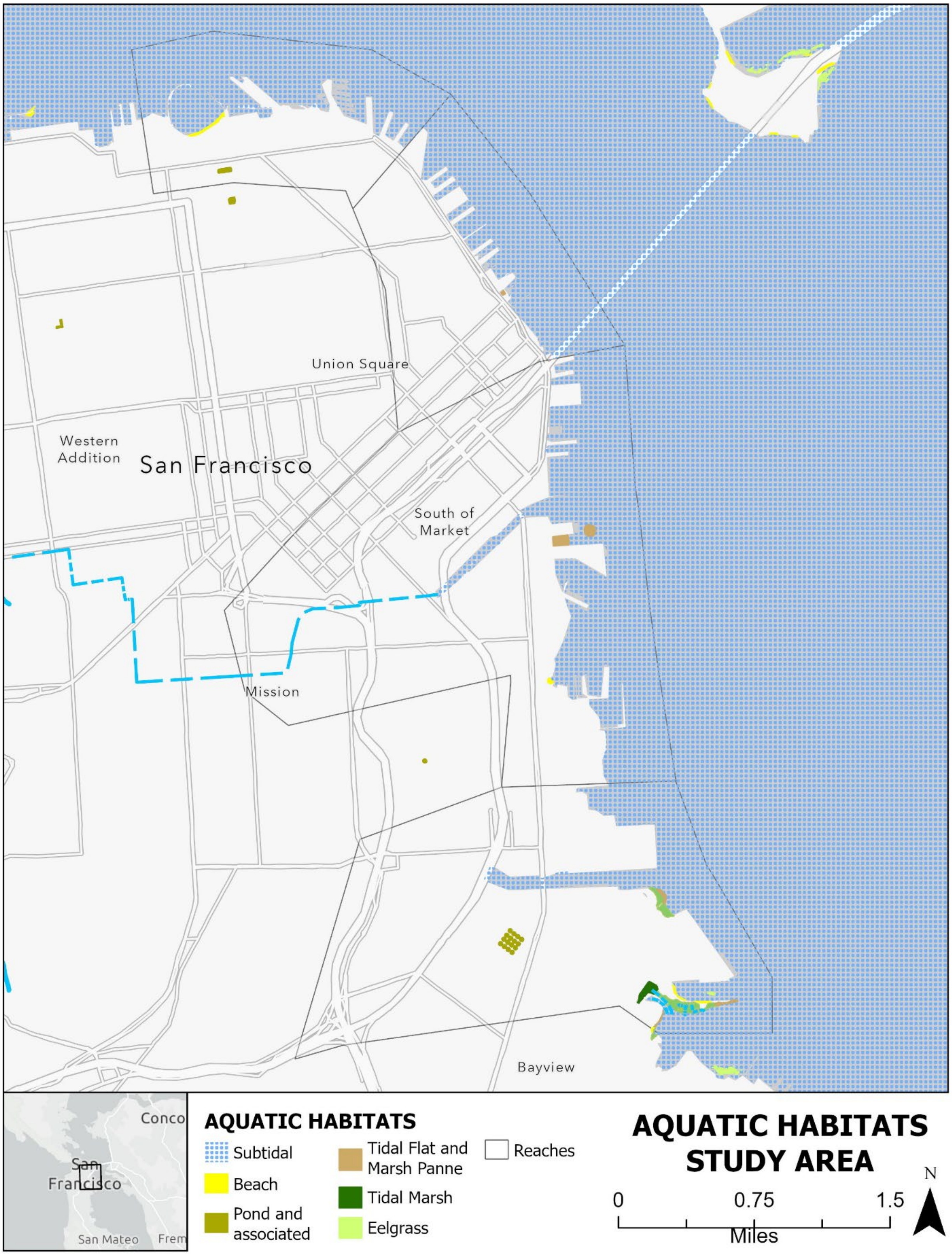
2.1.1 Subtidal Habitats (Open Water)

Subtidal habitats are submerged areas beneath the San Francisco Bay water surface to the Bay bottom and include mud, shell, sand, rocks, artificial structures, shellfish beds, eelgrass beds, macroalgal beds, and the water column above the bay bottom (Cosentino-Manning et al. 2010). Soft substrate comprises the majority of the bay's bottom (approximately 90%) and ranges between soft mud with high silt and clay content and areas of coarser sand. CARI maps any areas as subtidal if:

> … the area has at least 90 percent open water using a 100 square meters (m2) search area (meaning they have less than10% vegetation cover). Floating and submerged aquatic vegetation found in open water do not count towards the10%cover.

All areas, bayward of the existing shoreline are considered open water. The depth of these areas can range from a few feet in Lash Lighter Basin to more than 30 feet at or coming into the working piers. Artificial structures, such as concrete, composite, and wood pier pilings, can be found throughout the San Francisco waterfront and along Mission and Islais creeks.

Figure 2-1. Habitats in the Study Area



2.1.2 Eelgrass

CARI defines eelgrass habitats as: Marine or Estuarine areas that are dominated by eelgrass beds. Eelgrass is a native marine plant found globally within soft-bottom bays and estuaries. It is typically found in healthy, shallow bays and estuaries where the depth of occurrence is a function of light penetration. Eelgrass beds are dynamic, expanding and contracting seasonally and annually dependent on habitat quality. Importantly, eelgrass is considered an indicator community for the health of an estuary due to its sensitivity to changes in water quality. It enhances water quality through sediment trapping and habitat stabilization, transforms nutrients, oxygenizes water, and serves as a primary producer, nursery habitat, and forage area for commercially and recreationally important fish, as well as migratory birds.

In the study area, one approximately 0.4-acre eelgrass bed is documented in Lash Lighter Basin just north of Heron’s Head. Outside the study area about 0.3 miles south of Heron’s Head, a 2.5-acre bed is documented along the southern shoreline of India Basin.

2.1.3 Estuarine Intertidal (Wetland) Habitat

Intertidal habitats are the regions of the bay that lie between low and high tides (NOAA 2022b). CARI defines a wetland as:

> Under normal circumstances, a wetland (1) is saturated by groundwater or inundated by shallow surface water for a duration sufficient to cause anaerobic conditions within the upper substrate; (2) exhibits hydric substrate conditions indicative of such hydrology; and (3) either lacks vegetation or the vegetation is dominated by hydrophytes. Some additional classes including Rocky Intertidal, Beaches, and Dunes are currently nested under Wetland.

A total of four intertidal habitat types are found in the study area (Table 2-1). There are three CARI mapped intertidal habitat types in the study area including beaches, tidal flat and marsh panne, and tidal marsh. Often rocky intertidal habitat is noted as occurring along the San Francisco waterfront as well; however, there are no mapped Rocky Intertidal habitats as defined by CARI in the study area. The study team acknowledges that rocky intertidal habitat in the study area often includes artificial structures that would not typically be mapped as habitat and acknowledges the value such artificial structures have on the San Francisco Estuary especially along the waterfront where minimal native habitat exists. Therefore, this analysis has added rocky intertidal (with a modified definition) as a habitat occurring along the waterfront.

Additionally, formal delineation of waters of the U.S., including wetlands, occurred in 2015 along the Port of San Francisco waterfront between the open water basin north of Pier 40 and Heron’s Head Park at Pier 98. Two locations were documented as having wetlands but were not in the CARI database. They are included in this analysis.

Table 2-1. Sub-Habitat Types of Estuarine Intertidal Habitat Found in the Study Area

Sub-Habitat Type	Description	Location Found
Beaches	Generally unvegetated open sand/fine gravel areas along the coast that extend from mean low low water (MLLW) up to the dune toe.	Aquatic Cove, Crane Cove Park, Heron's Head, India Basin Park
Tidal Flat and Marsh Panne	Non-vegetated areas that satisfy the hydrology and substrate criteria	CARI Mapped: Beneath Ferry Building Wharf (no longer present), Pier 48 and 50, Pier 94, Heron's Head, India Basin Park Not-Mapped: along north and south banks of Islais and Mission creeks
Tidal Marsh	Emergent vegetation consists of erect rooted herbaceous hydrophytes (excluding mosses and lichens) and is usually dominated by perennial plants. Dominated by salt-tolerant species of emergent vascular vegetation, such as cordgrass (Spartina spp.), pickleweed (Salicornia spp.), and salt grass (Distichlis spp.) along the foreshore of the wetland and along the immediate banks of the larger tidal channels that tend to dewater at low tide.	CARI Mapped: Heron's Head, Pier 94, India Basin Park Not-Mapped: Islais Creek Park, East of Illinois Bridge on north bank of Islais Creek, on north bank of Islais Creek at Islais Creek Muni Park, Warm Water Cove
Artificial Rocky Intertidal	Artificial rock (quarried rip-rap) shoreline armoring, concrete bulkheads	Throughout the waterfront, along the shorelines of Mission and Islais creeks

2.1.4 Pond

A pond is defined as an unnatural, unvegetated area of open water. These areas are defined by CARI as depressional wetlands. Depressional Wetlands are features predominantly fed by surface water that form in topographic lows and precipitation, surface runoff, and ground water are their main sources of water. There are two mapped pond locations in the study area including: an approximately 3.0-acre pond at Heron’s Head Park, a series of 16 waste treatment ponds at the Southeast Wastewater Treatment Plan. A third location at Francisco Park was also mapped, but when comparing to recent aerial imagery, the pond is not present.

2.2 Impacted Habitats

2.2.1 Reach 1

In reach 1, beach and subtidal habitats are present. There are no measures that would be constructed within the existing beach habitats (Figure 2-2 and Figure 2-3). Floodproofing is the nearest construction activity to the beach habitat; however, it would occur at the immediate structure site and not directly or indirectly affect existing beach. There are numerous small sections of retreat throughout reach 1 that are difficult to see on the following figures. No work would be completed in these areas; however, over the long-term, these areas would be expected to convert to additional beach or intertidal habitat.

Pier demolition would be completed within the subtidal habitats resulting in temporary adverse impacts, but a long-term benefit to subtidal habitats through removal of existing piling, decking, and pier materials. Removal of the structures would remove bay fill and restore light and the pre-pier hydraulics (wave and currents) to approximately 1.0 acres of subtidal habitat. No permanent or long-term adverse impacts are anticipated for any habitats in this reach.

Figure 2-2. Aquatic Habitats in Reach 1

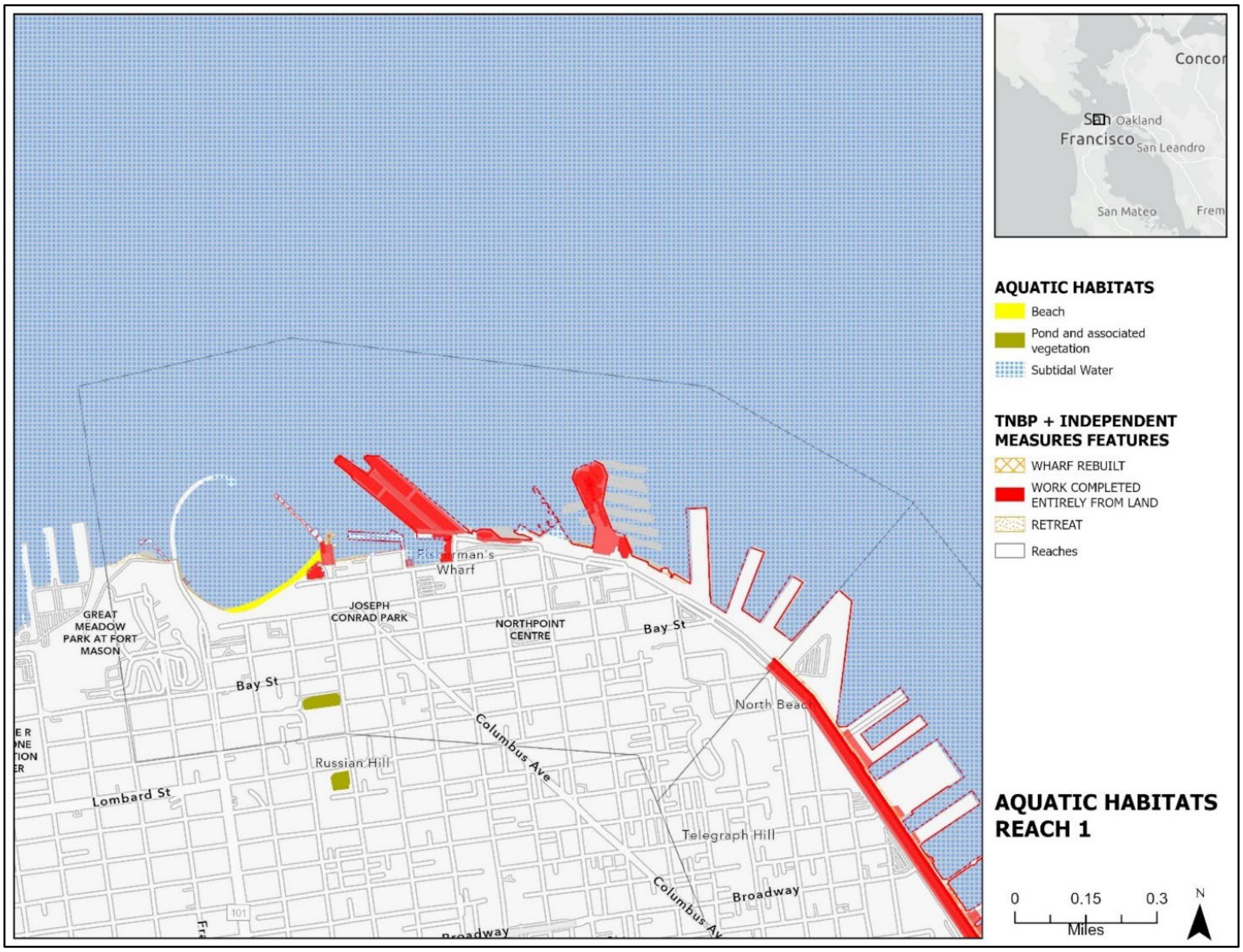
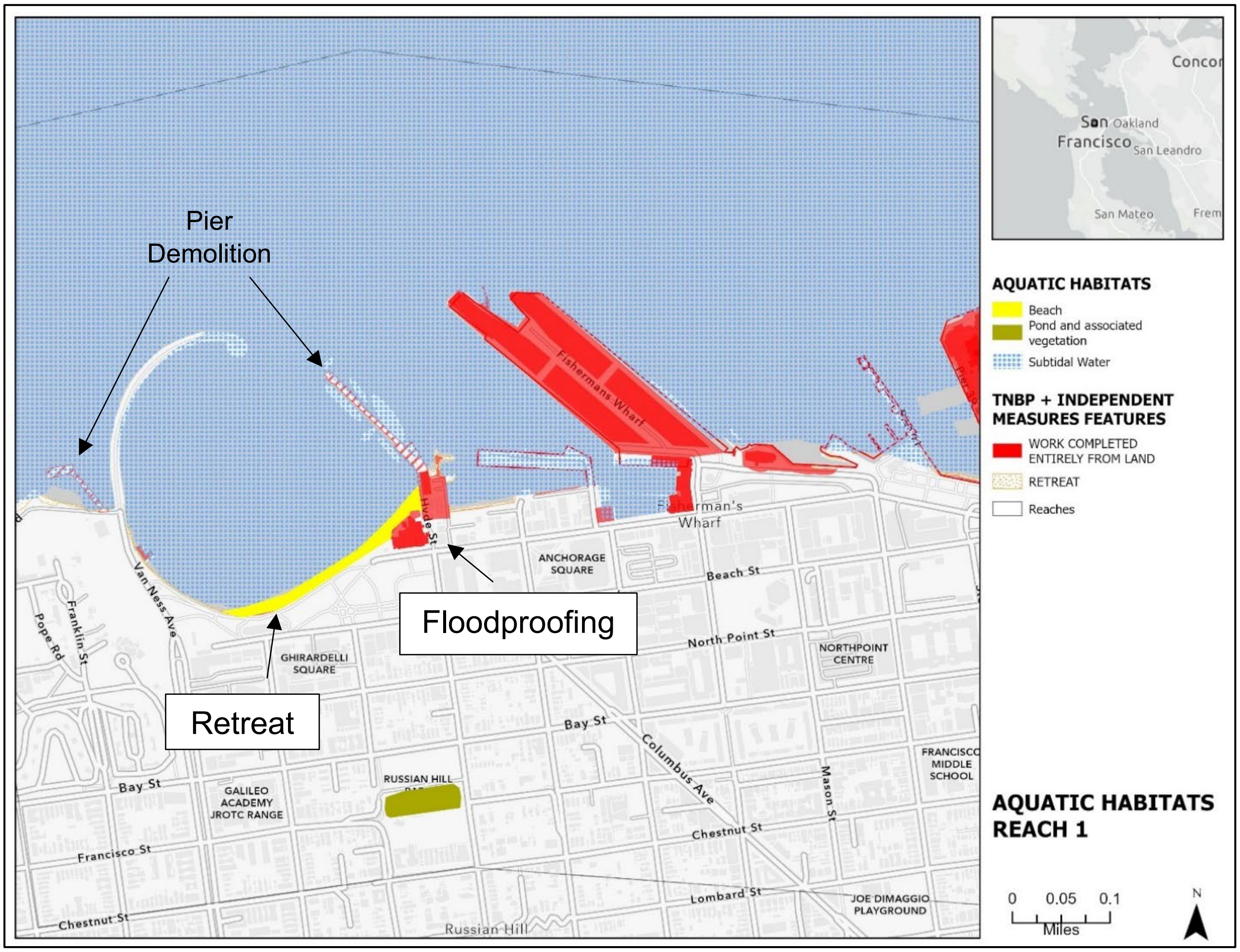


Figure 2-3. Close-Up of Beach and Pond Habitats in Reach 1 in Relation to the TSP



2.2.2 Reach 2

In reach 2, subtidal habitat is the only habitats found in or near the construction footprint (Figure 2-4 and Figure 2-5). A 0.25-acre area of tidal flat and marsh panne are mapped beneath the Ferry Building in reach 2. This site is no longer tidal flat and has converted to subtidal habitat (i.e. the area is permanently submerged now). Therefore, there are no adverse impacts to the tidal flat and marsh panne habitat.

Construction of the seawall and all seismic ground improvements would be constructed landward of the existing shoreline and therefore have no temporary or permanent adverse impacts on existing habitats. Wharf raising and rebuilding will temporarily impact subtidal habitats but is expected to result in no net change in subtidal habitat and may even experience a net benefit by removing old construction materials, such as creosote, that may be contributing to poor water quality and a reduction in bay fill that would provide open more water. Additionally, new pilings are expected to have a textured surface that would increase the surface area for aquatic organisms to attach to.

Permanent adverse impacts are expected to occur in this reach as a result of constructing the independent measures for consideration 2A and 2B. These two features are expected to fill in approximately 9.0 acres of subtidal habitat. The area immediately under the Ferry Building would result in a permanent net loss. The area where 2B is being constructed will have approximately 0.5 acres of bay fill to accommodate some utility and transportation needs; however, an additional 3.5 acres of bay fill is needed to construct the coarse beach (EWN feature) that will be placed over the utility/transportation bay fill and use ecological processes to protect the site rather than using hardened structures such as rip rap. Over the long-term, adding a coarse beach would be a net gain in a different habitat type (beach or intertidal habitat) in this reach, but would result in a permanent net loss of subtidal habitat.

It should be noted that all adverse permanent impacts are associated with construction of the independent measures. If they are not included in the final recommended plan designs, then no permanent adverse impacts are anticipated from constructing the TNBP.

Figure 2-4. Aquatic Habitats in Reach 2

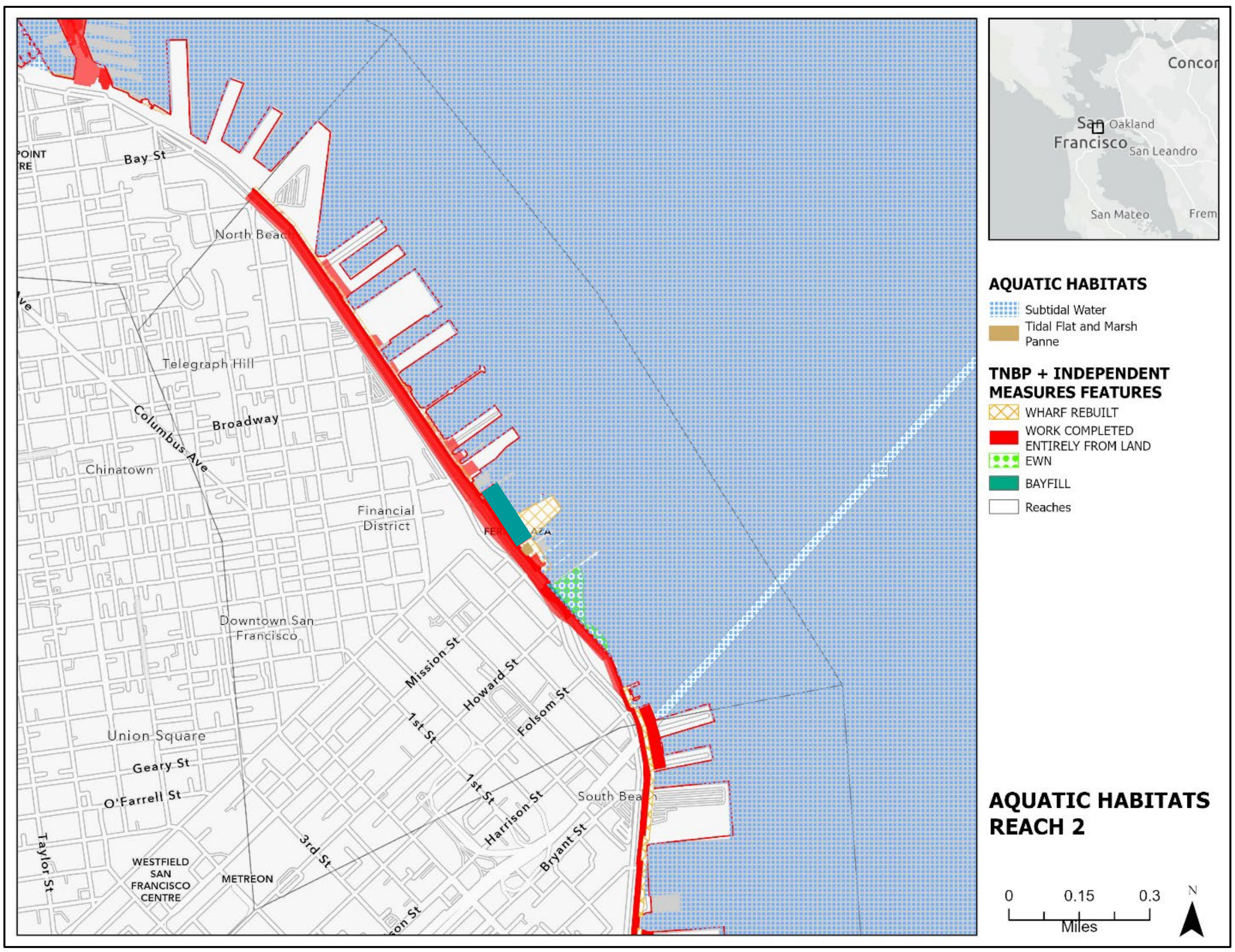
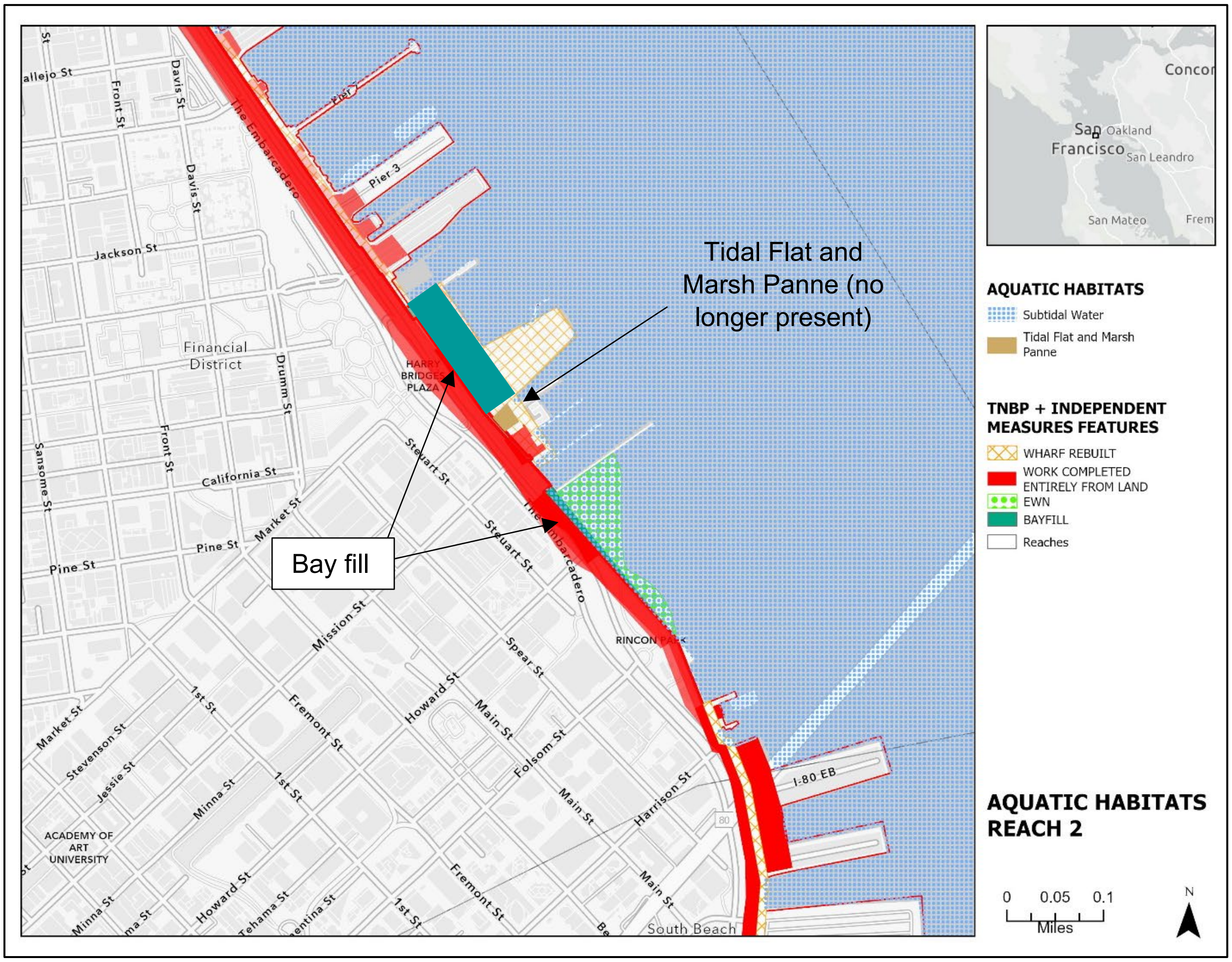


Figure 2-5. Close-Up of Tidal Flat and Marsh Panne in Reach 2 in Relation to the TSP



2.2.3 Reach 3

Subtidal, beach, artificial rocky intertidal, and tidal flat and marsh panne habitats are found in reach 3 (Figure 2-6). While not documented in the CARI database and not shown in the figures below, the shoreline of Mission Creek is primarily armored shoreline (artificial rocky intertidal) with pockets of tidal flat and marsh panne.

No TNBP and independent measures are proposed for construction in or near the CARI mapped beach and tidal flat and marsh panne habitats and all nearby measures are proposed landward of the existing shoreline and therefore would have no indirect effects to the habitats from changed hydrologic conditions (Figure 2-7). Similar to reach 2, wharf raising would have temporary adverse impacts on subtidal habitats, but would have a long-term benefit on water quality, hydrology, and aquatic organisms.

TNBP and Independent Measures are proposed along Mission Creek where artificial rocky intertidal and tidal flat and marsh panne are found. Each of the measures here would be constructed to have the toe of the planted berm to align with the mean high-water line, thus avoiding any bay fill or long-term permanent impacts to the subtidal, artificial rocky intertidal, and tidal flat and marsh panne habitats. However, during PED, site-specific habitat surveys should be completed to confirm that this assumption remains valid. If during those surveys the design is found to disturb or replace any of these habitats, minimization measures should be considered and could include features such as adding ecological armoring instead of rip rap or other toe and slope protection materials, redesigning the planted berm to be an ecotone levee where marsh and other intertidal habitats can be incorporated to protect the toe, or realigning the berm to avoid at a minimum bay fill and tidal pane and marsh habitat.

No permanent adverse impacts to any of the aquatic habitats in reach 3.

Figure 2-6. Aquatic Habitats in Reach 3

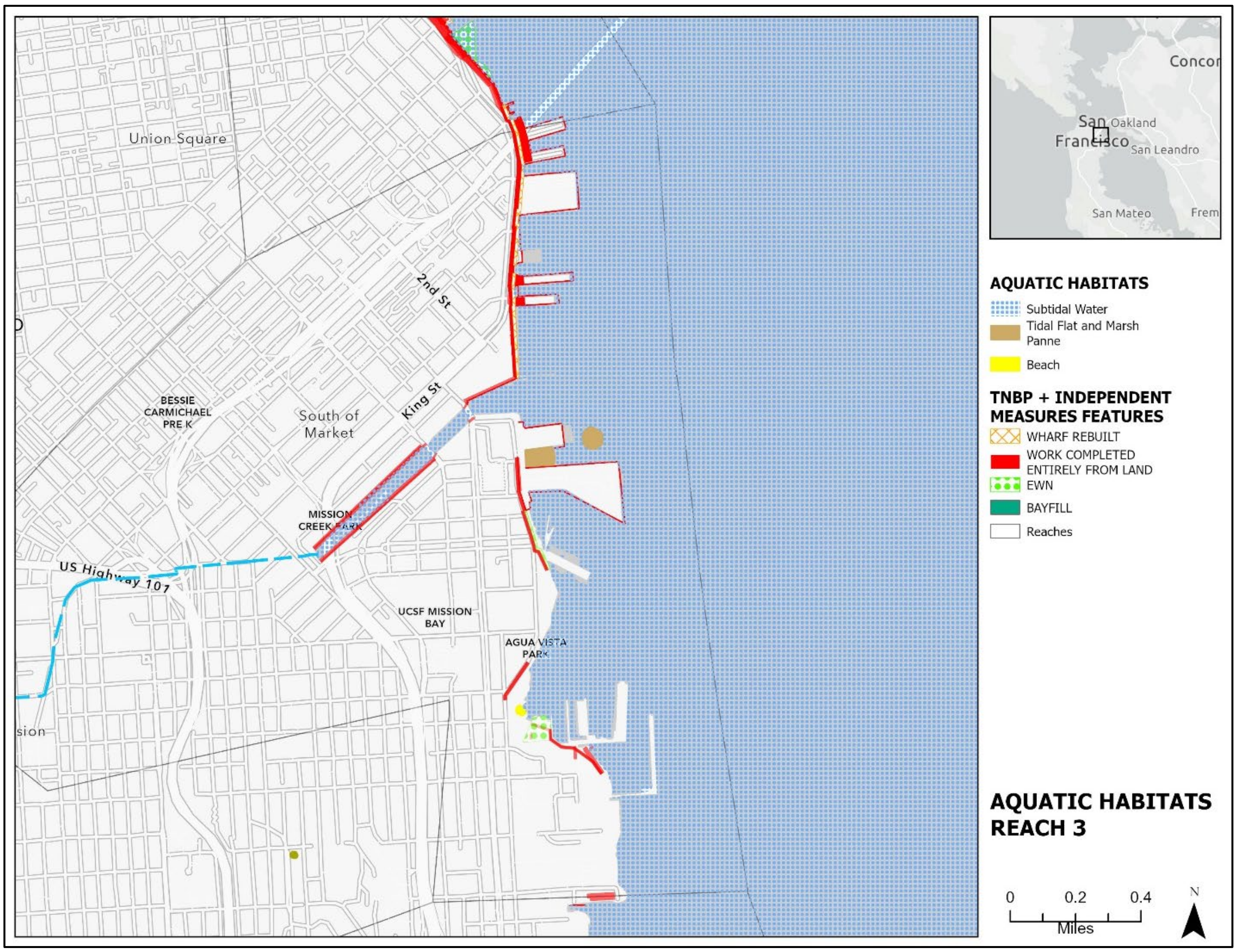
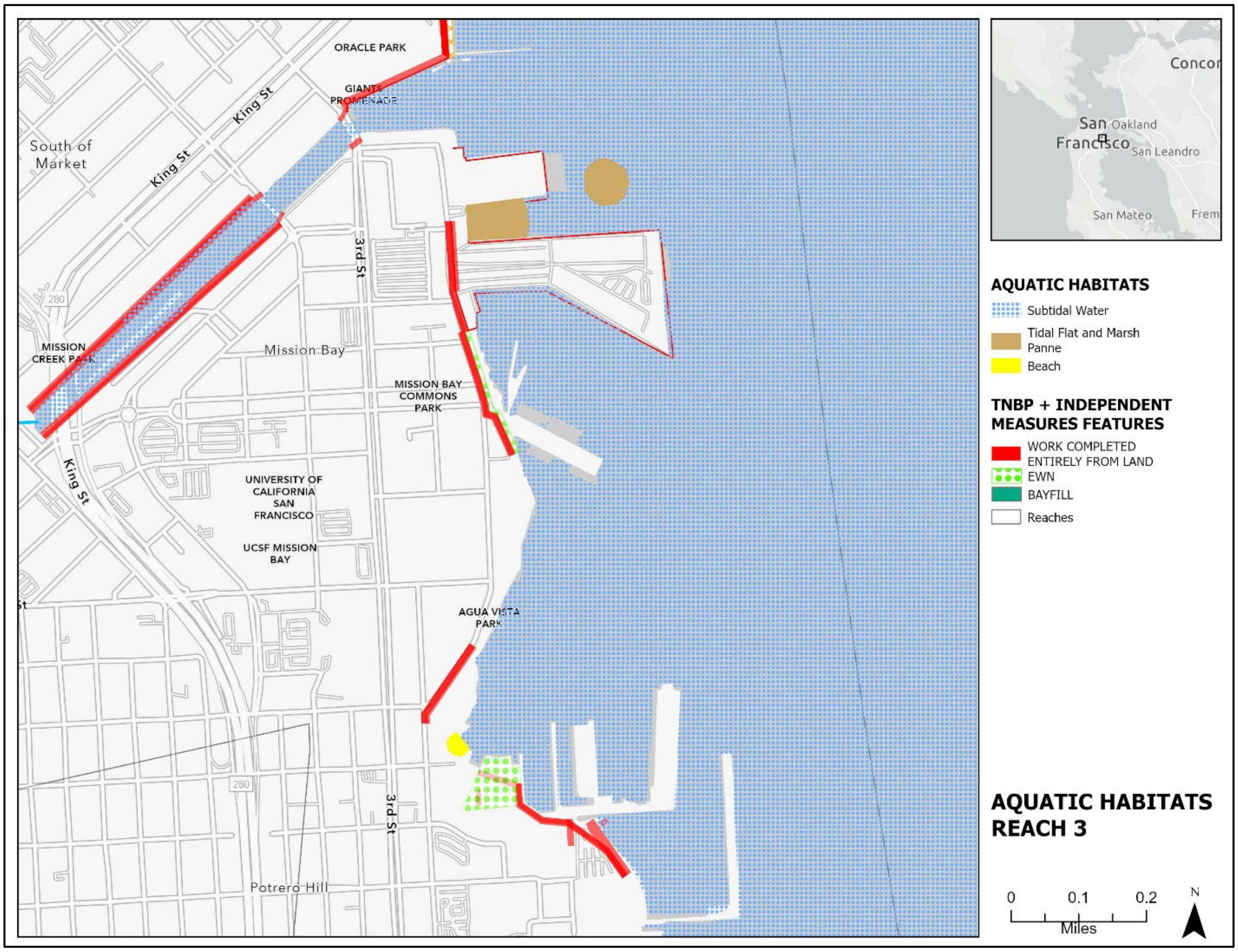


Figure 2-7. Close-Up of Beach and Tidal Flat and Marsh Panne in Reach 3 in Relation to the TSP



2.2.4 Reach 4

All aquatic habitat types are found in reach 4 (Figure 2-8). However, the TNBP and independent measures avoid construction in or near the beach, tidal flat and marsh panne, tidal marsh, eelgrass, and pond habitats (Figure 2-9). There is one measure (EWN ecotone levee) that would be constructed just south of the Pier 94 wetlands. Since this feature is an ecotone levee, over the long-term the constructed feature would be complementary to the existing tidal marsh and tidal flat and marsh panne habitats. While constructing the ecotone levee, BMPs would be incorporated to prevent movement of sediment into the existing habitats from the construction site and no surface waters would be diverted from or into those habitats that were not there prior to construction. Additionally, there would be stipulations that no staging areas, access roads, construction footprints would be sited in aquatic habitats. As a result, there would be no direct or indirect loss of the habitats at Pier 94.

Areas of tidal flat and marsh panne habitat and tidal marsh are present along the north bank of Islais Creek where TNBP measures are proposed. Similar to reach 3, as of now the planted levee design that could affect the area of habitat east of Illinois Bridge avoids construction below the mean high-water line. Construction and long-term operation of the structure should avoid any direct or indirect disturbance or loss of these habitats. During PED, additional site-specific surveys need to be completed and, if necessary, avoidance or minimization measures incorporated into the final design.

At the Islais Creek Muni Park site, existing habitats would be temporarily filled in or trampled to construct the ecotone levee. These habitats would be replaced as part of the EWN ecotone levee design and the habitat loss would be considered temporary until the restored vegetation reaches maturity and the intertidal habitat becomes fully functioning. The length between loss and restoration is dependent on how long construction takes at the immediate site, type of plants used, and growing conditions, but is anticipated to reach pre-construction conditions or better within one to three growing seasons after a one-year period of construction or two to five years. The purpose of the measure is to support the overall performance of the flood defense feature using natural processes. As a result, these features also provide habitat enhancements that are anticipated to result in a net increase in quantity and quality of intertidal and tidal marsh habitats.

Existing tidal marsh and tidal flat and marsh panne found at Islais Creek Park would be avoided to the greatest extent practicable while constructing the 42.75-acre EWN feature. This measure would remove all existing structures, concrete and pavement from the area and create an open space composed of intertidal habitat at the lower elevations and grading to upland habitat further inland. Over the long-term this will be a significant net increase in tidal marsh and intertidal habitats; however, the exact extent is unknown because site-specific elevation and designs have not been developed to understand the widths of each zone of habitat that would be created after construction is complete. Additionally, as sea levels rise, it is anticipated that each of the aquatic habitats would retreat inland and convert the upland habitats to tidal marsh and additional intertidal habitat would be created, resulting in additional increase in aquatic habitats.

Similar to reach 2 and 3, wharf raising would have temporary adverse impacts on subtidal habitats, but would have a long-term benefit on water quality, hydrology, and aquatic organisms.

Overall, the TNBP and Independent Measures are not expected to have any unavoidable adverse impacts and would over the long-term increase the quality and quantity of aquatic habitats in reach 4.

Figure 2-8. Aquatic Habitats in Reach 4

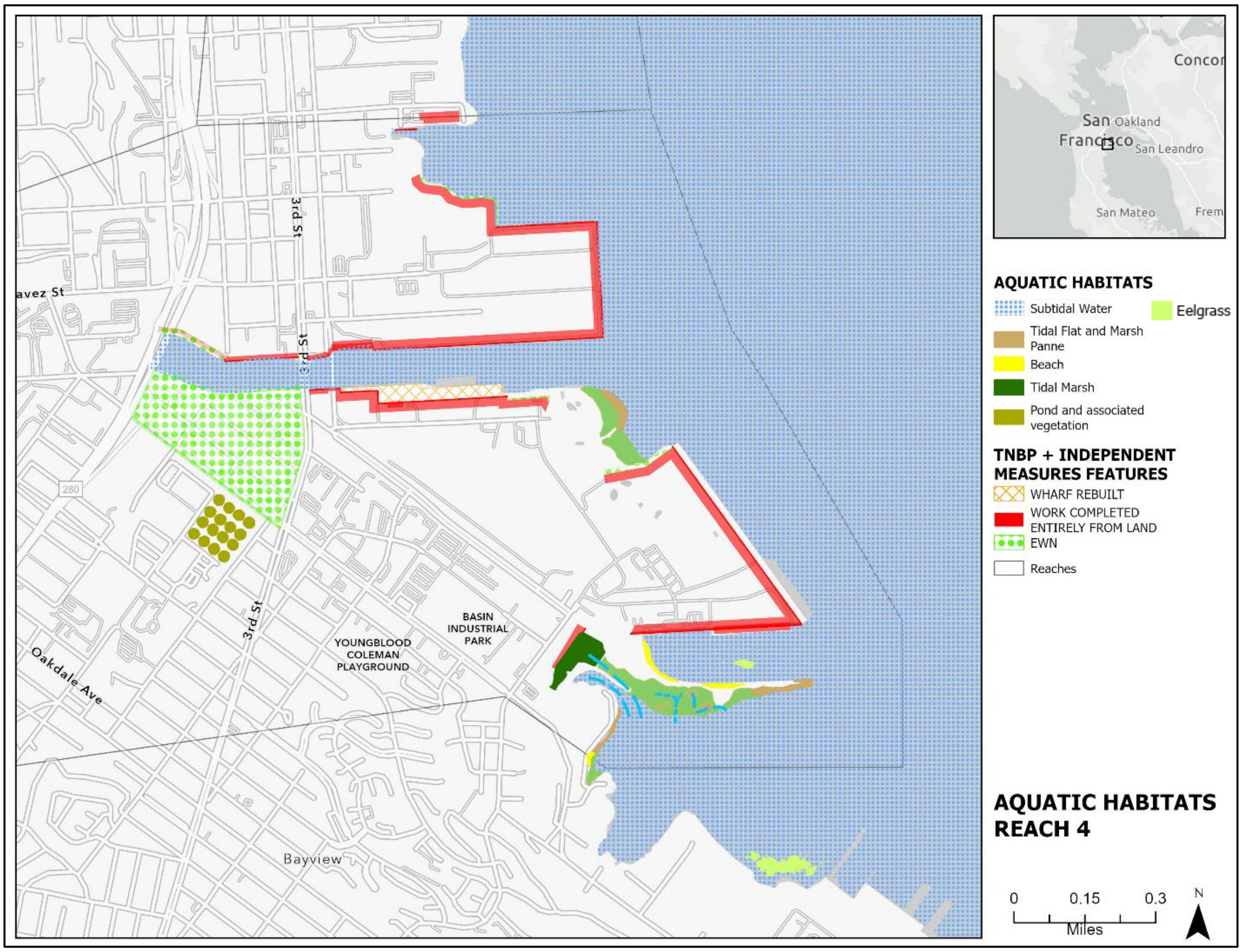
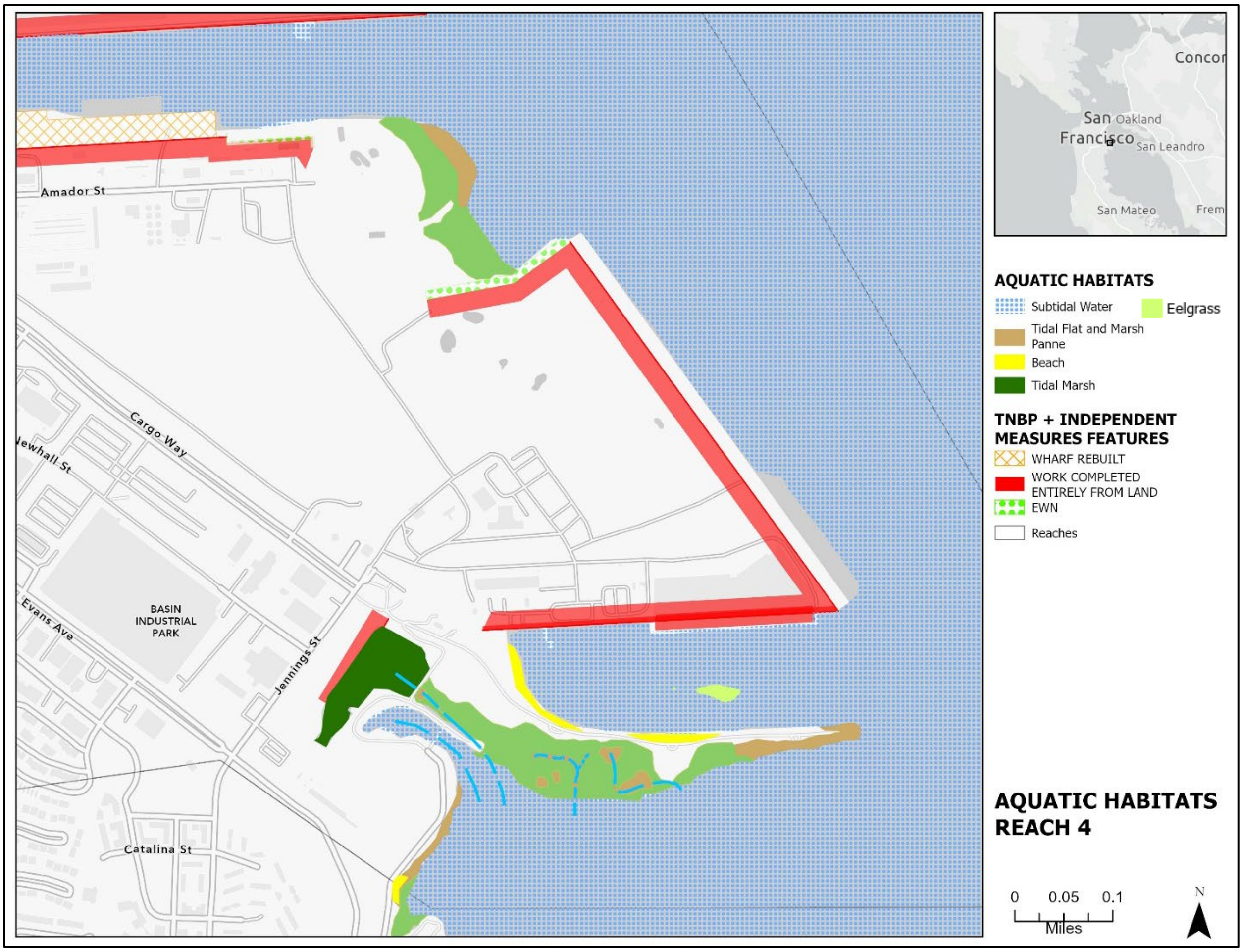


Figure 2-9. Close-Up of Aquatic Habitats in Reach 4 in Relation to the TSP



2.2.5 Summary

Unavoidable adverse impacts to subtidal habitat are expected from 9.0 acres of bay fill.

3.0 Habitat Modeling

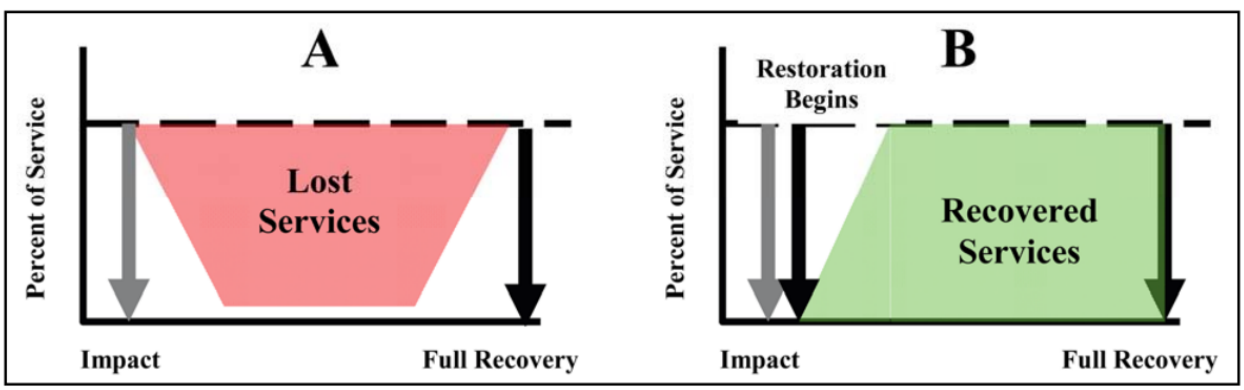
For purposes of this phase of feasibility, the worst-case scenario of implementation was assumed and included construction and long-term operation of the TNBP measures and construction of the independent measures where long-term adverse impacts are expected and no EWN benefits are realized. Additional coordination with the resource agencies will occur after the draft IFR-EIS is released to the public to better understand what is an appropriate assumption for the quantity of tidal marsh and intertidal habitat that would be restored/created. As a result, only the bay fill impacts to subtidal and tidal flat and marsh panne habitats were modeled.

3.1 Habitat Equivalency Analysis

Habitat Equivalency Analysis (HEA) is a method developed by the National Oceanographic and Atmospheric Administration (NOAA) to scale compensation for habitat damage resulting from oil spills and other damage-related impacts (NOAA 1997). HEA is currently only approved on a project-by-project basis. Single-use model certification is being sought from the Ecosystem Restoration Center of Expertise (Eco-PCX).

HEA focuses on complete, in-kind replacement of services lost between the time of impact and when the restored or created habitat becomes fully functional (Figure 1). HEA accomplishes this by incorporating the concept of discounting from economic theory (i.e. services for future years have a lower value on benefits because they take longer to accrue).

Figure 3-1. Estimation of (a) lost services, and (b) recovered services (after King 1997)



The structure of HEA is relatively simple. Calculations of how much habitat to restore or replace are based on estimates of the total loss in services supplied by the damaged or lost habitat. Total loss is estimated from the degree of initial damage to the resource and the loss in service that occurs during the time between the initial damage and when the restored or replaced habitat becomes fully functional. The basic unit of measurement for this approach is typically a discounted-service-acre-year (DSAY). A DSAY represents the value of all the ecosystem services provided by one acre of the habitat in one year. Once the DSAYs are calculated for the impacted habitat, the compensatory mitigation need can be established and adequate compensatory mitigation identified to offset the DSAYs in the form of acres of restored habitat.

The implicit assumption of HEA is that the public is willing to accept a one-to-one trade-off between a unit of lost habitat services and a unit of restoration project services so long as the services provided are comparable. The assumption of comparable services is met when the proposed restoration action provides services of the same type and quality, and of comparable value as those impacted.

Three critical pieces of information are necessary to complete the analysis: 1) the nature of the service that has been impacted or lost; 2) the extent of the initial damage, and 3) the rate at which recovery is likely to occur. Determining which service is most appropriate to replace and the degree to which the study area provided this service prior to impact are the most important steps in the HEA process. Information on the recovery rate of the service is also necessary to accurately assess losses that occur while the restored habitat is developing to its maximum possible functionality. Together with the estimated initial losses, this information yields the total amount of service lost over the period of the project is used to scale the estimate of how much habitat much is constructed or restored. This method assumes that equivalent habitats will provide equivalent services, meaning that the years of lost services can be compensated for by providing acres of additional habitat.

3.2 HEA Steps

HEA proceeds in seven steps including:

1) Determine the area of the impacted habitat.
2) Select an appropriate service to replace and a metric to represent the service.
3) Estimate the loss in service of the impacted habitat.
4) Determine the shape of the recovery curve.
5) Estimate losses occurring while recovery proceeds.
6) Estimate total losses.
7) Calculate the amount of restored habitat necessary to offset total losses.

First the area of the impacted site is estimated and a determination is made as to which service is to be the focus of compensation. It should be noted that while the basic calculations utilize a single service, the metric selected to represent the service may result in multiple services being effectively covered. After selecting the service and metric, the extent of immediate loss in service to the impacted habitat is estimated. Next, the shape of the recovery curve is determined and losses incurred while the habitat recovers or develops are estimated. The immediate and during-recovery loss estimates are summed and the area of restored habitat necessary to offset all losses is calculated. Estimates of how much habitat to restore (scaling) are made by making total losses (*L*) equal total gains (*G*). The following equations are used to calculate total losses and total gains using the following equation:

$$\text{Total Losses } (L) = V_L * \sum_{t=i}^{B} A_L * (1+d)^{(T-i)}$$

where

V_L = value per unit area of impacted habitat

A_L = area of impacted habitat

B = year in which services are finally recouped

i = year of impact

t = number of years between impact and start of restoration

T = base year

d = discount rate (usually 3 percent)

Gains are calculated from a similar equation,

$$\text{Total Gains } (G) = V_G * \sum_{t=j}^{M} S_t * (1+d)^{(T-i)}$$

where

V_G = value per unit area of restored

S_t = additional area of restored habitat constructed in year *t*

B = year in which services are finally recouped

j = year when gains begin

M = year in which services are finally recouped

T = base year

d = discount rate (usually 3 percent)

To perform the HEA calculations for the SFWCFS, Visual_HEA, a free computer software available online, was used (Sylvain et al. 2017, Kohler and Dodge 2006). Visual_HEA is a computer program developed to calculate the amount of required compensation. The program accepts input of parameters necessary to determine long-term service loss from the injury (injured area size and degree; times of injury, functional shape, and equilibrium; post-injury recovery); parameters to determine long-term service gain from compensatory restoration actions (times of restoration beginning and equilibrium; maximum service level; service gain function shape); and general program parameters (relative value of lost and gained services, baseline level of lost and gained services, discount rate).

3.2.1 Visual_HEA Inputs

The input parameters needed to perform a Visual_HEA analysis include the relative value of pre-injury services and compensatory services (this is a ratio), baseline levels of services (expressed as a percent), discount rate, year of claim, service loss parameters from the injury (size of injury site and time history of the loss), and service gain parameters from the compensatory mitigation (duration and levels of services gained).

Subtidal habitats would be converted to hard bottom and filled in beginning in 2035 when construction begins. It is assumed that 100 percent of the 9.0 acres of subtidal habitat are lost in 2035 and the loss would continue in perpetuity. For purposes of this analysis and to be conservative given that the construction sequencing is unknown at this time, the impacts are assumed to occur simultaneously in all impacted areas even though construction will take many years and bay fill will likely occur over multiple years.

Table 3-1. Input Parameters for Visual_HEA

Parameter	Description	Entered Value	Rationale/ Assumptions
Site Name	Name of analysis site, analysis, etc.	San Francisco Waterfront Flood Study	Study Name
Present Year	Year of Analysis. This gives the reference time from which discounted service losses and gains are calculated.	2035	Beginning of construction when the anticipated loss is expected to occur
Number of Injured Area Units	Size of impacted site in spatial units	9.0	Calculated based on feasibility level design and bay fill estimates
Discount Rate (%) per time unit	Amount of discounting to reflect the relative value of present versus future service levels	0.0001%	Discounting is supposed to be 0; however, the software will not allow 0. Sensitivity to changes was run. At 0.001 and 0.00001 the DSUYs changed by hundredths. 0.0001 was selected because it was closest to a whole number.
Baseline level of services	Level of service provided by the injured area prior to injury, expressed as a percentage	50%	The area of injury is currently degraded by the presence of artificial structures which reduces the service level when compared to non-degraded subtidal habitats. See section 3.2.2
Initial compensatory service level	Level of Services provided by the compensatory action area at the onset of the compensation.	Pier Demolition: 50% Piling Removal: 75%	Value is based on whether or not current site is capable of light penetration (i.e. decking present). See section 3.2.2

Parameter	Description	Entered Value	Rationale/ Assumptions
Area and time units		Acres, years	
Service loss display years	Time span of service loss to be displayed on the graphs (and to have as discrete calculation results in the printouts)	2035 - 2135	Planning horizon for the study is 100 years.
Nodes of Service gain and loss		Bay Fill (Injury): Services at 50% in 2034 and 0% at 2035 (continues in perpetuity). Piling Removal (Compensatory): Services at 75% in 2035 and 100% in 2036 (continues in perpetuity). Pier Demolition (Injury and compensatory): Services at 50% in 2035 and 100% in 2037 (continues in perpetuity)	See Assumptions documented in section 3.2.2.

3.2.2 Assumptions

3.2.2.1 Ratio of the Value of Services

The ratio of the value of services of the impacted area versus the mitigation site (after it reaches full services) was 1.0 (i.e. the value of services per acre of subtidal before the impact was equal to the value of the services per acre provided at the mitigation site).

3.2.2.2 Services

Artificial structures such as piers, pilings, bulkheads, mooring areas, and other structures contribute to lower quality subtidal habitat and supports fewer species than natural substrate habitats. Artificial substrates create hard substrates habitats where hard substrate might not have been previously; however, pier pilings provide habitat conditions that differ greatly from natural substrates and have been found to support different assemblages of aquatic biota often dominated by exotic species (Cohen 2008). Pilings can reduce the C:N ratio of adjacent sediments and pier decking or the presence of other materials that cast shade on sediments around the structure can decrease primary productivity and reduce the uptake of water column nutrients (Martinez et al. 2022). Additionally, structures built in the water can alter water flows and patterns of sediment erosion and deposition. All of these changes in environmental conditions have the potential to interfere with important functions of soft bottom ecosystems such as benthic community respiration, primary productivity, and sediment-water nutrient cycling.

Conversely, studies have shown that pilings and other artificial structures provide some habitat for invertebrates, roosts for birds, and spawning areas for herring. Studies have not quantified the extent to which animals benefit from or depend on hard substrates. (SFEI 2010)

When taking into consideration the adverse and beneficial impacts of the artificial structures on subtidal habitat, the amount of light penetration was the driver for determining the amount of service life the injured or compensation site provided. For purposes of this analysis, the following were assumed:

- All sites provided a minimum of 50% of that of a natural, unaltered subtidal environment in San Francisco Bay.
- For sites with overwater decking that precluded light penetration or provided significant shading, the service life was assumed to remain at 50%.
- For areas where only the pilings remained, the service life was assumed to increase to 75% due to an increase in the availability of light that influences sediment fluxes and nutrient cycling. Locations with pilings but no overwater decking are assumed to not reach 100% due to the structure presence and the modified water flows and currents that remain.

- Locations with no artificial structures present are assumed to achieve 100% service life.

The length of time it takes for the compensatory action to reach maximum level of service (100%) was again dependent on how much light is present pre-restoration. For pier removal, it is assumed that the site will reach full service life after 2 years. This assumes that it will take one year for the hydrology to rework the sediments and for light to restore nutrient cycling more similar to adjacent non-modified subtidal habitats. After one year, it is assumed that the benthic organism and primary producers will begin to recolonize the area and reach comparable conditions to non-modified subtidal habitats. For pile removal, it is assumed that the sediments are not as degraded as the pier removal and thus will take less time stabilize under the new hydrologic conditions and recolonize with benthic organisms and primary producers.

3.3 Results

The Visual_HEA model was run to determine the total discounted service unit years (DSUY) of the bay fill (injured site) and two potential compensatory sites including pile removal and pier removal. For each 1.0 acre of bay fill a total of 500,000 DSAY (denoted as DSUY in the figures) are lost (Figure 3-2 and Table 3-2), which totals 4,500,000 DSAY lost for the 9.0 acres of bay fill associated with implementing the Independent Measures at 2A and 2B.

The TNBP also includes 1.0 acre of pier removal as one of the project features that need to be accounted for when determining the mitigation need. HEA was used to calculate the benefit of pier removal and is shown as DSAY of units gained. One acre of pier removal results in a gain of 499,999 DSAY of subtidal habitat (Figure 3-2, and Table 3-2). As a result, the total mitigation need for the project is 4,000,001 DSAY (i.e. 4,500,000 DSAY [bay fill, permanent loss] – 499,999 DSAY [pier removal, permanent gain] = 4,000,001 DSAY mitigation need).

To compensate for the loss DSAY of subtidal habitat, 1.0 acre of pier removal (Figure 3-2) or 1.67 acres of pile removal (Figure 3-3) would be needed. A total of 8.0 acres of pier removal would be needed if pier removal is the only form of compensation to compensate for the 4,000,001 DSAY mitigation need. A total of 15.0 acres of pile removal would be needed if pile removal is the only form of compensation to compensate for the 4,000,001 DSAY mitigation need.

Table 3-2. HEA Results

Injury/Restoration	DSAY/ac	Injured Units: Replacement Habitat Size
Bay Fill	500,000	--
Pier Removal	499,999	1:1
Pile Removal	299,999	1:1.67

Figure 3-2. Loss of Services Associated with 1.0 Acre of Bay Fill and Gains Associated with 1.0 Acre of Pier Removal

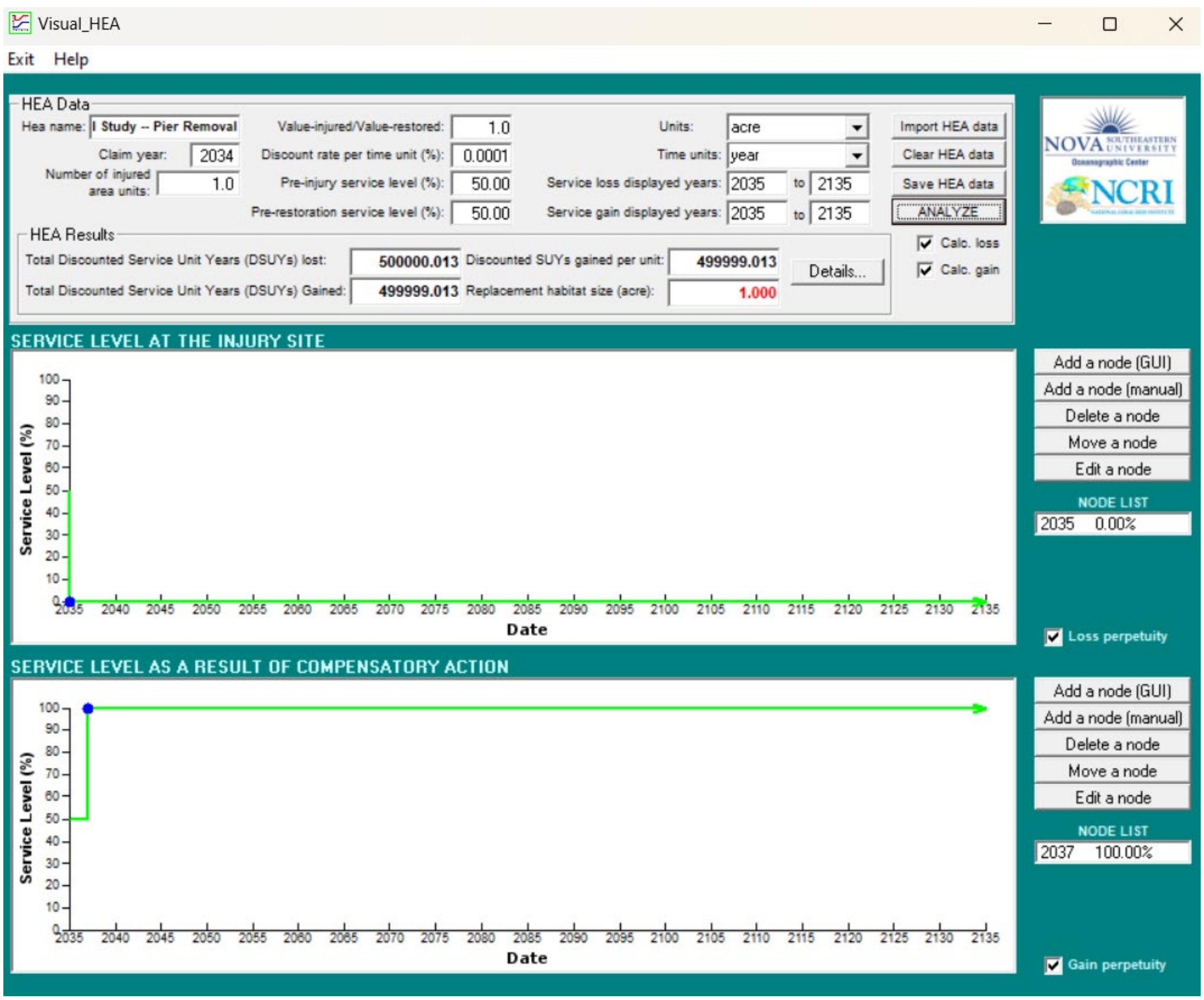
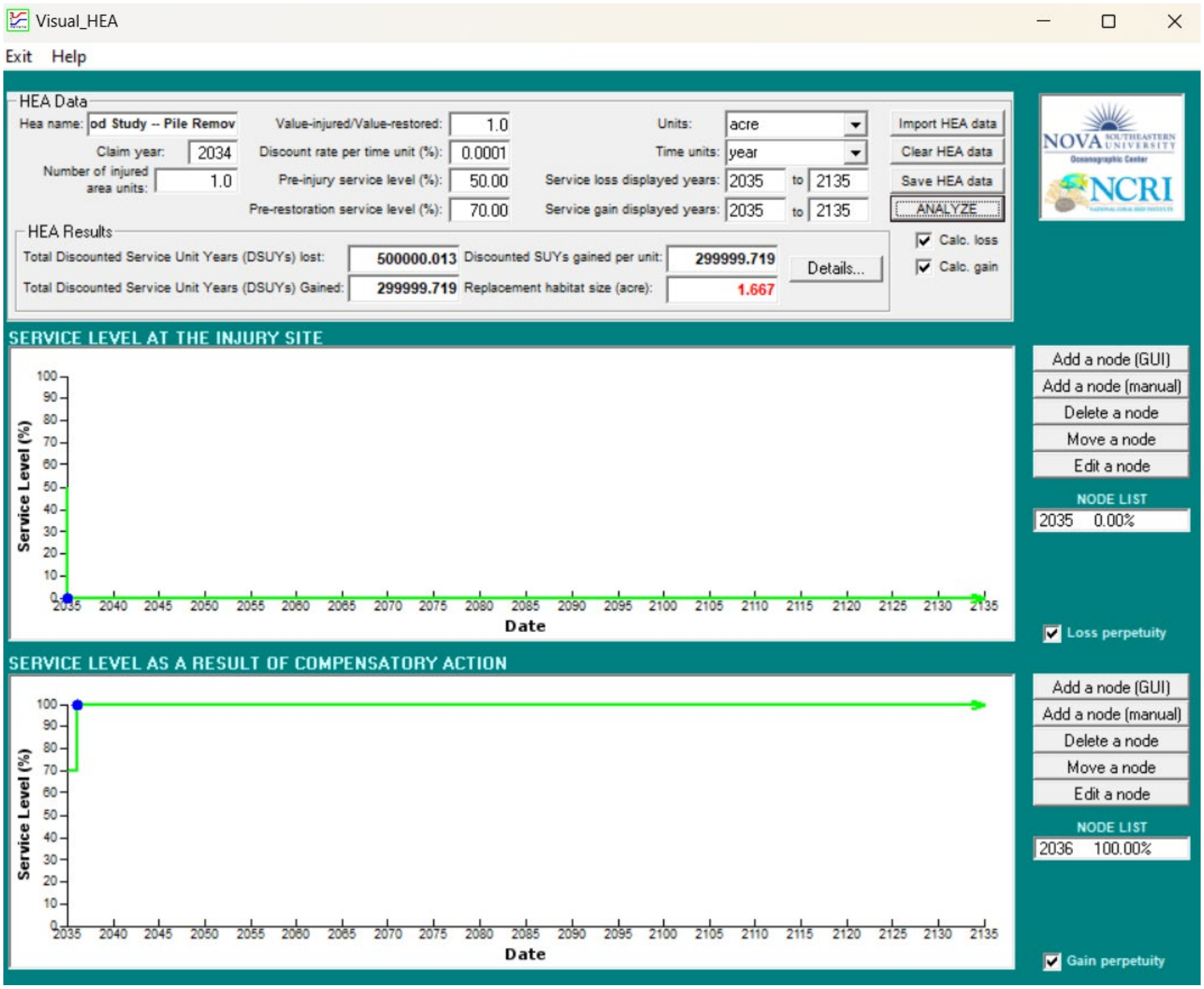


Figure 3-3. Loss of Services Associated with 1.0 Acre of Bay Fill and Gains Associated with 1.0 Acre of Pile Removal



4.0 Conclusion

A total of 4,000,001 DSAY of subtidal habitat is lost and require compensatory mitigation as a result of 9.0 acres of bay fill associated with construction of the Independent Measures (injury) and 1.0 acre of pier removal associated with construction of the TNBP. One acre of pier removal would compensate for 499,999 DSAY, while one acre of pile removal would compensate for 299,999 DSUY.

5.0 References

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Attachment 1: Detailed Maps of TNBP Features

Figure Attachment 1-5-1. TNBP Reach 1 (First Action)

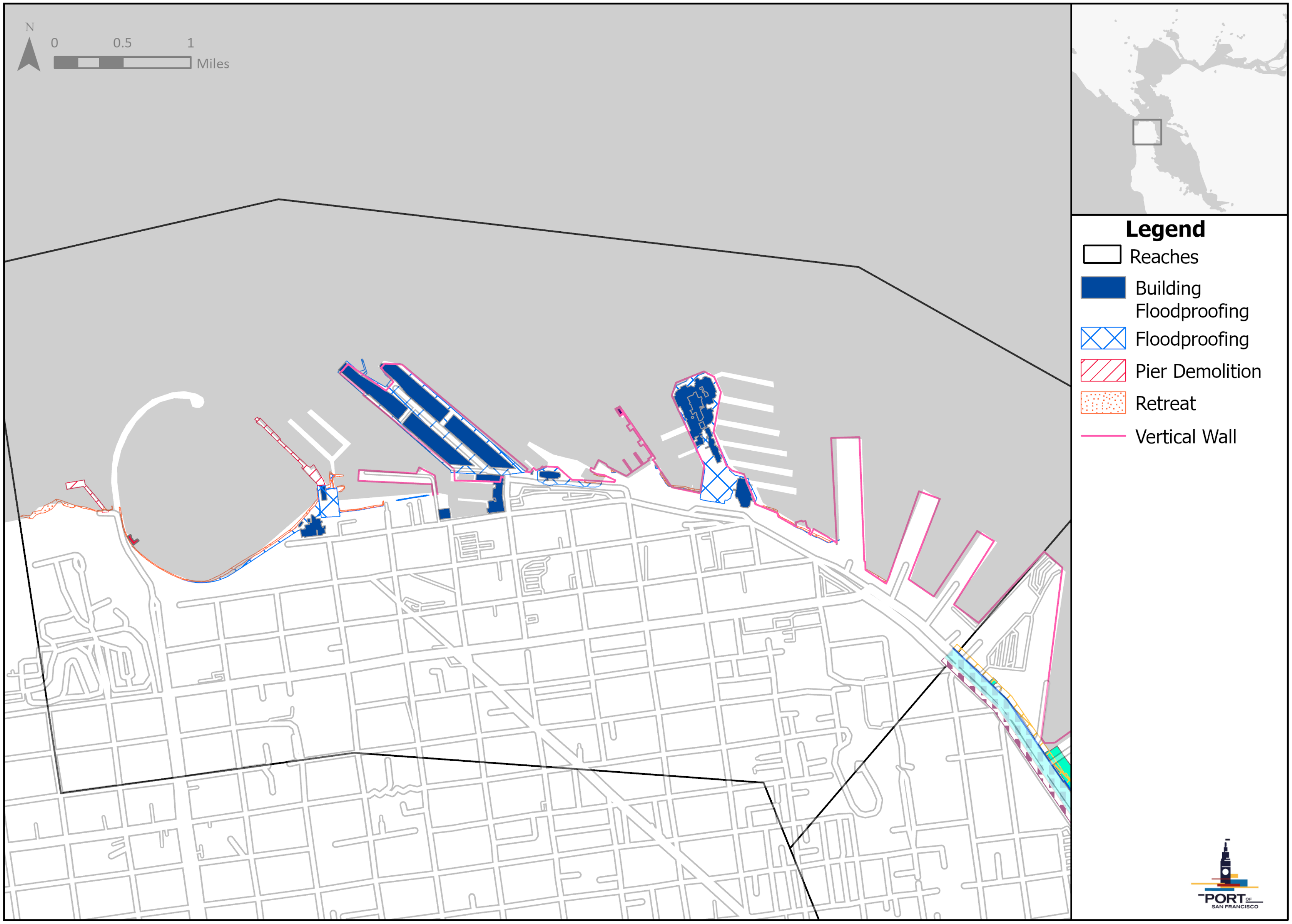

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Figure Attachment 1-5-2. TNBP Reach 2 (First Action)

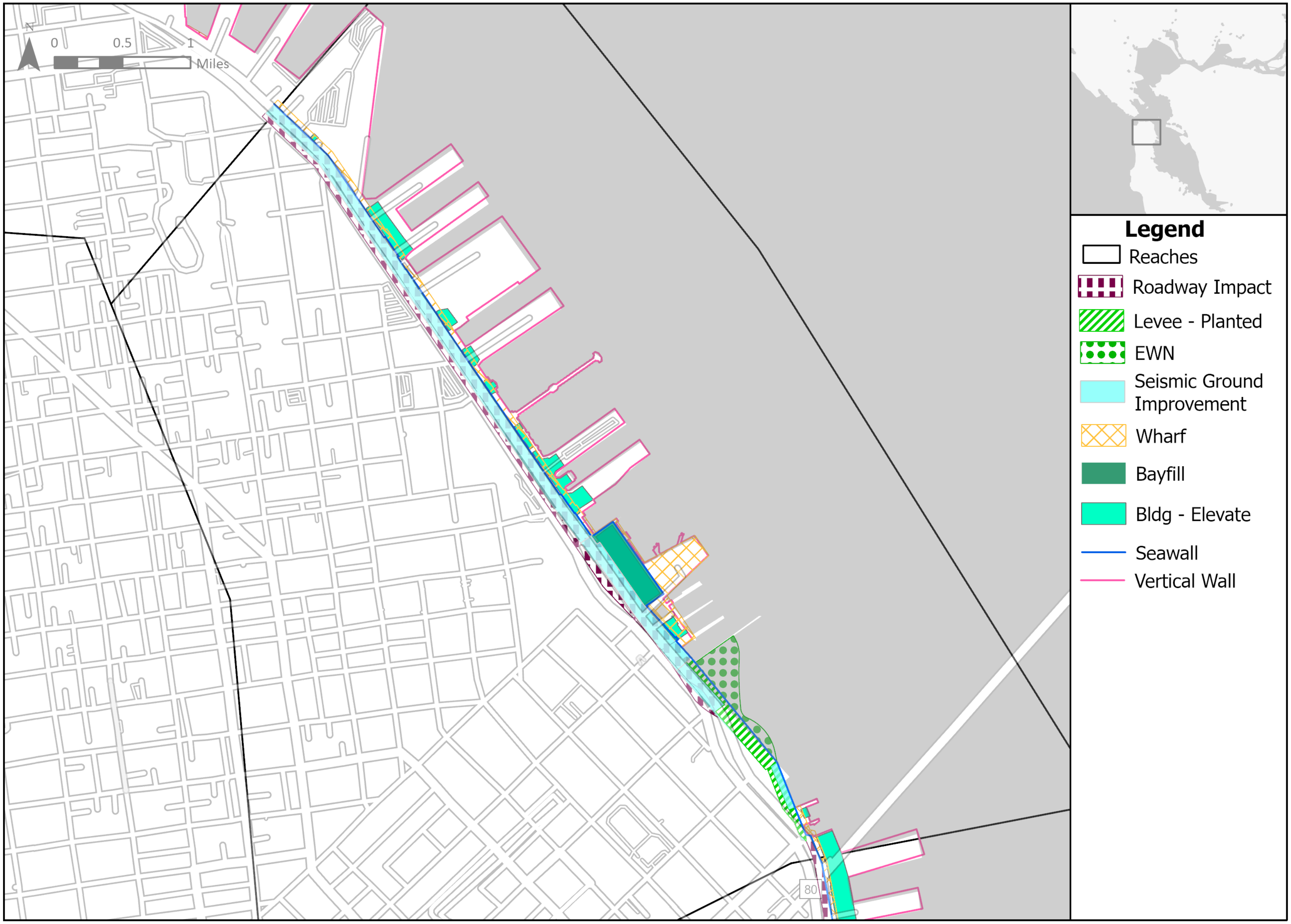

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Figure Attachment 1-5-3: TNBP Reach 3 (First Action)

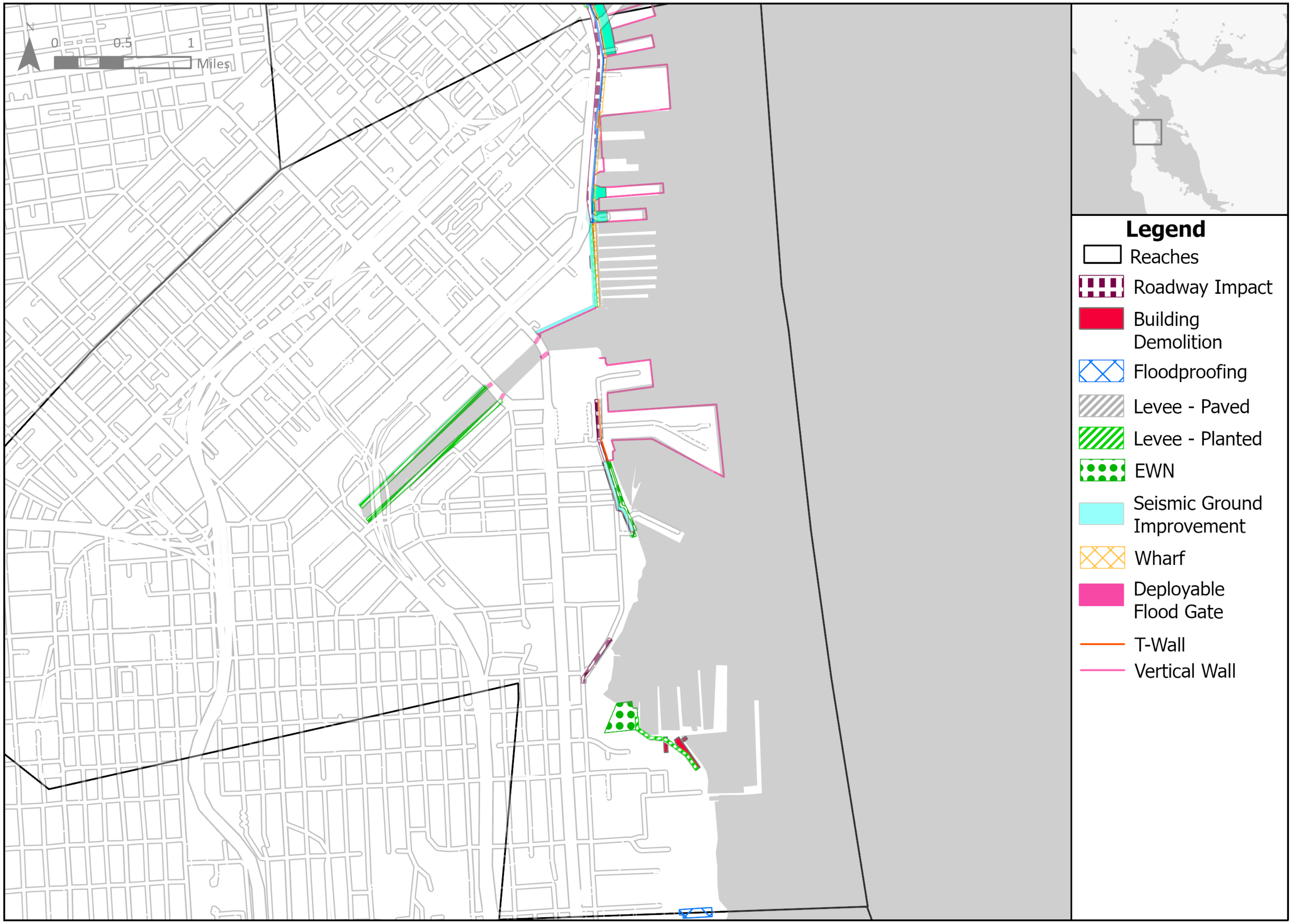

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Figure Attachment 1-5-4. TNBP Reach 4 (First Action)

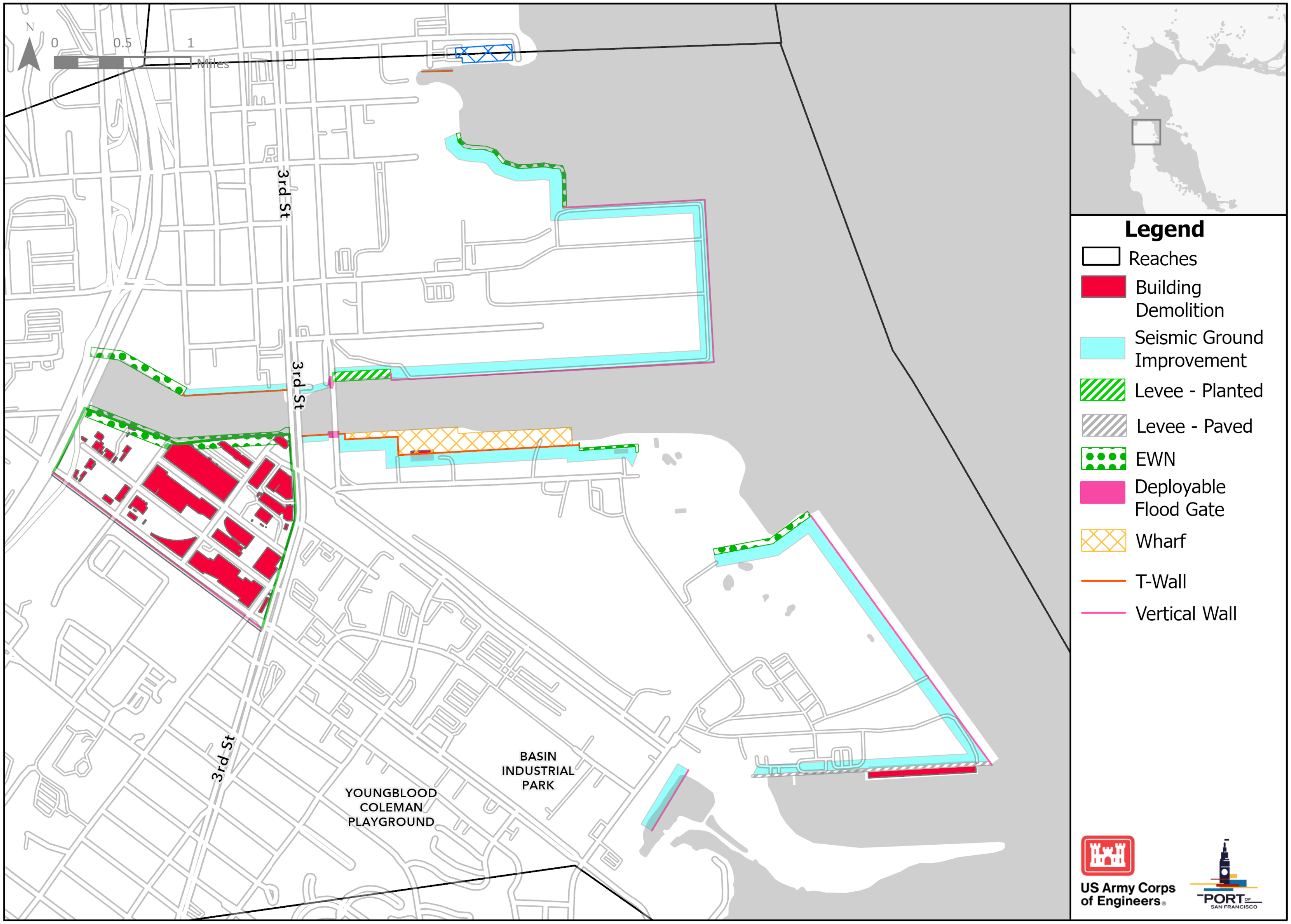

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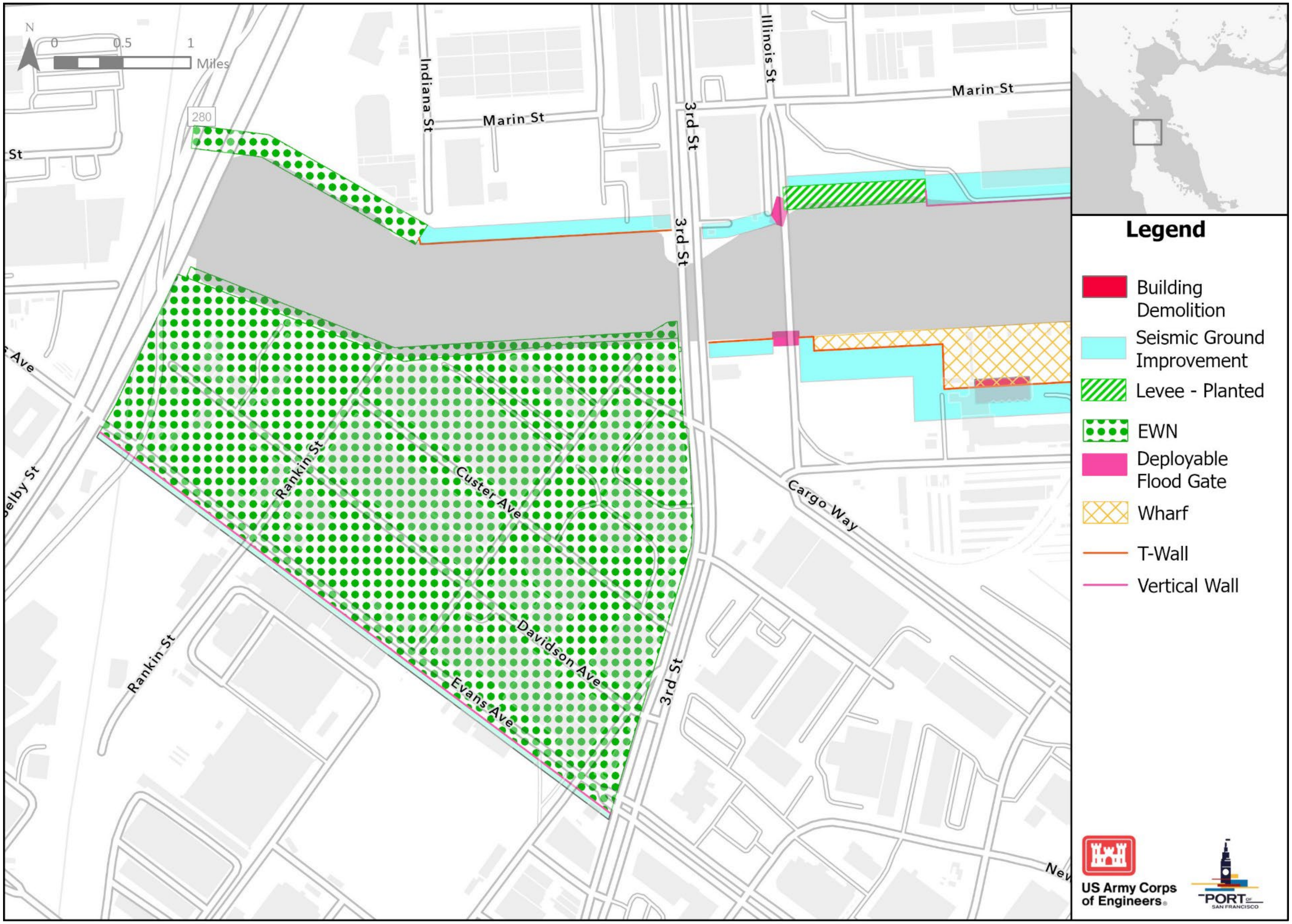
Figure Attachment 1-5-5. Close Up of TNBP with Independent Measure 4A, Reach 4 (First Action)



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Attachment 2: HEA Output Files

SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY, CA

APPENDIX D-1-6 HAZARDOUS, TOXIC AND RADIOACTIVE WASTE

JANUARY 2024

USACE TULSA DISTRICT | THE PORT OF SAN FRANCISCO

US Army Corps of Engineers

PORT OF SAN FRANCISCO

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1.0 Affected Environment

The following sections describe the Federal and State regulatory setting for hazardous, toxic, and radioactive waste in the study area.

1.1 Regulatory Setting

1.1.1 Federal

The Federal agencies that act to regulate hazardous, toxic, and radioactive waste include the United States Environmental Protection Agency (USEPA), the Occupational Safety and Health Administration (OSHA), the Nuclear Regulatory Commission (NRC), the U.S. Department of Transportation (USDOT), and the Department of Health and Human Services. At the Federal level, the Resource Conservation and Recovery Act (RCRA), provides the regulatory framework for the USEPA to regulate waste management including the generation, transport, and disposal of hazardous substances. The USEPA regulates hazardous substance sites under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA provides the USEPA a means to regulate hazardous substances through the Federal regulations contained primarily in Titles 29, 40, and 49 of the Code of Federal Regulations (CFR). The primary Federal laws and guidelines governing hazardous substances are summarized below.

1.1.1.1 Pollution Prevention Act (42 USC 13101 et seq.)

The Pollution Prevention Act focuses on reducing the amount of hazardous substances, through cost-effective changes in production, operation, and raw materials use. Opportunities for source reduction are often not realized because existing regulations, and the industrial resources required for compliance, focus on treatment and disposal. Source reduction is fundamentally different and more desirable than waste management or pollution control.

Pollution prevention includes practices that increase efficiency in the use of energy, water, or other natural resources, and protects the U.S. resource base through conservation.

1.1.1.2 Clean Water Act Section 311

The Clean Water Act (CWA) regulates the discharge of oil and other hazardous substances into surface waters of the United States including lakes, rivers, streams, wetlands, and coastal areas. Regulation of the CWA is through the Environmental Protection Agency.

1.1.1.3 Occupational Safety and Health Act (29 USC 651 et seq./29 CFR Part 1910)

OSHA provides the regulatory guidance to ensure that employers implement occupational health and safety standards that provide their workers with a safe work environment that is free of recognized hazards such as exposure to toxic chemicals, or other hazards that could cause serious physical harm. The California Occupational Safety and Health Administration (Cal/OSHA) is the agency responsible for administering this Federal act.

1.1.1.4 Comprehensive Environmental Response, Compensation, and Liability Act 42 USC 9601 et seq./40 CFR Part 300)

CERCLA, commonly referred to as Superfund, provides for liability of owners and operators of contaminated sites responsible for releases of hazardous waste at a given site, establishes prohibitions and requirements concerning closed and abandoned hazardous waste sites, and establishes a trust fund for cleanup when a responsible party cannot be identified. Section 105(a)(8)(B) of CERCLA implements a Hazard Ranking System (HRS) to screen which contaminated sites are placed on the National Priorities List (NPL), and subsequently eligible for remedial action. The USEPA is the responsible agency for administering CERCLA.

The Superfund Amendments and Reauthorization Act (SARA) amended CERCLA on October 17, 1986. SARA emphasizes the importance of permanent remedies and innovative treatment technologies in cleaning up hazardous waste sites, requires Superfund actions to consider the standards and requirements found in other Federal and State environmental laws and regulations, provides new enforcement authorities and settlement tools, increases state involvement in every phase of the Superfund program, increases the focus on human health problems posed by hazardous waste sites, encourages greater citizen participation in making decisions on how sites should be cleaned up, and increases the size of the Superfund trust fund to $8.5 billion.

SARA also requires USEPA to revise the hazard-ranking system so that it accurately assesses the relative degree of risk to human health and the environment posed by uncontrolled hazardous waste sites that may be placed on the NPL.

1.1.1.5 Resource Conservation and Recovery Act (42 USC 6901 et seq./40 CFR Part 261-265)

RCRA is a Federal statute that provides authority to the USEPA to control hazardous waste from “cradle to grave”. This includes the generation, transportation, treatment, storage, and disposal of hazardous waste. Although hazardous waste is regulated by USEPA through RCRA, under Subtitle C, USEPA authorizes the State of California to enforce RCRA provisions. RCRA Subtitle C sets criteria for hazardous waste generators, transporters, and treatment, storage and disposal facilities, including permitting requirements, enforcement and corrective action or cleanup. The primary authority enforcing the RCRA hazardous waste requirements in California is the California State Department of Toxic Substances Control (DTSC).

1.1.1.6 Toxic Substances Control Act (15 USC 2601 et seq./40 CFR Parts 700-799)

The Toxic Substances Control Act (TSCA) of 1976 provides USEPA with authority to require reporting, record-keeping and testing requirements, and restrictions relating to chemical substances and/or mixtures. TSCA addresses the production, importation, use, and disposal of specific chemicals including polychlorinated biphenyls (PCBs), asbestos, radon and lead-based paint. In 1978, TSCA specifically banned the manufacture, processing, or distribution of any PCBs other than in a totally enclosed manner (15 USC 2605). Although DTSC is a lead regulatory agency for site cleanups in California, engagement with the USEPA is required when addressing PCB-contaminated sites (40 CFR Part 761).

1.1.2 Local Bay Protection and Toxic Cleanup Program Legislation of 1989

The California State Legislature established the Bay Protection Toxic Cleanup Program (BPTCP) in 1989 to comply with the California Water Code, Division 7, Chapter 5.6, Sections 13390-13396.5. The goals of the BPTCP related to hazardous, toxic, and radioactive waste include:

- Protect existing and future beneficial uses of bay and estuarine waters.
- Identify and characterize toxic hot spots
- Plan for the prevention and control of further pollution at toxic hot spots
- Develop plans for remedial actions of existing toxic hot spots and prevent the creation of new toxic hot spots.

The BPTCP is a comprehensive effort led by the State Water Resources Control Board (SWRCB) to programmatically link environmental monitoring and remediation planning. The BPTCP efforts and main activities related to hazardous, toxic, and radioactive waste include the following:

- Development and implementation of regional monitoring programs designed to identify toxic hot spots. These monitoring programs include analysis for a variety of chemicals, toxicity tests, measurements of biological communities, and various special studies to support the program.
- Development of a consolidated database that contains information pertinent to describing and managing toxic hot spots.
- Preparation of criteria to rank toxic hot spots that are based on the severity of water and sediment quality impacts.
- Development of Regional and Statewide Toxic Hot Spot Cleanup Plans that include identification and priority ranking of toxic hot spots, identification of pollutant sources, identification of actions already initiated, strategies for preventing formation of new toxic hot spots, and cost estimates for recommended remedial actions.

1.1.3 USACE HTRW Regulations

ER 1165-2-132 governs USACE activities in water resources projects. ER 1165-2-132 defines Hazardous, Toxic and Radioactive Wastes (HTRW) as follows:

> (1) Except for dredged material and sediments beneath navigable waters proposed for dredging, for purposes of this guidance, HTRW includes any material listed as a "hazardous substance" under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601 et seq (CERCLA). (See 42 U.S.C. 9601(14).) Hazardous substances regulated under CERCLA include "hazardous wastes" under Sec. 3001 of the Resource Conservation and Recovery Act, 42 U.S.C. 6921 et seq; "hazardous substances" identified under Section 311 of the Clean Air Act, 33 U.S.C. 1321, "toxic pollutants" designated under Section 307 of the Clean Water Act, 33 U.S.C. 1317, "hazardous air pollutants" designated under Section 112 of the Clean Air Act, 42 U.S.C. 7412; and "imminently hazardous chemical substances or mixtures" on which EPA has taken action under Section 7 of the Toxic Substance Control Act, 15 U.S.C. 2606; these do not include petroleum or natural gas unless already included in the above categories. (See 42 U.S.C. 9601(14).)

ER 1165-2-132 sets forth policy guidelines related to investigation and treatment and handling of HTRW:

> Civil Works project funds are not to be employed for HTRW related activities except as provided herein, or otherwise specifically provided in law.
>
> Construction of Civil Works projects in HTRW-contaminated area should be avoided where practicable.
>
> Where HTRW contaminated areas or impacts cannot be avoided, response actions must be acceptable to EPA and applicable state regulatory agencies.
>
> For cost-shared projects, the local sponsor shall be responsible for ensuring that the development and execution of Federal, state, and/or locally required HTRW response actions are accomplished at 100 percent non-project cost. No cost sharing credit will be given for the cost of response actions.
>
> During the Feasibility Phase, alternative project plans may consider avoidance of HTRW as well as possible responses. At least one alternative plan should be formulated to avoid HTRW sites to the maximum extent possible, consistent with project objectives. These assessments, conducted during the feasibility stage, are shared with the local sponsor for cost-shared studies.

1.2 Existing Conditions

The existing conditions for hazardous, toxic, and radioactive waste is described below. The study area for hazardous, toxic, and radioactive waste in this EIS is the Project footprint. A records search was performed to identify the hazardous sites, toxic waste sites, or radioactive waste sites in the Project footprint. The sites identified include locations where releases of hazardous substances or petroleum products have occurred into the soil, groundwater, or surface water. This section addresses potential contaminants in the soil.

The evaluation included Federal, state, and local databases to identify sites where the presence of hazardous, toxic, or radioactive waste has been previously documented. No environmental sampling of soil or groundwater was performed as part of this evaluation. The results of the records search identified over 157 potential environmental contamination sites within the study area. Of the potential sites identified, approximately 61 are located within the project area with known impacts to the soil or groundwater due to hazardous substances.

For the sites located within the study area, additional information was obtained from the EnviroStor and GeoTracker databases maintained by DTSC and SWRCB respectively for the purpose of determining potential impacts from these sites in relation to potential future construction activities. The potential for these sites to impact the construction activities was determined based on the presence of suspected soil and/or groundwater contamination, mobility within the soil-groundwater-air matrix, and the potential for construction activities to affect the contaminated media. As a result of the screening of the sites, 18 sites were identified within the Project footprint with the potential to impact the future construction activities. These sites are listed below in Table 1-1 and shown on Figure 1. An additional 34 Leaking Underground Storage Tank (LUST) Sites that have received regulatory closure were identified within the project footprint. Although these LUST sites have received regulatory closure, there is potential for waste/contamination to remain in the soil and groundwater that may require special management and disposal related to future construction activities.

Table 1: Hazardous Materials Release Listings for San Francisco Waterfront Flood Resiliency Study

Department of Toxic Substances Control Sites					
Map ID	**Site Name/ Address**	**EnviroStor ID or Global ID**	**Program Type**	**Status**	**Description**
1	Site K (Sea Wall Lot 333), 1-59 &	38750002	State Response	Certified O&M – Land	Site K is located at 1 through 59 1/2 Townsend Street in San Francisco and is

	1/2 Townsend Street			Use Restrictions Only	owned by the San Francisco Redevelopment Agency. The site was underwater during the 1800's but filled with soil and construction debris by 1913. Previous site occupants included a paint warehouse, ship service companies, and a forklift service company. Approved RA. The removal activities at the site consisted of excavation and bioremediation of soil containing petroleum cap. Approximately 246 cubic yards of petroleum hydrocarbon contaminated soil were biotreated on an asphalt paved lot and subsequently used as backfill. The cap covers all portions of the property and consists of a layer of 10 mils Visqueen plastic and a 4-inch-thick concrete slab. A 3-story residential building and 1-story at-grade parking lot has been constructed on site. Approved PEA. Documented fuel leaks at the site impacted the soil and groundwater. DTSC approved a hazardous waste management plan on May 6, 1991. Recorded Deed Restriction. Certified Site. Site Screening noted 5 underground tanks removed. hydrocarbons above 1,000 mg/kg and the placement of a concrete slab.
2	PG&E Former Beach Street Manufactured Gas Plant 250 Beach Street		Voluntary Cleanup	Active	The former Beach Street manufactured gas plant (MGP) site is in what is known as the Fisherman's Wharf area of San Francisco. The site occupies the city block bounded by Beach Street, Mason Street, Jefferson Street, and Powell Street. Gas plant operations were conducted on-site from about 1899 until about 1931. The MGP was not significantly damaged by the 1906 earthquake and fire. PG&E purchased the property in 1911 and operated the MGP until around 1931, when usage of manufactured gas in San Francisco was replaced by natural gas. The gas holders from the MGP were used for natural gas storage until 1956-1957, at which point PG&E sold the property. The site was subsequently redeveloped for commercial use. Groundwater monitoring is ongoing with additional groundwater monitoring well installation planned for fourth quarter 2019 and first quarter 2020. (JT August 14, 2019).
3	Pier 39 Marina Sediment	60001256	Cleanup Program	Open - Remediation	Pier 39 is owned by the Port of San Francisco (the Port). Pier 39 periodically

			Site		needs to be dredged to maintain vessel navigation depths. Polycyclic aromatic hydrocarbons (PAHs) have been detected in Pier 39 marina sediment. The concentrations and proportions of individual PAH compounds are consistent with manufactured gas plant (MGP) residues. The suspected source of PAHs, the former Beach Street MGP and upland area, is located about 100 feet south of Piers 41 and 43 and is overseen by the Department of Toxic Substances Control (DTSC) (Envirostor Number 60001256). PG&E is addressing the MGP residues in sediment. The final Remedial Investigation Report was submitted in January 2020. MGP impacts to sediment extend from Pier 39 East Basin Marina (inclusive) on the east to Pier 45 (exclusive) on the west. A draft feasibility study and remedial action plan (FS/RAP) was circulated for public comment during fall 2021. The next steps include addressing the comments, finalizing the FS/RAP, and issuance of a site cleanup requirements order.
4	Mission Bay - PIER 64/MISSION BAY Redevelopment Center	SL18397817	Cleanup Program Site	Open - Verification Monitoring	Former bulk petroleum facilities were located along and near 16th Street that were supplied by petroleum pipelines. On the eastern terminus of 16th Street, a marine terminal was used to transfer petroleum fuels via pipelines. The former bulk fuel storage facility was previously operated by Associated Oil, Tidewater Oil, and Phillips Petroleum on the northeast corner of 16th Street and Illinois Street. On the southeast corner of 16th Street and Illinois Street, Union Oil Company operated a former bulk fuel storage facility. Potential contaminants of concern at this site include metals/heavy metals, petroleum/fuels/oils, and PAHs. Diesel, Gasoline, Heating Oil / Fuel Oil, Lead, Asbestos. A May 21, 1999, Risk Management Plan (RMP) was approved by the Regional Water Board for the 300-acre Mission Bay Redevelopment Area. The RMP describes risk management procedures prior to development, during development, and after development. The purpose of the procedures is to protect people from exposure to poor quality fill materials and lower-level, widespread environmental pollution that could not be feasibly cleaned up. On March 21, 2000,

					a covenant and environmental restriction ("deed restriction") on the property was executed. The deed restriction obligates future landowners to comply with the RMP. Prior to 1906, the Development Project Area was part of the San Francisco Bay. In 1906, the land was created by filling in the marshlands and shallow tidal flats at the San Francisco Bay margin with serpentine rock and soils from the nearby Potrero Hill. Serpentine is a type of ultramafic rock that commonly contains naturally occurring asbestos. An 8-acre area near the vicinity of former Pier 64 was remediated in 2005 to remove separate-phase petroleum pursuant to Board Site Cleanup Order No. R2-2005-0028.
5	Pier 70, Crane Cove Park, Upland And Sediment		Cleanup Program Area	Open - Verification Monitoring	Crane Cove Park is a portion of the Port of San Francisco's Pier 70 property. In 2002, there was a release of polychlorinated biphenyls (PCB) transformer oil, and the Port initiated an emergency clean up response. Remedial activities for the PCBs were overseen by US EPA in accordance with TSCA. Concentrations of PCBs in soil remain at approximately 10 feet below surface. Sediment data adjacent to Crane Cove Park identified concentrations of metals, petroleum hydrocarbons, polyaromatic hydrocarbons (PAHs), PCBs, and dioxins and furans. The sediments were capped in 2020, and the Port is currently conducting bathymetric annual cap inspections to verify its presence.
6	8 22nd (Pier 70), 8 22nd Street,	T10000016753	LUST Cleanup Site	Open - Assessment & Interim Remedial Action	This 12,000-gallon Leaking Underground Storage Tank (LUST) site was identified on May 25, 2020. Historical records from 1945 indicate that the tank was formerly connected to a boiler system used by Bethlehem Steel Company. The LUST was removed in July 20 to July 22, 2020. The SWRCB indicates that the groundwater is impacted by total petroleum hydrocarbons (TPH).
7	Islais Creek			Unknown	The western portion of Islais Creek (west of the 3rd Street Bridge) was designated as “toxic hot spot” by RWQCB in 1999 due to elevated concentrations of metals, PAHs, PCBs, and pesticides in sediment and observed toxicity to aquatic organisms in toxicity tests. Sediment samples

					from the eastern portion of Islais Creek, from 3rd Street Bridge to the Bay, contained lesser concentrations of COCs, so the site was not designated a toxic hot spot. Discharges from four combined sewer overflows and a wastewater outfall to the creek are the primary sources of contaminants to Islais Creek (RWQCB 1999). This site is under water today.
8	PG&E Potrero, 1201 Illinois Street	38490009	Cleanup Program Site	Open Verification Monitoring	The former Potrero Power Plant site occupies 34 acres. The site has been used for industrial activities since the mid-1800s. Historical uses have included the manufacture and repair of ships, metal foundries, refining of sugar, and making of barrels. A manufactured gas plant (MGP) operated in the northern portion of the site from the 1870s to 1930. The area of the site associated with the electric generating Potrero Power Plant was constructed in the 1910s and was closed in March 2011. Potential contaminants of concern identified in the soil and/or groundwater include 1,1,1-trichloroethane (TCA), arsenic, asbestos - NOA, dichloroethane, (DCA),dichloroethene (DCE), lead, PAHs, tetrachloroethylene (PCE), trichloroethylene (TCE), and vinyl chloride. There are Deed Restrictions in place for this site specifying the type of approved development and uses.
9	Transbay Cable - SF Converter Station	SL0607510024	Cleanup Program Site	Case Closed	Since the 1870s, the site has been used for sugar refining, bulk petroleum storage, and various mixed industrial and warehousing operations. Remedial activities were performed at the site in 2008. The site is subject to a Deed Restriction related to subsurface soil that may contain residual concentrations of TPHs, PAHs, and metals. The site is currently occupied by Transbay Cable for use as an electric convertor station.
10	Western Pacific Railroad Yard, 25th and Illinois Streets	38400001	Historical	Refer SWRCB	A MGP operated on the northeast portion of the site from 1872 until 1930. The MGP was dismantled in the early 1960's and consisted of gas holders, purifiers, lampblack separators and pits, generator houses, tar storage facilities, retort houses and several aboveground storage tanks. From the 1950's until 1999, PG&E owned and operated a power plant at the site. The power plant property was sold

					to Southern Energy Potrero LLC (now "Mirant Potrero LLC"). Subsurface soil may contain residual concentrations of Arsenic, halogenated solvents, hydrocarbon solvents, lead, and unspecified solvent mixtures.
11	SF Electric Reliability Project	SL0607583505	Cleanup Program Site	Open - Inactive	The site was formerly used by Western Pacific Railroad as a switchyard for rail cars. The soil and groundwater at the site are contaminated with inorganic and organic chemicals including lead, arsenic, chromium, cobalt, PAHs, and volatile organic compounds (VOCs). The contamination may have been caused by previous operations and/or by the nature of artificial fill material, composed of crushed bedrock building debris, sand, and other typical fill material. The case remains open but inactive. Deed restrictions at this site prohibit disturbing the remedy and monitoring system that is in place. Additional restrictions limit the types of permitted uses at the site.
12	CCSF - Pier 80, 0 Cesar Chavez St/Pier 80 San Francisco, CA 94124	T0607500270	LUST Cleanup Site	Open - Eligible for Closure	This site was associated with a former vehicle maintenance facility. Two USTs were located at this site, a 2,000-gallon gasoline tank and a 10,000-gallon diesel tank. These USTs were removed in 1987. During the UST removal, the diesel tank was discovered to be leaking which had impacted the soil and groundwater. After remedial activities in 2012 and follow-up sampling of the soil and groundwater, the site is pending closure approval by the SWRCB.
13	Islais Creek Area, Pier 90, BTW Cargo WY & Amador Street Near Pier 94 & 92	38490005	Cleanup Program Site	Open – Remediation as of 3/1/2022	This location is reported by DTSC as a Special Program RCRA 312 – Past Hazardous Waste Disposal Inventory Site. The project property is on Pier 90 located along the south side of Islais Creek Channel, at the northeast intersection of Amador and Illinois streets and Cargo Way. The site is a former Exxon Mobil bulk oil facility with prior operations by Texaco and General Petroleum Corporation. The area was used for oil storage and transport from at least 1924 to sometime between 1975 and 1989. Multiple large above ground storage tanks and the associated piping were located on the property. The tanks had been removed by 1989. Review additional site characterization

					letter describes the Installation of six monitoring wells. The utility corridors may act as preferential pathways for contaminant migration. Contaminants: Arsenic, copper, diesel, gasoline, lead, nickel, total petroleum hydrocarbons, Waste oil / motor / hydraulic / lubricating, zinc.
14	SF Energy Company Cogeneration Project Seawall Lot 344	38490011	Voluntary Cleanup	Not reported	The site is a proposed cogeneration facility in San Francisco's Hunter's Point neighborhood. Analytical results of soil samples contain lead up to 2,000 ppm, TPH and low levels of pesticides, PAHs, and PCBs in the fill material. Currently, the site is essentially an open field which has been used for construction material storage. The site is currently fenced, restricting access. A Removal Action Workplan requires that the site be capped with a combination of asphalt, concrete, and clean fill material.
15	Pier 94 Fill Site	L10008948177	Land Disposal Site	Open - Closing/with Monitoring	In 1961, the Port initiated construction of what was intended to be a marine terminal in the area now designated as Piers 94 and 96 by placing fill material, primarily clean soil, rock, dredged material, and construction debris behind a perimeter debris dike. Future development at the site would require a Site Mitigation Plan (SMP) to outline proper soil and groundwater handling procedures and appropriate site capping requirements to mitigate human and ecological exposure to the hazardous materials identified during the site investigation. Previous investigations identified soil impacted by metals and base/neutral compounds, and groundwater with TPH diesel range (TPH-d).
16	Pier 98 Fill Site	L10006608309	Land Disposal Site	Open	Heron’s Head Park (the Site) is an approximately 26 acre park built on a peninsula of land jutting into India Basin in southeast San Francisco. Owned by the Port of San Francisco, this park began its life as “Pier 98” land comprised of fill placed in San Francisco Bay to construct a container terminal in the early 1970s. Toxicity tests on groundwater and soil found no significant potential for the site to impact water quality. A Geosynthetic Clay Liner (GCL) has been constructed over portions of the landfill to minimize

					potential for leachate generation in a portion of the Site where organic material had been placed along with inert fill material. In July 2009, a Post-Closure Land Use Plan (PLUP) for the former Pier 98 landfill was completed describing the Port's maintenance and monitoring program for the former landfill area, including landfill cover (vegetated cover), drainage, settlement, ponding and erosion.
17	Pier 70 Fill Site	L10007414613	Land Disposal Site	Open	The SWRCB indicated no specific contaminants of concern at this municipal solid waste landfill. No additional site history provided by the SWRCB.
18	PG & E Hunters Point, 1000 Evans Ave Hunters Point Power Plant	38490002	Voluntary Cleanup	Certified O&M – Land Use Restrictions Only	The 38 acre site was used for ship and barge building in the early 1900s. The original power generation plant was constructed on the site in the 1920s and utilized fuel oil. The Plant was shut down on May 15, 2006. The soil and/or groundwater at this site are contaminated with hazardous substances, including TPH, PAHs, metals, and PCBs. Much of the site contains fill material derived from local serpentine rock which contains NOA and the metals, nickel, chromium and cobalt. This site has a cap and the cap should not be disturbed.

Source: California Department of Toxic Substances Control (DTSC). 2022. Envirostor website (https://www.envirostor.dtsc.ca.gov/public/). Accessed December 2022; SWRCB. 2022. GeoTracker website (https://geotracker.waterboards.ca.gov/). Accessed December 2022.

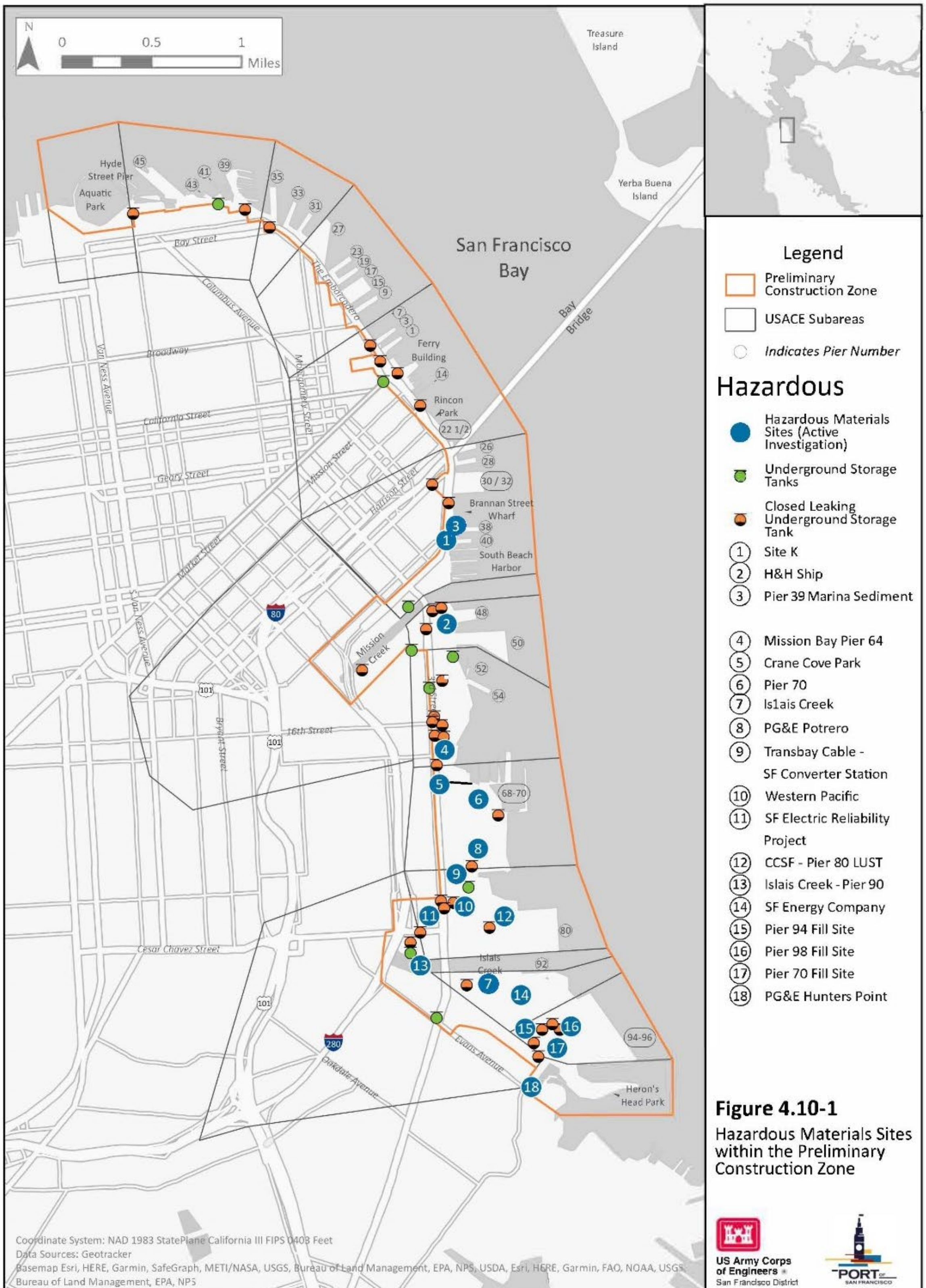
Of the 18 hazardous materials release listings, two are further described below based on the higher potential to impact future construction activities.

Port of San Francisco, Pier 70. Most of Pier 70 is listed on the National Register of Historic Places as the Union Iron Works Historic District and is home to the headquarters for both Union Iron Works and Bethlehem Steel. Pier 70 has been the home of shipbuilding and repair operations from the time of the Spanish American War in 1898 through today, supporting multiple war efforts. Pier 70, and much of San Francisco's eastern waterfront, is comprised largely of fill that was historically placed in the Bay to construct new land. These "fill soils" contain chemical constituents that were present in the debris, soil, and native serpentine rock that comprise the fill. In some areas, the soil was also impacted by the former industrial uses and legacy shipbuilding activities. The constituents found in the Pier 70 soils include naturally occurring and introduced metals (lead, arsenic, cadmium), petroleum hydrocarbons, PCBs, and asbestos. Some contaminants may be present at concentrations above environmental screening levels. Historic buildings at Pier 70 may also contain hazardous building materials such as lead-based paint and asbestos. The soil within the Pier 70 area is subject to a “Risk Management Plan” that functions as the remedial action plan for the site and ensures that contaminants in the existing soil do not pose a risk to human health or the environment. The remedial action includes installation of durable cover over contaminated soil areas to prevent exposure to, or dispersion of, the soil by wind, water, or construction activities. The required durable cover also mitigates the potential for soil mobilization during a flood event.

PG&E Potrero, 1201 Illinois Street. The former Potrero Power Plant site occupies 34 acres. The site has been used for industrial activities since the mid-1800s. Historical uses have included the manufacture and repair of ships, metal foundries, refining of sugar, and making of barrels. A Manufactured Gas Plant (MGP) operated in the northern portion of the site from the 1870s to 1930. The MGP used coal and oil to produce a form of natural gas. The area of the site associated with the electric generating Potrero Power Plant was constructed in the 1910s and was expanded in the 1960s. In March 2011, the power plant was permanently retired.

Environmental investigations that have been performed at the site have identified residual contamination in the soil, soil vapor, and groundwater from the past activities that have occurred at the site. The remedial areas identified at the site include Station A Area, Unit 3 Area, Tank Farm Area, Northeast Area, PG&E’s Switchyard and Construction Yard, and Offshore Area. Potential contaminants of concern identified in the soil and/or groundwater at these remedial areas include arsenic, asbestos - NOA, cyanide, DCA, DCE, lead, metals, PAHs, PCBs, pesticides, phenols, VOCs, semi-volatile organic compounds (SVOCs), TCA, and TPH. Various remedies for the site include: active remediation, engineering controls (including durable covers), institutional controls, compliance with the sitewide Risk Mitigation Plan, and compliance with O&M Plans. There are deed restrictions in place for this site specifying the type of approved development and uses.

Figure 1: Hazardous Materials Sites within the project footprint



San Francisco Waterfront Flood Resiliency Study
Integrated Feasibility Report / Environmental Impact Statement

1.09.11/12/29/20/revision 1/Dave Golles/DRAFT

1.2.1 Port of San Francisco HTRW Review

Note: This Appendix is called Hazardous, Toxic and Radioactive Waste. While there are multiple contaminated sites on Port property as documented in this Appendix, the fill and use history of the Port does not suggest the presence of any radioactive waste on Port property and thus, as a result, no investigation as to the presence of radioactive waste has been conducted, nor has any radioactive waste been identified on Port property.

1.2.1.1 Embarcadero Seawall Environnemental Risk Assessment Report

In May 2020, the Port of San Francisco prepared its Environmental Risk Assessment Report as part of its Embarcadero Seawall Multi-Hazard Risk Assessment.

Contaminated soils along the waterfront create the potential for mobilization of such materials into the nearshore environments in the event of seismic or flood events. This in turn could compromise commercial water use, water-related recreation, and ecological assets and functions.

Onshore terrestrial contaminated areas were identified through an Environmental Data Resources (EDR) search of existing local, state, and federal databases for the area from Aquatic Park to Oracle Park, including all port facilities, the Embarcadero, and land area up to the first inland row of buildings (EDR, 2018). Because these local, state, and federal records cover spills, accidents, and investigations only over the last three decades (nominally since 1990), areas of potential onshore terrestrial contamination related to prior industrial uses of the waterfront were identified through a general review of port history. In addition, information on creosote piles was obtained from the California Coastal Conservancy (Werme et al., 2010).

The San Francisco waterfront area has been used for a great variety of activities since the middle of the 19th century when fill activities started (in the 1840s and 1850s). The waterfront has a history of industrial and port uses, including ship berthing, ship and vehicle fueling, storage and transfer of petroleum and other hazardous materials, and railroad and vehicle operations. The project area would have experienced a variety of spills into soils, water, and sediments related to those activities. In addition, the former Embarcadero Freeway ran along portions of the waterfront from the Bay Bridge to Broadway Avenue prior to demolition after the 1989 Loma Prieta earthquake. Contaminants associated with freeway use include oil, grease, polycyclic aromatic hydrocarbons (PAHs), cadmium (from vehicle brakes), other heavy metals (such as nickel, copper, and zinc) and aerially deposited lead (from leaded fuel), leaving vehicle-related road runoff remnants.

As a result of this historic activity and as shown in database records showing prior spills, at least some areas of groundwater and soil under the Embarcadero and surrounding area are contaminated.[1] A review of environmental databases indicates this contamination includes diesel, gasoline, heavy metals, PAHs, and other contaminants

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1 A complete delineation of the entire waterfront would require sampling investigation beyond the scope of this study.

(EDR, 2018). Contaminated sites are present along the waterfront, including those associated with former leaking underground storage tanks (LUSTs) as shown on Figure 2-1.

Creosote was used for many years as a method for preserving maritime structures from decay. As a result, there is concern that chemicals leaching from existing creosote-treated structures pose environmental risks, including biological impacts on organisms such as Pacific herring. Creosote-treated piles are located throughout the San Francisco waterfront, including areas near Aquatic Park Cove, Pier 43, Pier 35, Pier 33, Pier 31, Pier 29, Pier 23, Pier 19, Pier 17, Pier 15, Pier 3, Pier 1, Fire Department Station 35, Pier 26, Pier 28, Piers 30–32, and Pier 38 (Werme et al., 2010).

Figure 2 shows the location of reported LUSTs and creosote piles along the project area.

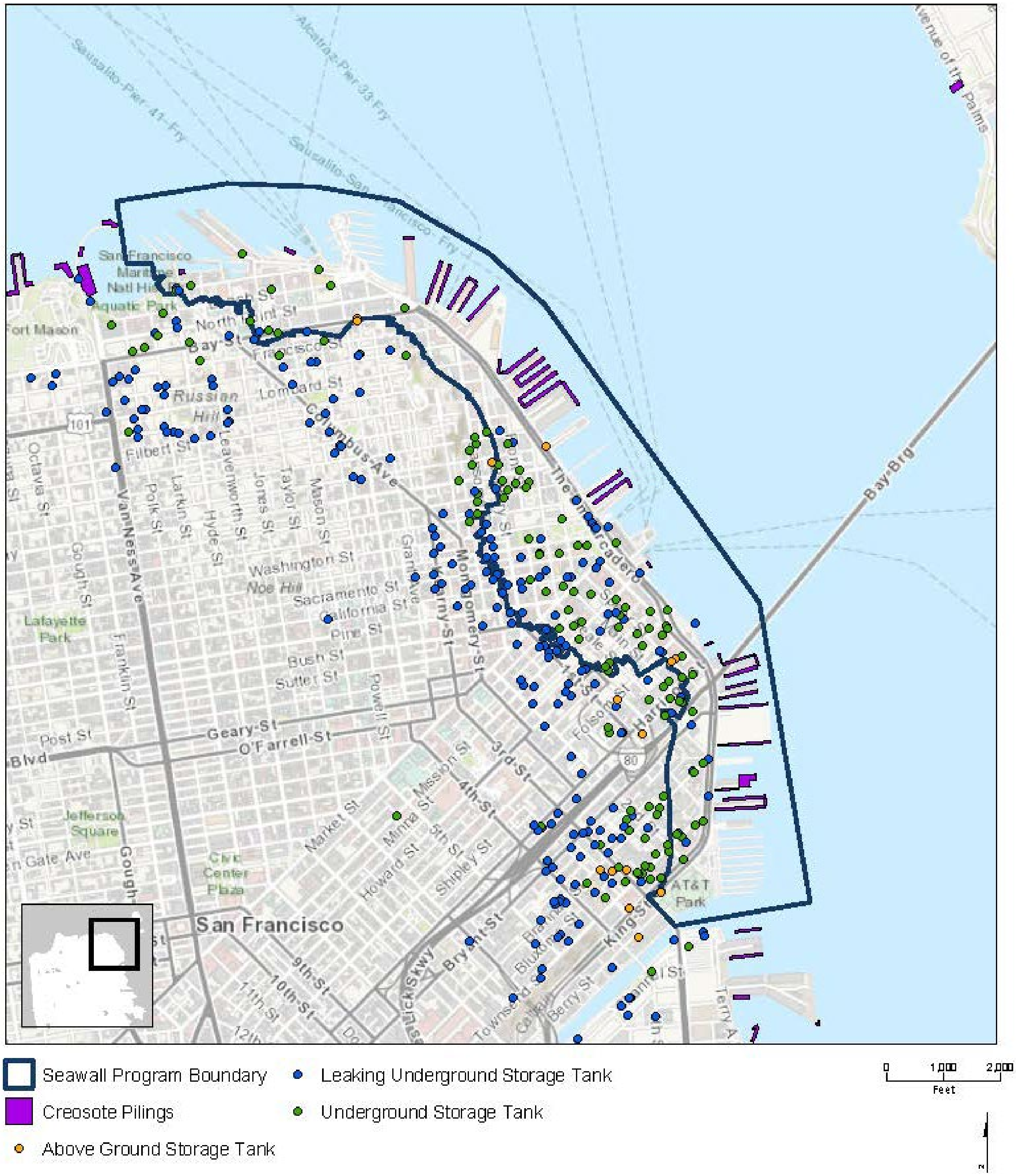
1.2.1.2 Contaminated Lands: Mission Creek/Mission Bay and Islais Creek/Bayview

In January 2023, the Port of San Francisco prepared its report on Contaminated Lands: Mission Creek/Mission Bay and Islais Creek/Bayview.

San Francisco's Southern Waterfront has a long history of industrial uses and activities that have left a legacy of contamination underground and in the shallow groundwater. Many contaminated sites have been remediated (cleaned up to reduce or prevent environmental damage) under the authority of California Environmental Protection Agency's Department of Toxic Substances Control (DTSC) and the Regional Water Quality Control Board (RWQCB) which regulate cleanup of polluted and contaminated sites in California. Approved remediation methods often allow residual concentration of contaminants to remain underground, underneath a concrete or asphalt cap, a thick layer of clean soil, or other barrier to prevent environmental or public exposure to residual contaminants. These sites also retain institutional controls, which are administrative and legal controls that minimize the potential for human exposure to contamination and protect the integrity of the remediation efforts. For example, institutional controls may limit or restrict land use on a contaminated site, such as residential uses or schools, that are not consistent with the level of cleanup completed.

Many existing regulations and remediation methods do not yet consider climate change. As sea levels rise and shallow groundwater tables rise, contaminated sites in low-lying nearshore areas could be exposed to sea level rise-driven flood hazards and higher groundwater tables that exceed the original remediation design conditions. In areas of Bay fill and sandy soils, higher groundwater tables can also increase the liquefaction risk in response to seismic events. These changing hazards could create unintended human health and environmental exposure pathways. The exposure risk varies by type of contaminant, concentration, and frequency or severity of the hazard.

Figure 2: Embarcadero Hazardous Sites

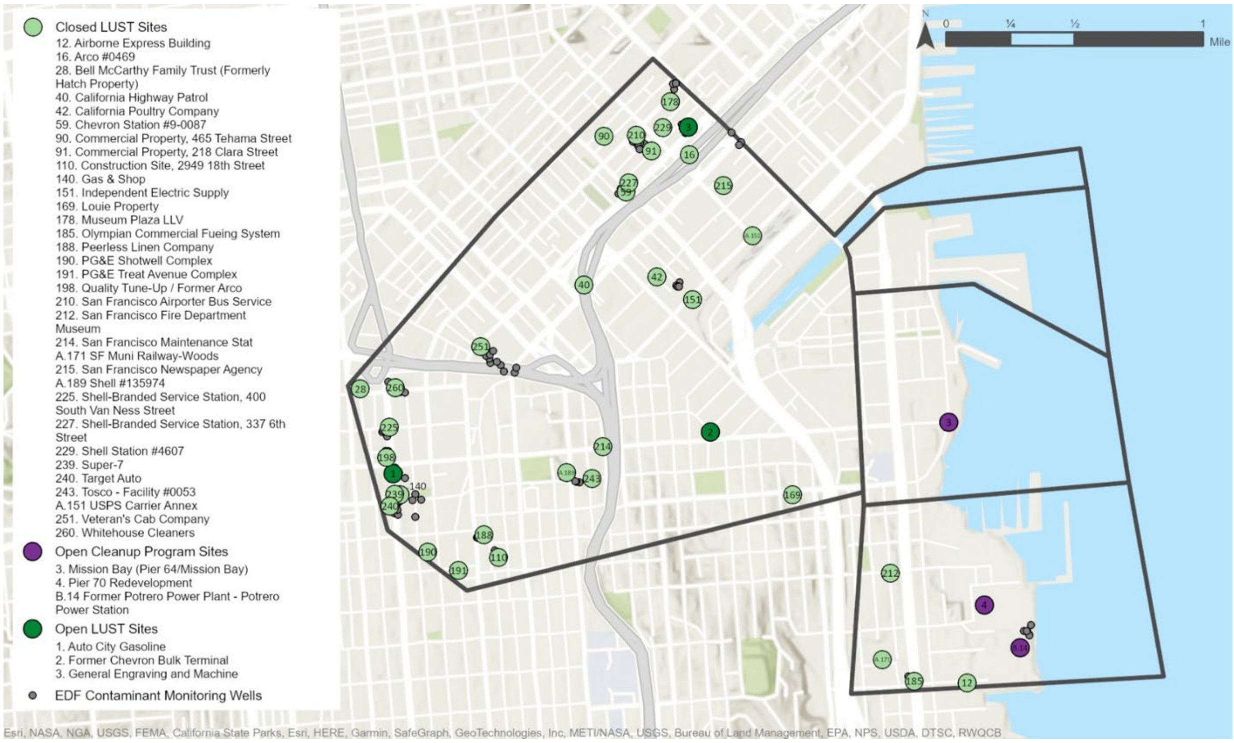


This review included sites regulated by DTSC and RWQCB and cataloging the source of the contamination, contaminants of concern, remediation status, remediation methods used, and any institution controls that remain in place. This review did not include potential contaminated sites under the authority of the City of San Francisco, such as the Maher and Voluntary Remedial Action Program (VRAP).

This study also includes an initial assessment of the depth to the shallow groundwater table at the identified sites, including the amount of sea level rise that could result in the groundwater table rising above the ground surface (that is, emergent groundwater). The following provides a high-level summary of the sites cataloged.

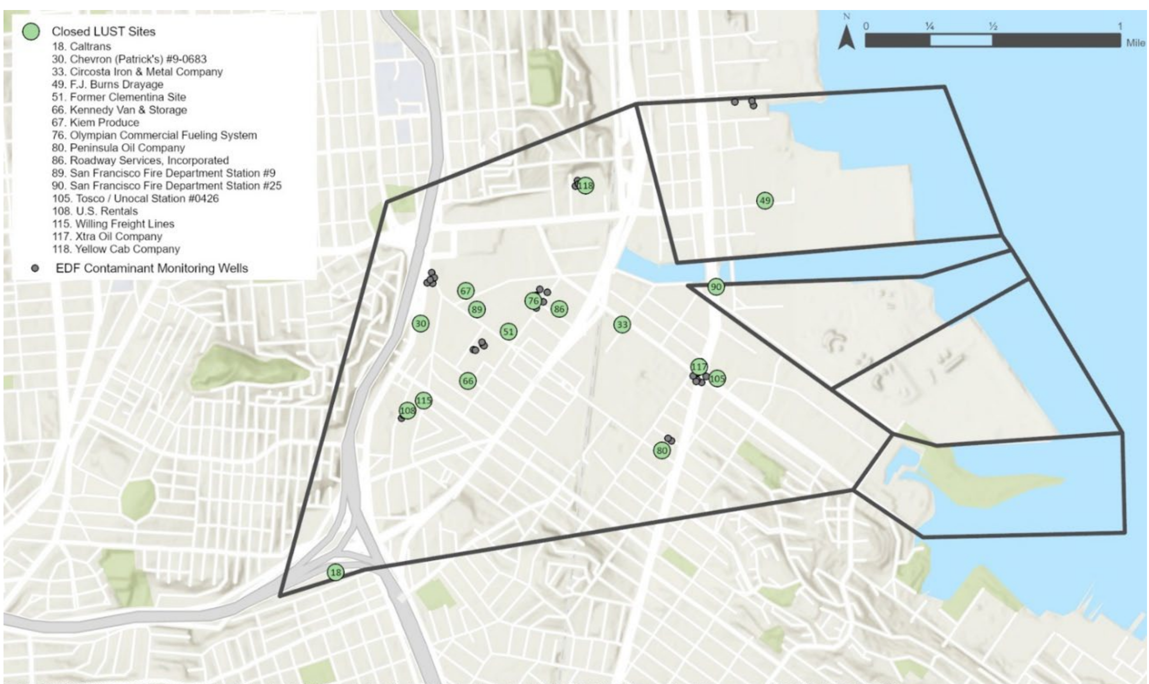
- DTSC Sites:
  - 17 DTSC Sites were identified in the Mission Creek/Mission Bay geography and 11 sites were identified in the Islais Creek/Bayview geography.
  - With 84-inches sea level rise (an upper-end estimate of sea level rise that could occur by 2100), seven (7) sites could be exposed to coastal flooding from direct overtopping of the shoreline by coastal floodwaters, ten (10) could experience emergent groundwater, and 18 could have shallow groundwater table within 6 feet of the ground surface.
- RWQCB Sites:
  - 36 Open Cleanup Program Sites were identified in the Mission Creek/Mission Bay geography and 5 were identified in the Islais Creek/Bayview geography.
  - Three (3) Closed Cleanup Program Sites were identified in the Mission Creek/Mission Bay geography, and three (3) were identified in the Islais Creek/Bayview geography.
  - Four (4) Open Leaking Underground Storage Tank (LUST) sites were identified in the Mission Creek/Mission Bay geography, and three (3) were identified in the Islais Creek/Bayview geography.
  - 282 Closed LUST Sites were identified in the Mission Creek/Mission Bay geography, and 162 sites were identified in the Islais Creek/Bayview geography.

Figure 3: Mission Creek/Mission Bay EDF Contaminant Monitoring Wells with Associated RWQCB Sites



Source: (RWQCB 2022)

Figure 4: Islais Creek/Bayview EDF Contaminant Monitoring Wells with Associated RWQCB Sites

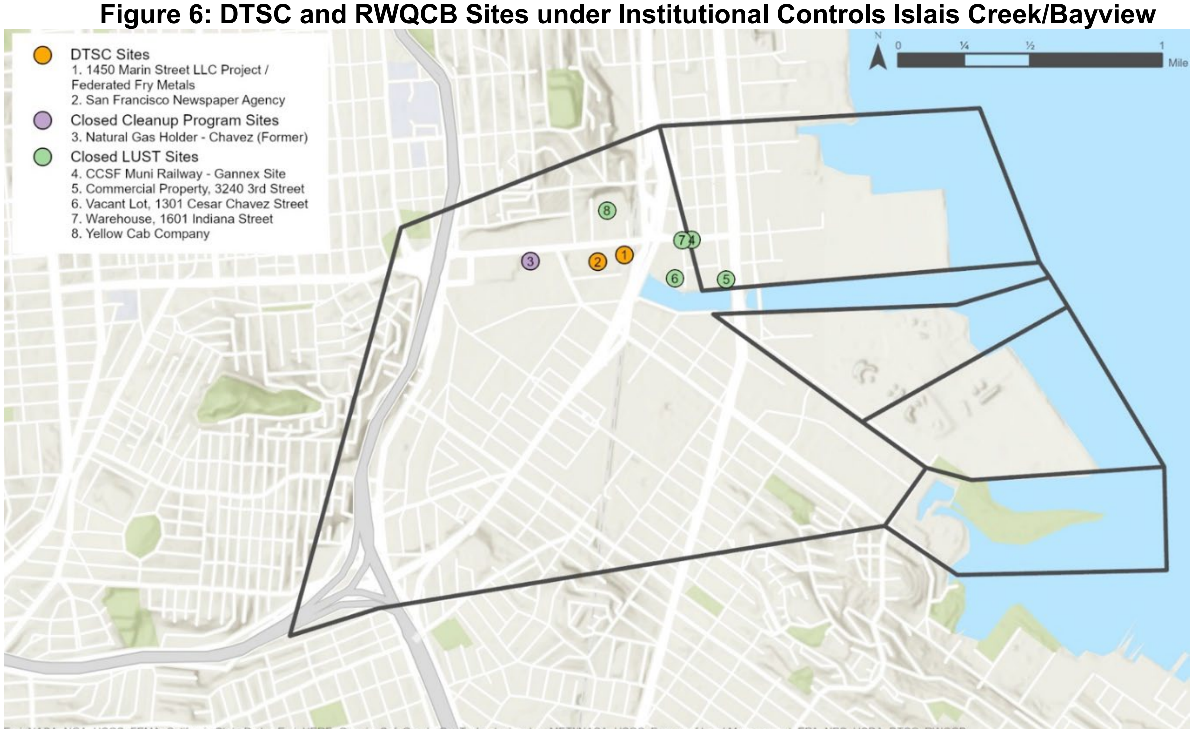


Source: (RWQCB 2022)

Figure 5: DTSC and RWQCB Sites under Institutional Controls Mission Creek/Mission Bay

Source: DTSC, 2022; SWRCB, 2022

Figure 6: DTSC and RWQCB Sites under Institutional Controls Islais Creek/Bayview



Source: DTSC, 2022; SWRCB, 2022

The report on Contaminated Lands: Mission Creek/Mission Bay and Islais Creek/Bayview provides a starting point for addressing potential concerns related to contaminated sites and climate change, with a focus on sea level rise and rising groundwater. However, this report does not identify the contaminated sites of greatest concern, nor does it provide recommendations for additional analysis, monitoring or remediation that may be required for some sites.

The report recommended potential next steps including:

- Step 1 - Establishing criteria to evaluate, rank, and prioritize the contaminated sites that require further action. Such criteria may include features or details such as:
    - What contaminants (such as, heavy metals, volatile constituents, petroleum hydrocarbons, polycyclic aromatic hydrocarbons, polychlorinated biphenyls) have the greatest potential to be mobilized with rising groundwater levels?
    - What types of human health or ecological exposure risks could be created or made worse with rising groundwater levels, such as human health risk from dermal contact, increased risk of vapor intrusion, or increased risk to ecological receptors?
    - Are existing buildings present such that impacts related to vapor intrusion are of concern?
    - Are the environmental impacts resulting from coastal flooding or rising groundwater short- or long-term impacts (for example, would the impacts result in the need for mitigation or remediation, or would the impacts be short-lived and not require aggressive actions).
    - Is there the potential for a “regulatory re-opener” (for example, sites with institutional controls or residual contamination could trigger regulatory involvement)?
- Step 2 - Apply the criteria to the cataloged sites and organize the sites by ranking and priority:
    - Develop a ranking or scoring system (using either a simple set of questions or weighted scoring system) using the established set of criteria.
    - Rank or score each site using the criteria.

    - Identify the sites with the most critical and/or immediate concerns.

  - Step 3 - Provide recommendations and next steps for the highest-priority sites:

    - Summarize the prioritized sites.

    - Develop and provide recommended actions, strategies, and next steps for each prioritized site.

    - Document the results and findings of Steps 1, 2, and 3.

The Port is pursuing additional funding to advance this field of study.

2.0 Environmental Consequences

2.1 Impacts on the Non-Structural and Action Alternatives

Under the no action alternative, capped and un-capped HTRW areas would be exposed to flooding and erosion from RSLC, which could result in releasing contaminants that impact water, soil, and sediment quality, as well as human health. Additionally, exposure may also occur where the lines of defense for alternatives are constructed landward of any HTRW sites. Table 2 provides a summary of potential HTRW impacts for the action alternatives. Additional investigation and testing will be required prior to construction. The existence and extent of any HTRW will be identified and appropriately addressed, and the performance and costs of HTRW cleanup and response are not included as part of the Federal project.

Table 3 provides information on known HTRW concerns within the project area and an evaluation of potential actions to limit impacts for alternatives The following recommendation is based on the review described in Section 2.0 above. Avoidance is recommended for many of these sites, however, if that is not possible then mitigation methods will need to be proposed and agreed on by the EPA or its subsidiary for each of the noted locations. Subsequent phases of this project will likely need more in depth site investigations, such as a Phase 2 site assessment that includes testing of the different materials, where possible.

Table 2: Evaluation of HTRW for Each Alternative

Alternative B	Alternative F	Alternative G	Total Benefits Plan
Pier removal, demolition, and relocation are anticipated to have ***less than significant*** impacts to HTRW. Demolition and relocation activities could result in wind-driven dust or run off that could impact air and water quality. Pier removal would temporarily increase turbidity and sediment suspension. Overall, pier removal is likely to have long-term ***beneficial*** impacts by removing creosote-laden pilings, thereby lessening the risk of contamination.	HTRW would be impacted during wharf replacement and new seawall construction during pile driving activities. These are anticipated to be ***less than significant*** as many HTRW sites can be mitigated. In-bay fill would diminish risk of contamination from contaminated soils and sediments. Addition of EWN features (e.g., marsh enhancement, ecological armoring) would be expected to decrease contamination risks in localized areas, offering ***beneficial*** impacts.	FRM features would be constructed along the shoreline in Reaches 1 and 2, while they would be constructed landward in Reaches 3 and 4 to allow for flooding in front of the measures. This would allow for more flooding in the southern reaches and thereby increase risk of contamination from the numerous HTRW sites located in the southern reaches. Construction would have temporary impacts to HTRW that can be mitigated or avoided and would be ***less than significant.***	HTRW would be impacted during wharf replacement and localized areas of new seawall construction during pile driving activities. These are anticipated to be ***less than significant*** as many HTRW sites can be mitigated or avoided. In-bay fill would diminish risk of contamination from contaminated soils and sediments. Addition of EWN features (e.g., marsh enhancement, ecological armoring) would be expected to decrease contamination risks in localized areas, offering ***beneficial*** impacts.

2.2 Views of the Non-Federal Sponsor (Port of San Francisco)

Given the industrial history of the Port of San Francisco (Port), the Port has extensive experience with environmental site investigation and remedial activities conducted either by the Port or by other responsible parties.

The Port believes that the level of potential future investment under the proposed Total Maximum Net Benefits Plan also provides an opportunity to address past harms associated with environmental contamination. Under earlier sections of this Appendix, the preliminary analysis of contaminated sites suggests “avoidance” as a strategy for implementation of the Total Benefits Plan, consistent with ER 1165-2-132.

The Port believes that the avoidance approach may miss the opportunity to leverage local and Federal investment in the Total Maximum Net Benefits Plan to address past harms associated with existing contamination, particularly when:

- Regulatory agencies with oversight authority have approved risk management plans authorizing future construction activities: and/or
- Proposed measures such as ground improvement or structural shoreline stabilization would have the benefit of providing either *in situ* treatment of existing contamination or would prevent migration of such contamination to the Bay.

The Port acknowledges that USACE operates under strict regulations designed to protect Federal taxpayers from paying for remediation of local contamination.

Table 3: Evaluation of HTRW Sites in the Study Area

Site ID	Alternative	Description	Evaluation
Buildings constructed prior to 1980	All	A large number of Buildings within the project footprints were constructed prior to 1980 and may have asbestos, lead and/or other regulated materials present which will need to be remediated prior to construction.	Recommend ascertaining the status of these buildings with either a survey by a licensed inspector or records of abatement and previous survey that clears the buildings.
Hyde Street Harbor 482 Jefferson St.	G 2040 Final & Construction G 2090 Final & Construction F 2040 LOD F 2040 T Wall E Sect 2- Embarcadero Wharf fill C	Site Type: Cleanup Program Site Status: Open - Assessment & Interim Remedial Action In April 2020, the Port reported hydrocarbon sheen on the surface water of San Francisco Bay at the Hyde Street Harbor (HSH). The Port identified the source of the sheen as a release of R-99 diesel fuel (also referred to as renewable diesel) from the piping associated with the fueling station at the Property. The sheen was identified about 35 feet from the San Francisco Bay shoreline. The soil, groundwater, and the surface water of San Francisco Bay have been impacted by the release of R-99. In addition, light nonaqueous-phase liquid has been measured floating on the groundwater in the onshore area where the release occurred. The U.S. Environmental Protection Agency's Office of Emergency Services (OES) responded to the initial release and provided regulatory oversight of response actions conducted by Pilot Thomas and the Port. Those activities were focused on impact assessment and fuel recovery. The Vapor Intrusion Work Plan has been prepared to evaluate the threat of vapor intrusion at nearby buildings and the risk to building occupants.	Prior to construction this site will need to be certified as "clean" by the EPA in accordance with ER 1165-2-132. Ground-disturbing activities in this area are likely to encounter known hazardous constituents (HTRW) present in the soil and groundwater. Recommend avoidance.
PG&E Former Beach Street Manufactured Gas Plant 250 Beach Street	G 2040 Construction Footprint	Site Type: Voluntary Agreement Cleanup Program Site Status: Active The former Beach Street manufactured gas plant (MGP) site is located in what is known as the Fisherman's Wharf area of San Francisco. The site occupies the city block bounded by Beach Street, Mason Street, Jefferson Street, and Powell Street. Gas plant operations were conducted on-site from about 1899 until about 1931. The MGP was not significantly damaged by the 1906 earthquake and fire. PG&E purchased the property in 1911 and operated the MGP until around 1931, when usage of manufactured gas in San Francisco was replaced by natural gas. The gas holders from the MGP were used for natural gas storage until 1956-1957, at which point PG&E sold the property. The site was subsequently redeveloped for commercial use. Groundwater monitoring is ongoing with additional groundwater	Recommend Avoidance of this area – Construction footprint overlaps a small corner of this site and may be easily re-routed.

Site ID	Alternative	Description	Evaluation
		monitoring well installation planned for fourth quarter 2019 and first quarter 2020. (JT August 14, 2019).	
Pier 39 Marina Sediment	G 2040 Final & Construction G 2090 Final & Construction – adj. (Adjacent only) F 2040 T Wall, LOD & Cantilever– adj E Sect. 2 – Embarcadero Wharf fill D 2090 D 2040 Fill & Wharf	Site Type: Cleanup Program Site Status: Open Remediation Pier 39 is owned by the Port of San Francisco (the Port). Pier 39 periodically needs to be dredged to maintain vessel navigation depths. Polycyclic aromatic hydrocarbons (PAHs) have been detected in Pier 39 marina sediment. The concentrations and proportions of individual PAH compounds are consistent with manufactured gas plant (MGP) residues. The suspected source of PAHs, the former Beach Street MGP and upland area, is located about 100 feet south of Piers 41 and 43, and is overseen by the Department of Toxic Substances Control (DTSC) (Envirostor Number 60001256). PG&E is addressing the MGP residues in sediment. The final Remedial Investigation Report was submitted in January 2020. MGP impacts to sediment extend from Pier 39 East Basin Marina (inclusive) on the east to Pier 45 (exclusive) on the west. A draft feasibility study and remedial action plan (FS/RAP) was circulated for public comment during fall 2021. The next steps include addressing the comments, finalizing the FS/RAP, and issuance of a site cleanup requirements order.	Recommend avoidance. Alternatives G 2040 Construction footprint and E Section 2 – Embarcadero Wharf fill have significant overlap. Whereas all others listed are adjacent and may easily avoid disturbing the sediment. Ground/sediment-disturbing activities in this area are likely to encounter known hazardous constituents (HTRW) present in the soil.
Site K (Seawall Lot 333) (38750002) 1-59&1/2 Townsend Street	C, D, E, F & G- adj.	Site Type: State Response or NPL Status: Certified O&M – Land Use Restrictions Only Site K is located at 1 through 59 1/2 Townsend Street in San Francisco, and is owned by the San Francisco Redevelopment Agency. The site was underwater during the 1800's but completely filled with soil and construction debris by 1913. Previous site occupants included a paint warehouse, ship service companies, and a forklift service company. Approved RA. The removal activities at the site consisted of excavation and bioremediation of soil containing petroleum cap. Approximately 246 cubic yards of petroleum hydrocarbon contaminated soil were biotreated on an asphalt paved lot and subsequently used as backfill. The cap covers all portions of the property and consists of a layer of 10 mils Visqueen plastic and a 4-inch thick concrete slab. A 3-story residential building and 1-story at-grade parking lot has been constructed on site. Approved PEA. Documented fuel leaks at the site impacted the soil and groundwater. DTSC approved a hazardous waste management plan on May 6, 1991. Recorded Deed Restriction. Certified Site. Site Screening noted 5 underground tanks removed. hydrocarbons above 1,000 mg/kg and the placement of a concrete slab.	Avoidance of this site should be feasible as Alternatives C, D, E, F and G do not directly overlap with this site and are adjacent only. If ground disturbing activities are planned at this site that will penetrate or damage the cap, recommend engagement with EPA to determine possible path forward.

Site ID	Alternative	Description	Evaluation
Mission Bay Redevelopment Area	G 2090 Final & Construction G 2040 Final & Construction F 2040 Embankment F 2040 LOD F 2090 Embankment F 2090 LOD E Sect. 4 -Levee/Berm w/ mod.& ext. EWN E Sect. 3- Bulkhead wall w/ fill E Sect. 2- Embarcadero Wharf fill D 2090 D2040 C	Site Type: Cleanup Program Site Status: Open – Site Assessment – Land Use Restrictions Diesel, Gasoline, Heating Oil / Fuel Oil, Lead, Asbestos A May 21, 1999, Risk Management Plan (RMP) was approved by the Regional Water Board for the 300-acre Mission Bay Redevelopment Area. The RMP describes risk management procedures prior to development, during development, and after development. The purpose of the procedures is to protect people from exposure to poor quality fill materials and lower-level, widespread environmental pollution that could not be feasibly cleaned up. On March 21, 2000, a covenant and environmental restriction ("deed restriction") on the property was executed. The deed restriction obligates future landowners to comply with the RMP. Prior to 1906, the Development Project Area was part of the San Francisco Bay. In 1906, the land was created by filling in the marshlands and shallow tidal flats at the San Francisco Bay margin with serpentine rock and soils from the nearby Potrero Hill. Serpentine is a type of ultramafic rock that commonly contains naturally-occurring asbestos. An 8-acre area near the vicinity of former Pier 64 was remediated in 2005 to remove separate-phase petroleum pursuant to Board Site Cleanup Order No. R2-2005-0028.	Avoidance of this area is recommended. Ground-disturbing activities in this area are likely to encounter known hazardous constituents (HTRW) present in the soil and groundwater. If ground-disturbing activities are planned, invasive site investigation will be required to determine the nature and extent of contamination in accordance with ER 1165-2-132, paragraphs 8.c.(1) and 9.a. Additionally, this area is under Land Use Restrictions that would require coordination with RWQCB. Further investigation is warranted and will be required.
Pier 70, Crane Cove Park, Upland And Sediment	G 2090 Final & Construction – adj only G 2040 Final & Construction F 2040 Embankment F 2040 LOD F 2090 Embankment & LOD – minor overlap E Sect. 3 – Bulkhead wall w/ fill E Sect. 4 – Levee/Berm w/ mod. EWN D 2090 LOD	Cleanup Program Area Open - Verification Monitoring Crane Cove Park is a portion of the Port of San Francisco's Pier 70 property. In 2002, there was a release of polychlorinated biphenyls (PCB) transformer oil and the Port initiated an emergency clean up response. Remedial activities for the PCBs were overseen by US EPA in accordance with TSCA. Concentrations of PCBs in soil remain at approximately 10 feet below surface. Sediment data adjacent to Crane Cove Park identified concentrations of metals, petroleum hydrocarbons, polyaromatic hydrocarbons (PAHs), PCBs, and dioxins and furans. The sediments were capped in 2020, and the Port is currently conducting bathymetric annual cap inspections to verify its presence.	Avoidance of this area is recommended. Ground-disturbing activities in this area are likely to encounter known hazardous constituents (HTRW) present in the soil/sediment. This site is being investigated by the NFS and more information about projected/completed cleanup of site should be acquired.

Site ID	Alternative	Description	Evaluation
	D 2040 Berms		
Pier 70	G 2090 Final & Construction – minor overlap G 2040 Final & Construction F 2040 Embankment & LOD F 2090 Embankment – minor overlap F 2090 LOD E Sect. 4 – Levee/Berm w/ mod. EWN D 2090 Berm D 2040 Berm C – adj only	Site Type: Cleanup Program Site Status: Open – Remediation - Land Use Restrictions Pier 70 historical use includes shipyards dating to mid-1800s, including the manufacturing, maintenance, and repair of marine vessels. The Port of San Francisco owns the 64-acre property and is in the process of redevelopment with private parties who will take on long-term leases. Generally, soil and/or groundwater has been impacted to some degree with petroleum, metals, asbestos, and polyaromatic hydrocarbons (PAHs). A Risk Management Plan was developed in 2013, approved by the Water Board, and requires a "Durable Cover" be maintained over the property. The final Durable Cover will be built with the redevelopment of the property. The Site is divided into three primary areas: Crane Cove Park (Port), Historic Core (Orton Development) and the Special Use District (Forest City/Brookfield Properties).	Avoidance of this area is recommended. Ground-disturbing activities in this area are likely to encounter known hazardous constituents (HTRW) present in the soil/sediment. This site is being investigated by the NFS and more information about projected cleanup of site should be acquired. Risk Management Plans, Land Use Restrictions, Deed restrictions and other controls have already been instituted for varying parts of this property. Recommend further investigation to determine a path forward.
Potrero Power Plant	G 2090 Final & Construction -adj. only G 2040 Final & Construction – Minor overlap F 2040 Alt. LOD, Embankment, T wall and LOD F 2090 LOD	Cleanup Program Site Open – Long Term Management This was the site of the Former Potrero Power Plant. The subject property has been used for various commercial and industrial activities since 1872, including sugar refining, barrel manufacturing, electric power generation, and a manufactured gas plant (MGP). The last of these activities, electric power generation, was concluded in 2011. The project area includes 34-acres of the former power plant facility and approximately 22-acres of the adjacent off-shore sediments. For purposes of remedial investigation and planning, the Site was divided into seven operational areas, with six on-shore areas (Switch Yard/General Construction Yard, Hoe Down Yard, Station A, Northeast, Tank Farm, and Unit 3) and one off-shore area (Offshore).	Avoidance of this area is recommended. Ground-disturbing activities in this area are likely to encounter known hazardous constituents (HTRW) present in the soil/sediment. This site is being investigated by the NFS and more information about projected cleanup of site should be acquired. Risk Management Plans, Land Use Restrictions, Deed restrictions and other controls have already been instituted for the varying parts of this property. Recommend further investigation to determine if there is a path forward.

Site ID	Alternative	Description	Evaluation
MME Expansion (Frmr Sfer) Project/ Former Western Pacific	G 2040 Final & Construction F 2040 Embankment & LOD E Sect. 4 – Levee/Berm w/ extensive EWN D 2040 EWN and Berms D 2090 EWN and Berms	Open - Site Assessment As Of 11/3/2021 ACTIVITIES PROHIBITED WHICH DISTURB THE REMEDY AND MONITORING SYSTEMS WITHOUT APPROVAL ASPHALT COVER NOT TO BE DISTURBED WITHOUT APPROVAL DAY CARE CENTER PROHIBITED ELDER CARE CENTER PROHIBITED HOSPITAL USE PROHIBITED LAND USE COVENANT NO EXCAVATION OF CONTAMINATED SOILS WITHOUT AGENCY REVIEW AND APPROVAL NO GROUNDWATER EXTRACTION AT ANY DEPTH WITHOUT APPROVAL NOTIFY PRIOR TO SUBSURFACE WORK PUBLIC OR PRIVATE SCHOOL FOR PERSONS UNDER 21 PROHIBITED RAISING OF FOOD PROHIBITED REQUIRES SURFACE COVERS RESIDENCE USE PROHIBITED The Site is owned by the City and County of San Francisco and lies in an area reclaimed from the San Francisco Bay in the Islais Creek Estuary. A former owner, Western Pacific Railroad, used the area as a switchyard for rail cars. The soil and groundwater of the site are contaminated with inorganic and organic chemicals, including lead, arsenic, chromium, cobalt, polynuclear aromatic hydrocarbons (PAHs), and volatile organic compounds (VOCs). The contamination may have been caused by previous operations or by the nature of artificial fill material, composed of crushed bedrock building debris, sand, and other typical fill material. The City had proposed constructing a power plant to handle demand during peak hours (a "peaker plant") but the proposal was withdrawn in 2008. A deed restriction was recorded against the property in 2002.	Avoidance of this area is recommended. Ground-disturbing activities in this area are likely to encounter known hazardous constituents (HTRW) present in the soil and groundwater. If ground-disturbing activities are planned, invasive site investigation will be required to determine the nature and extent of contamination in accordance with ER 1165-2-132, paragraphs 8.c.(1) and 9.a. Additionally, this area is under Land Use Restrictions that would require coordination with RWQCB. Further investigation is warranted.

Site ID	Alternative	Description	Evaluation
		The current development plan for the Site is to construct a temporary bus facility for SFMUNI. Lead oversight for the case was transferred from the RWQCB to the SFDPH on 11/3/2021.	
Islais Creek	G 2040 Final & Construction E Sect. 6 – Bulkhead Wall and Wharf @maritime terminal, E Sect. 4 – Levee/Berm w/ mod. EWN D 2040 PS Wall, LOD, Fill and Wharf, EWN, Berms D 2090 LOD, EWN C	The western portion of Islais Creek (west of the 3rd Street Bridge) was designated as “toxic hot spot” by RWQCB in 1999 due to elevated concentrations of metals, PAHs, PCBs, and pesticides in sediment and observed toxicity to aquatic organisms in toxicity tests. Sediment samples from the eastern portion of Islais Creek, from 3rd Street Bridge to the Bay, contained lesser concentrations of COCs, so the site was not designated a toxic hot spot. Discharges from four combined sewer overflows and a wastewater outfall to the creek are the primary sources of contaminants to Islais Creek (RWQCB 1999). This site is under water today.	Avoidance of this area is recommended. Sediment and/or Ground-disturbing activities in this area are likely to encounter known hazardous constituents (HTRW). If ground-disturbing activities are planned, invasive site investigation (Phase II) will be required to determine the nature and extent of contamination in accordance with ER 1165-2-132, paragraphs 8.c.(1) and 9.a. Further site investigation is needed.
Pier 90	G 2040 Final & Construction G 2090 Final & Construction F 2040 Embankment & LOD F 2090 Embankment & LOD E Sect. 6 – Bulkhead wall and wharf @maritime terminal. D 2040 LOD, EWN, Berms, Extension Wall & Fill and Wharf D 2090 LOD & Wall Wharf and Fill C	Site Type Cleanup Program Site Status Open – Remediation as of 3/1/2022 The project property is on Pier 90 located along the south side of Islais Creek Channel, at the northeast intersection of Amador and Illinois streets and Cargo Way. The site is a former Exxon Mobil bulk oil facility with prior operations by Texaco and General Petroleum Corporation. The area was used for oil storage and transport from at least 1924 to sometime between 1975 and 1989. Multiple large above ground storage tanks and the associated piping were located on the property. The tanks had been removed by 1989. Review additional site characterization letter describes the Installation of six monitoring wells. The utility corridors may act as preferential pathways for contaminant migration. Contaminants: Arsenic, copper, diesel, gasoline, lead, nickel, total petroleum hydrocarbons, Waste oil / motor / hydraulic / lubricating, zinc	Avoidance of this area is recommended. Ground-disturbing activities in this area are likely to encounter known hazardous constituents (HTRW). If ground-disturbing activities are planned, invasive site investigation (Phase II) will be required to determine the nature and extent of contamination in accordance with ER 1165-2-132, paragraphs 8.c.(1) and 9.a. Further site investigation is needed.

Site ID	Alternative	Description	Evaluation
San Francisco Energy Company Cogeneration Project, Seawall Lot 344	G 2090 Final & Construction G 2040 Final & Construction F 2040 Embankment, LOD F 2090 Embankment, LOD E Sect. A – Extensive EWN D 2040 Sheetpile, LOD, Fill and Wharf, EWN, Berms D 2090 LOD, EWN C	SITE_TYPEVoluntary Cleanup No updates or documents other than the voluntary cleanup agreement available. The Site Action Plan (aka Removal Action Workplan) was approved. The site was part of the San Francisco Bay until Bay filling activities established a land mass in this area. Proponent has represented that while this area was filled in, it was never developed. Analytical results of soil samples contain lead up to 2,000 TPH and low levels of pesticides, PNAs, and PCBs in the fill material. A Voluntary Cleanup Agreement was signed on 8/21/95 to provide oversight for the characterization and cleanup of the project as part of the California Energy Commission siting process for a cogeneration plant. A Site Action Plan (aka: Removal Action Workplan) as approved on March 14, 1996, which required that the Site be capped with a combination of asphalt, concrete, and clean fill material. The removal action was not implemented because implementation was dependent upon certification of the project by the California Energy Commission.	Avoidance of this area is recommended. Ground-disturbing activities in this area are likely to encounter known hazardous constituents (HTRW). If ground-disturbing activities are planned, invasive site investigation (Phase II) will be required to determine the nature and extent of contamination in accordance with ER 1165-2-132, paragraphs 8.c.(1) and 9.a. Further site investigation is needed.
Pier 94 & 96 Fill Site	G 2090 Final & Construction- adj. G 2040 Final & Construction F 2040 Embankment, LOD, No strategy- adj. F 2090 Embankments – adj F 2090 LOD E Sect. A – Ext. EWN E Sect. 6- Bulkhead wall &wharf @maritime terminal E Sect. 5- Bulkhead wall @ maritime terminal D 2040 Sheetpile, LOD, Extension Wall, EWN D 2040 Berms – adj. only D 2090 LOD, EWN	In 1961, the Port initiated construction of a marine terminal in the area now designated as Piers 94 and 96 by placing fill material, primarily clean soil, rock, dredged material, and construction debris behind a perimeter debris dike. Future development at the site would require a site mitigation plan to outline proper soil and groundwater handling procedures and appropriate site capping requirements to mitigate human and ecological exposure to the hazardous materials identified during the site investigation. In 1961, the landfill was created by constructing a perimeter debris dike from the existing shore extending east out into the bay from Pier 92 in the north to Pier 96 in the south. The debris dike was comprised of wood, brick, metal, and concrete with sandy gravel, silty sand, and clay (Geo/Resources, 1990). In 1964, about 2.5 million cubic yards of dredge spoils from Pier 80 were placed within the dike. From 1965 to 1975, an unknown quantity of construction debris and municipal waste were placed over the bay mud dredge spoils. The thickness of the waste unit ranges from about 9 feet to 29 feet. According to Geo/Resources, the waste unit is comprised of a heterogeneous mixture of wood, brick, concrete, roots, terra cotta, metal, plastic, and household debris, mixed with silty sandy clay and silty clayey sand. Between 1975 and 1977, a 2- to 5-foot layer of rocky soil with minor amounts of debris was placed over the waste unit (Geo/Resources, 1990). The landfill never operated as a municipal solid waste landfill; however, because of the nature of some of the fill that comprises the	Avoidance of this area is recommended. Ground-disturbing activities in this area have the possibility of encountering known hazardous constituents (HTRW) present in the soil and groundwater. If ground-disturbing activities are planned, invasive site investigation will be required to determine the nature and extent of contamination (if any remains) in accordance with ER 1165-2-132, paragraphs 8.c.(1) and 9.a. More information about the specific contaminants and their location will likely present a path forward.

Site ID	Alternative	Description	Evaluation
	C	upland portions of Pier 94, an approximately 14-acre area ("Site") is regulated as a Class III landfill (non-hazardous solid waste) by the RWQCB. The Port's filling activity was initially authorized by the RWQCB under WDRs issued in March of 1972 (Order No. 72-9). The WDRs were revised and updated in 1975, 1987, and 2003.	
Pier 98 Fill Site	D 2040 Sheetpile	Heron's Head Park (the Site) is an approximately 26 acre park built on a peninsula of land jutting into India Basin in southeast San Francisco. Owned by the Port of San Francisco, this park began its life as "Pier 98", land comprised of fill placed in San Francisco Bay to construct a container terminal in the early 1970s. The Port's original fill placement in the 1970s was permitted by Waste Discharge Requirements (WDR) issued by the California EPA, Regional Water Quality Control Board (Water Board). In compliance with those requirements, after filling ceased the Port investigated soil conditions and monitored chemical constituents in groundwater for over ten years. The Water Board review found that the data indicated no significant potential for the site to impact water quality. The Water Board approved construction of the park, including placement of a Geosynthetic Clay Liner (GCL) over portions of the landfill to minimize potential for leachate generation in a portion of the Site where organic material had been placed along with inert fill material.	Only D 2040 Sheetpile footprint is in the vicinity of this site, therefore, recommendation is to adjust the footprint to avoid the area where the GCL and landfill site exist by removing a ½ a mile from design.
Pier 70 Fill Site	Unable to determine	The California State Water Resources Control Board (SWRCB) indicated no specific COCs at this municipal solid waste landfill. No additional site history was provided by SWRCB (Port 2021a).	No project impact anticipated with information provided. Unable to determine extent of landfill site.
PG&E Hunters Point	G 2090 Final & Construction G 2040 Final & Construction F 2040 Embankment, LOD F 2090 Embankment, LOD E Sect. 4 Levee/Berm w/ ext. EWN D 2040 LOD, EWN, Berms D 2090 LOD, EWN, Berms C	The site is approximately 38 acres bounded by San Francisco Bay to the east. In the early 1900s, the Site area was used for ship and barge building. The original power generation plant was constructed on the Site in the 1920s and utilized fuel oil. In 1948/1949, two additional steam units and three additional aboveground fuel storage tanks were added to the plant and fill material was placed in the southeastern portion of the Site for development of this area. In 1958, an additional steam unit and three above ground fuel storage tanks were added. In 1969, the breakwater around the cooling water lagoon outlet was constructed. By 1975, the dike between the breakwater and Pier 96 was completed, creating the cooling water lagoon. Another aboveground fuel storage tank 8 had been added by this time. In 1976, a gas fueled turbine unit was constructed. By 1977, another above ground fuel storage tank had been added.	Avoidance of this area is recommended. Ground-disturbing activities in this area are likely to encounter known hazardous constituents (HTRW) present in the soil and groundwater. If ground-disturbing activities are planned, invasive site investigation will be required to determine the nature and extent of contamination in accordance with ER 1165-2-132, paragraphs 8.c.(1) and 9.a.. Additionally, this area is under Land Use Restrictions that would require coordination with RWQCB. Further investigation is warranted.

Site ID	Alternative	Description	Evaluation
		In 2002, PG&E removed 8 of the nine aboveground fuel storage tanks which were primarily used to store heavy fuel oils. One aboveground fuel storage tank (no. 9) was retained to store the distillate (low sulfur) fuel used by the Unit Number 1 peaking turbines as necessary for electric system reliability. The Plant was shut down on May 15, 2006. The aboveground plant structures have been removed and the below ground structures are being dismantled. Reports, containing the results of environmental media sampling conducted at the Site, indicate that the soil and/or groundwater are contaminated with hazardous substances, including total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), metals and polychlorinated biphenyls (PCBs). Much of the Site contains fill material derived from local serpentine rock which contains naturally Construction -occurring asbestos (NOA) and the metals, nickel, chromium and cobalt.	
Federated Fry Metals	G 2090 Final & Construction – adj G 2040 Final & - adj	1450 Marin Street LLC Project / Federated Fry Metals is a State Response site that is under Certified O&M and Land Use Restrictions status. COCs include lead and mercury. Federated Metals Corporation owned and operated a secondary metals plant in a heavily industrialized section of San Francisco. Operations at the site included the production of lead and brass ingot. Oxides were formed during smelting and removed in the form of slag. It is also believed that approximately 1,500 yd3of crushed and washed pre-1950s-style battery boxes were deposited onsite. Currently, the site is capped with asphalt. In an email exchange between DTSC and ACE Drilling & Excavation (DTSC 2020), DTSC noted that in a site inspection (conducted in November 2020) minor cracks were observed. DTSC recommends the continued monitoring of the cracks and scheduled repairs if the cracks worsen or if impacted soil beneath the cap is exposed. The site is in compliance with the restrictions and requirements of the Land Use Covenant, and the cap surface continues to be an effective barrier over the impacted soil.	No project impact anticipated. This site is adjacent to Alternatives G 2090 and G 2040 only, therefore, avoidance should be possible.

2.3

3.0 References

California Department of Toxic Substances Control (DTSC). 2022. Envirostor website (https://www.envirostor.dtsc.ca.gov/public/). Accessed December 2022.

SWRCB. 2022. GeoTracker website (https://geotracker.waterboards.ca.gov/). Accessed December 2022.

SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY, CA

DRAFT APPENDIX D-1-7
LAND USE

JANUARY 2024

USACE TULSA DISTRICT | THE PORT OF SAN FRANCISCO

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1.0 Affected Environment

1.1 Regulatory Framework

1.1.1 Federal Regulatory Setting

- No federal regulations related to land use are applicable to the Project.

1.1.2 State Regulatory Setting

- The Public Trust Doctrine

The City and County of San Francisco, through the San Francisco Port Commission, was granted sovereign tide and submerged lands in trust through legislation referred to as the 1968 Burton Act. Since that enactment, the California Legislature has amended the Port's statutory trust grant through over 20 statutes. Many of these amendments were enacted to facilitate the improvement of the infrastructure and historic structures on trust lands along the San Francisco waterfront (California State Lands Commission [SLC] 2023).

The Public Trust provides that tide and submerged lands and the beds of lakes, streams and other navigable waterways are to be held in trust by the State for the benefit of the people of California. San Francisco Bay tidal and submerged lands fall into this Public Trust Doctrine. The Common Law doctrine of the Public Trust protects the public's right to use California's waterways for navigation, fishing, boating, natural habitat protection and other water-oriented activities.

Under this doctrine, the Port of San Francisco through the Burton Act has a duty to protect and sustain its coastal tidelands and submerged lands for public purposes ranging from navigation and commerce to recreation and conservation, as well as the authority to defend the public's interests when they are at risk. Historically, the Public Trust has referred to the basic right of the public to use its waterways to engage in "commerce, navigation, and fisheries."; the doctrine has been broadened by various landmark court decisions to include the right to swim, boat, and engage in other forms of water recreation, and the right to preserve lands in their natural state to protect scenic and wildlife habitat values. The Public Trust, as a common law doctrine, is not static but is continuously evolving to protect the public's use and needs in California's waterways (SLC, 2023; Center for Ocean Solutions 2017).

- San Francisco Bay Conservation and Development Commission Plans

In 1965, the McAteer-Petris Act established the San Francisco Bay Conservation and Development Commission (BCDC). As a state agency, BCDC is charged with protecting and enhancing the Bay and has regulatory responsibility over development within the Bay and along the Bay's shoreline. BCDC accomplishes its mission by minimizing fill in wetlands and mudflats, and encouraging the use, restoration, and protection of marshes, salt ponds, and wildlife refuges. Additionally, BCDC supports maritime activities and requires public shoreline access for new waterfront projects. BCDC permits are required for projects within the Bay or within 100 feet of the shoreline.

The waterfront is located within the area of jurisdiction of the BCDC, which includes the Bay itself to the highest tide line (mean high-tide line) as well as the first 100 feet shoreward from that line (the shoreline band) around San Francisco Bay. This jurisdiction requires consideration of several BCDC plans, such as The Bay Plan and the San Francisco Waterfront Special Area Plan. BCDC's Adapting to Rising Tides Program is also relevant.

The Bay Plan defines BCDC's role in protecting the Bay through control of filling and dredging within the Bay, and shoreline development adjacent to the Bay. The San Francisco Waterfront Special Area Plan is an amendment to the Bay Plan prepared in partnership with the Port to apply policies of the Bay Plan specifically to the plan area. Port projects must comply with the San Francisco Waterfront Special Area Plan, McAteer-Petris Act, and the Bay Plan.

The Adapting to Rising Tides Program is a collaborative effort across the region to help Bay Area communities adapt to sea level rise (SLR) and storm flooding by providing an adaptation planning approach that integrates sustainability and transparent decision making (Port of San Francisco 2020a).

- Ocean Protection Council Sea Level Rise Guidance

Rising Seas in California: An Update on Sea-Level Rise Science (2018 Update), developed by the Ocean Protection Council's Science Advisory Team, summarizes the current state of SLR science. This information was used to update the state's SLR guidance, which provides a methodology for state and local governments to analyze risks and incorporate SLR considerations into planning efforts. The City of San Francisco is revising its SLR planning guidance for capital planning projects within its Sea Level Rise Vulnerability Zone (SLRVZ) in accordance with the new state guidance (Port of San Francisco 2020a).

1.1.3 Local Regulatory Setting

All Port projects must comply with the City and County of San Francisco's (City's) Planning Code, General Plan, and associated Area Plans including existing height limits. A 40-foot height limit applies to projects on all piers except the Ferry Building. The majority of seawall lots also have a 40-foot height limit, except for a few parcels with higher limits. A June 2014 San Francisco ballot measure, Proposition B: Waterfront Building Heights, requires voter approval for new projects to exceed established height limits (Port of San Francisco 2020a).

- San Francisco General Plan and Special Area Plans

The San Francisco General Plan (General Plan) sets forth San Francisco's comprehensive, long-term land use policy. The General Plan provides general policies and objectives to guide land-use decisions and contains policies that relate to physical environmental issues. The General Plan consists of 10 issue-oriented plan elements: Air Quality, Arts, Commerce and Industry, Community Facilities, Community Safety, Environmental Protection, Housing, Recreation and Open Space, Transportation, and Urban Design. In addition to the guidance in the General Plan, the City has adopted a series of Special Area Plans within the project area, including the Northeastern Waterfront Plan (Reach 1); Downtown, Transit Center District, and Rincon Hill plans (Reach 2); East Soma and Central Waterfront plans (Reach 3) and the Central Waterfront and Bayview-Hunters Point plans (Reach 4) (Figure 1-1).

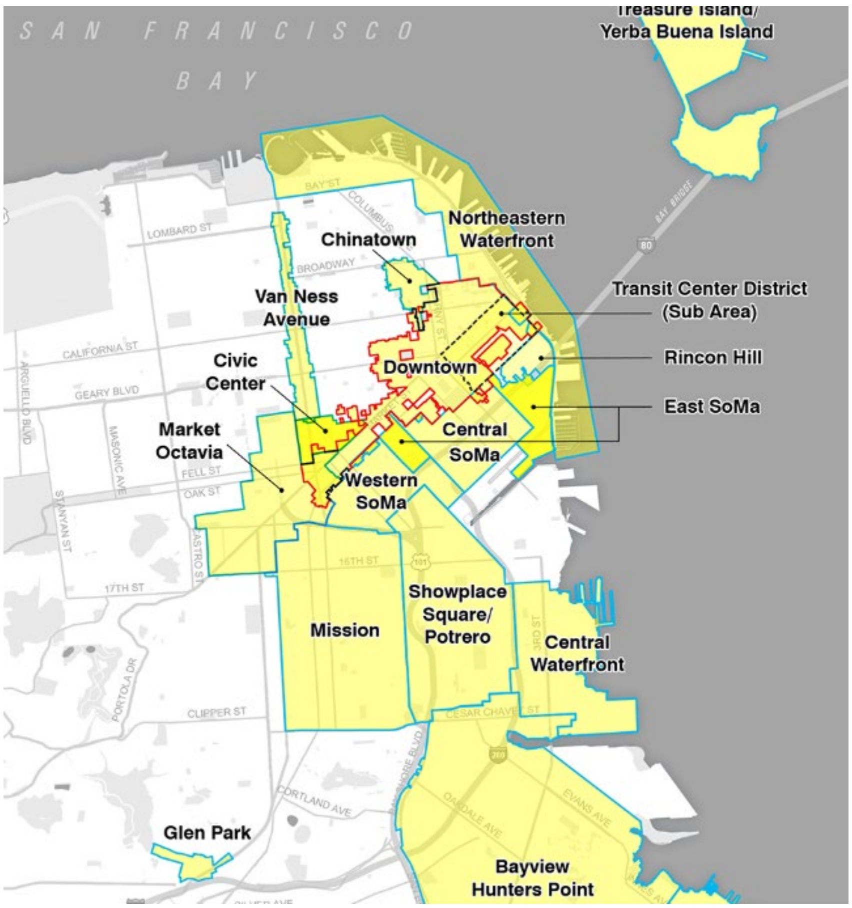

Figure 1-1. San Francisco Special Plan Areas

- San Francisco Planning Code

The San Francisco Planning Code (Planning Code), which incorporates the City's zoning maps by reference, implements the General Plan and governs permitted uses, densities, and configuration of buildings in San Francisco. Permits to construct new buildings (or to alter or demolish existing ones) may not be issued unless (1) the proposed project conforms to the Planning Code, (2) allowable exceptions are granted pursuant to provisions of the Planning Code, or (3) amendments to the Planning Code are approved as part of the project. The Planning Code provides location-specific development and use regulations that govern density and configuration of buildings. Because the Construction area is located on Port land, relevant sections of the Planning Code are included in this land use discussion as a reference for the surrounding land uses and zoning. Zoning maps are available online for the City (City and County of San Francisco 2023a and 2023b).

- The Waterfront Plan

The Port's Waterfront Plan (previously the Waterfront Land Use Plan) is the Port's official planning document and governs the use, design and improvement of Port property, and was adopted by the Port Commission on April 11, 2023. The Final Waterfront Plan is the result of a 3-year public planning process by the Waterfront Working Group (Port of San Francisco, 2023).

As Port projects must comply with the Planning Code and General Plan, BCDC San Francisco Bay Plan (Bay Plan), and San Francisco Waterfront Special Area Plan, the Waterfront Plan compiles these requirements (Port of San Francisco 2020a and 2023).

1.1.4 Other Relevant Plans

- Plan Bay Area 2050

The Association of Bay Area Governments and the Metropolitan Transportation Commission adopted Plan Bay Area 2050 as the Bay Area's long-term regional transportation and land use blueprint in October 2021. The plan connects housing, the economy, transportation, and environmental elements to provide a more equitable and resilient Bay Area. The plan identifies an action plan for 80 specific measures across 35 different strategies.

- Public Realm Plans and Studies

Various City agencies have prepared public realm related plans and studies, including the Fisherman's Wharf Public Realm Plan (2010) and Central Waterfront-Dogpatch Public Realm Plan (Adopted 2018), as well as various transportation plans and projects through San Francisco Public Works, the San Francisco Planning Department, and the San Francisco Municipal Transportation Agency. These include Better Streets projects, transportation projects (such as the Embarcadero Enhancement Project) and the San Francisco Bicycle Plan (2009) amongst others. These transportation plans and projects along or adjacent to the waterfront are of important consideration to the Port. The City also has several plans focused on sustainability, environmental protection, and open space preservation, such as the Green Connections project to link people to parks, open space and the waterfront; an Urban Forest Plan; Groundplay, an effort to transform underused public spaces into enjoyable public spaces; and standards for bird-safe buildings (Port of San Francisco 2020a).

1.2 Existing Condition

This section describes the land uses in the Construction area and in the immediate vicinity.

1.2.1 Existing Land Uses

In 1968, the Burton Act mandated the transfer of Port lands from State management to the City and created the Port Commission to develop, lease, administer, manage, and maintain Port lands. Today, Port lands provide a myriad of maritime, commercial, cultural, and public services. Port land use has shifted from primarily maritime to mixed maritime, commercial, recreational, open space, and other uses over time. Breakbulk cargo flourished along the Embarcadero through World War II when the U.S. military displaced the Port's traditional maritime tenants. Starting in the 1970s, cargo shipping replaced breakbulk shipping and these activities relocated to modern terminals in Oakland and the Port's Southern Waterfront. The historic finger piers have been adapted to accommodate public-oriented maritime commerce alongside long-standing industrial maritime operations resulting in one of the most diverse maritime portfolios in the nation. Recreational boating marinas at Pier 39 and South Beach Harbor and small craft docks in several other locations accommodate a growing interest in water recreation. The Port also provides berths for historic ships and its deep-water pier berths accommodate visiting military and research vessels along this shoreline.

The 1989 Loma Prieta earthquake led to the demolition of a double-decker freeway over the Embarcadero that had been a barrier between San Francisco and the waterfront and spurred the Port to prepare a Waterfront Land Use Plan (Waterfront Plan) for its properties. The 1997 Waterfront Plan, revised several times, guided the reconnection of the city with its waterfront and provided new revenues aligned with local values and legal responsibilities. The Waterfront Plan shaped many land use and development decisions that, along with major public works and Redevelopment Agency projects, resulted in today's waterfront (Port of San Francisco 2020a). Highlights include the Embarcadero Promenade, a revitalized Ferry Building with commercial shops and restaurants, and historic building rehabilitation at Pier 1; Piers 1.5-3-5 bulkhead buildings; Pier 15 (the Exploratorium), and the Ferry Arch. New building construction included Oracle Park and the James R. Herman Cruise Terminal at Pier 27. In addition, many dilapidated piers were removed to create open water areas and major open space parks and plazas at Brannan Street Wharf, Rincon Park, Cruise Terminal Park, and Pier 43 Promenade and Plaza. Numerous other public improvements are documented, including major plans and improvements outside of the Project area at Mission Rock and Pier 70 Union Iron Works Historic District in the central waterfront area (Port of San Francisco 2020a).

In 2019, the Waterfront Plan Working Group of citizen and waterfront stakeholders produced comprehensive recommendations to update the Plan. In April 2023, the Port Commission approved the Final Waterfront Plan. The Final Waterfront Plan has nine goals and supporting policies, including new direction to promote racial and social equity, and climate change resilience and sustainability which support the detailed work of the Port's Waterfront Resilience Program The Waterfront Plan describes the Port's long-term goals and policies to guide the use and improvement of Port piers and properties along its 7½ mile waterfront, from Fisherman's Wharf to India Basin/Bayview.

1.2.2 Land Use Designations

This section describes the land use categories that broadly characterize the predominant uses for city blocks and Port facilities in the Construction Area, as shown in the Land Use Sub-Appendix 1. A general description of land uses is provided in the Embarcadero, Mission Creek and Islais Creek reaches (see descriptions below).

Two land use categories, Maritime land use and Port Open Space & Public Access are discussed qualitatively as this is not within the City of San Francisco zoning map designations. For detailed discussions of land uses on Port property within the Construction Area, see the Embarcadero Seawall Program Land Use Risk Assessment (Port of San Francisco 2020a). These land use types are described below:

- **Port Open Space & Public Access** describes all open space and public access on Port managed property, which includes a network of public access areas and open spaces oriented toward the Bay visually or physically. The waterfront includes several areas of mixed maritime and open space land use such as Ferry Plaza, which houses a public farmer's market and ferry terminals, as well as several small piers that provide recreation and fishing access. Many piers also provide public access along their aprons, or their perimeters, where the public can walk and enjoy views of the Bay. Additionally, the Embarcadero Promenade provides a pedestrian and bicycle path for transportation along the waterfront, and is this area's section of the regional San Francisco Bay Trail, a 500-mile long regional pedestrian and bicycle path around the Bay.
- **Maritime land** is an important land use category, discussed qualitatively and not shown as a separate land use on the figures. This land use depends on a waterfront location to operate and includes uses that support maritime activities such as industrial, storage, office and other uses. Several maritime functions are active within the Construction Area, including cruise, excursion, water recreation, commercial fishing, harbor services, passenger ferry and water taxi, and temporary and ceremonial berthing. Cargo shipping and ship repair functions occur in the southern waterfront, along with additional water recreation, harbor service, passenger ferry and temporary berthing operations. The Port continues to reserve piers and land for maritime activities consistent with its public trust responsibilities. Maritime berthing functions adjacent to piers and wharves

are also not reflected on the land use map. Additional information regarding maritime land use and activity north of Mission Creek is available in the Embarcadero Seawall Program Maritime Commerce Risk Assessment (Port of San Francisco 2020b).

These six land use categories include three mainland uses for the Port's lands – Commercial, Industrial, and Open Space.

The remaining categories pertain to city land uses and are grouped as Open Space, Commercial (also found in Port's lands), Residential, Mixed Use, Industrial, and Public Land Use. These land use categories are on the City of San Francisco zoning map designations and are shown in Figures LU-1 through LU-11 in the Land Use Sub-Appendix 1. They represent the following land uses:

- **Open Space** depicts any open space and public access on City-managed property available for public enjoyment such as parks, plazas, and recreational areas, and areas that provide public access for recreation or scenic vistas.
- **Commercial land** use includes for-profit businesses and the trading of goods or services. Commercial land uses within the Preliminary Construction Zone and within the subareas include retail stores, hotels (including inns and motels), restaurants, fitness studios, entertainment, and visitor services such as parking. This category also includes some mixed uses (without residential) and office land use (management, information, professional services).
- **Residential land** use represents properties with housing including condominiums, apartments, single-family homes, and affordable housing. Residential use on Port lands occurs only where the properties were determined to be surplus to the public trust.
- **Mixed Use** land use signifies mixed uses (with residential). The study area contains several residential complexes as well as mixed office and residential buildings. This category also includes any medical facilities.
- **Industrial land** use generally includes industrial activities such as manufacturing; production, distribution and repair (PDR); or storage. A significant amount of industrial activity occurs in the southern waterfront, and much of the industrial land use consists of warehousing. On Port piers, industrial uses are generally part of mixed maritime and industrial areas and can also include other mixed uses such as office space and cultural, institutional and educational uses, such as museums (e.g. the Exploratorium Science Museum on Pier 15) and art galleries.
- **Public land use** includes publicly managed properties and infrastructure services, such as wastewater treatment plants (e.g. the Southeast Waste Water Treatment Plant in the Islais Creek Reach) and public

transportation lots, as well as vacant land, but generally no Open Space and Public Access, which is depicted under the open space categories.

These six land uses are determined by their Zoning Districts, a key component of the Planning Code (SF Planning Department 2023).

1.2.3 General Overview of Land Uses along San Francisco's Waterfront

The Project area is highly developed and characterized by multiple land uses. It encompasses portions of several San Francisco neighborhoods, including Russian Hill and North Beach (Fisherman's Wharf), the Financial District, South of Market (SoMa)/Mission Bay, Potrero Hill/Central Waterfront, and Bayview North/Islais Creek (see Figure 4.10-A through 4.10-E, San Francisco Neighborhoods). These are described in four reaches below, starting with the northernmost portion of the project area and proceeding to the southernmost portion.

This section describes the land uses that currently exist in these neighborhoods along the waterfront, referencing the reaches used throughout the assessment; Embarcadero, which includes Reaches 1 and 2, Mission Creek (Reach 3) and Islais Creek (Reach 4), named after respective major geographical features in each reach.

1.2.3.1 Land Use Profile – Embarcadero Reaches (Reaches 1 and 2)

The Embarcadero Reaches (see Land Use Sub-Appendix 1, Figures LU-1 through LU-11) stretch from Fort Mason and Aquatic Park along the northeastern waterfront to the span of the Bay Bridge, covering 5 subareas: *Aquatic Park, Fisherman's Wharf, Piers 31-35, Northeast Waterfront and Ferry Building.* San Francisco's urban waterfront here is vibrant and diverse, a place for maritime use and public enjoyment. Architecturally, the waterfront is distinguished by piers and bulkhead buildings built for maritime commerce before World War II, many of which are part of a national register historic district and cultural resources for the city. Piers continue to perform maritime functions that operate alongside, or as part of, many of the city's leading visitor destinations, including the Ferry Building, the Exploratorium, Alcatraz Landing, Pier 39, Fisherman's Wharf, and Hyde Street Pier. An open space system provides recreation along the Bay shoreline and these facilities make the San Francisco waterfront a destination, attracting more than 24 million people annually.

Land use in the *Aquatic Park Subarea* is predominantly *Open Space* along the waterfront. Most of the waterfront in this subarea belongs to the San Francisco Maritime National Historic Park, including Hyde Street Pier and its several historic vessels, the Maritime Museum in the historic bathhouse, and Aquatic Park Pier (also known as Municipal Pier), which extends into the water from the end of Van Ness Avenue. The subarea includes Aquatic Park Cove and a portion of Fort Mason Golden Gate National Recreation Area (GGNRA). Both Aquatic Park Pier and Aquatic Park Cove, the subarea's main waterfront elements, also belong to Aquatic Park Historic District. Dock uses are temporary and ceremonial, allowing fishing access through four public points.

Other land uses include water recreation, and ceremonial berths for historic ships and interpretive exhibits. The Aquatic Park Subarea covers many historic and recreational attractions.

Most of the *Fisherman's Wharf Subarea* is identified as a *Commercial District* - reflecting the many restaurants and retail enterprises catering largely to tourists. This includes a number of hotels and visitor services. Piers 39 through 47 are home to historic buildings and assets, restaurants, hotels, fishing, water recreation, and terminals for San Francisco Bay Ferry, Blue & Gold Fleet, and Red & White Fleet. Some piers provide additional shoreline access, and there are several small landscaped open space areas throughout Fisherman's Wharf. In addition to recreational uses, Fisherman's Wharf also has an active fishing industry. The adjacent North Beach neighborhood includes *Residential* land uses. As shown on Figures LU-1A through LU-10A, a Muni bus storage and maintenance facility (Kirkland Division) and the San Francisco Public Utilities Commission's North Point Wet-Weather Facility are both visible as *Public* land use, covering more than a block each.

Along *Piers 31 through 35*, the piers are all zoned as *Industrial*, while a portion of the waterfront and the water treatment plant as well as Telegraph Hill/Pioneer Park are identified as *Public*. Across from the piers, on the west side of the Embarcadero, blocks on land are identified *Commercial*, including mostly offices, and in one case a parking garage. There is also some *Mixed Use,* including *Residentia*l use, skirting the Project area. Piers 31, 33, and 35 provide berths for excursion terminals, fish processing and potential future berths, and a secondary two-berth cruise terminal. These piers, as well as the subarea's seawall sections, bulkhead wharves, and most of the buildings, are part of the Port of San Francisco's Embarcadero Historic District.

Along the *Northeast Waterfront*, a multitude of land uses are present. The piers in this subarea are zoned *Industrial,* with some being used as storage sheds. Inland across the Embarcadero, the area is zoned as *Commercial* and *Mixed Use.* There is also a wide variety of *Maritime* uses at piers in this subarea: with piers for cruise ships, harbor services including bar pilots, temporary and ceremonial berths, and inactive/reserve berths. Port property in this subarea includes a series of historic buildings and finger piers, a cruise terminal, bulkhead wharves, and seawall lots. The seawall, bulkhead wharves, and most of the piers of this subarea are part of the Embarcadero Historic District. Significant waterfront and tourist attractions of this subarea include the Exploratorium, historic piers, iconic views of the bulkhead buildings, the James R. Herman Cruise Terminal, and multiple restaurants, including the Pier 23 Café Restaurant and Bar and the Waterfront Restaurant. The subarea also includes areas zoned as *Open Space* for recreation, such as the Embarcadero Promenade, which runs along the entire length of the subarea's waterfront, supporting recreational use and foot traffic between tourist attractions.

The *Ferry Building Subarea* includes the Ferry Building, the Port's headquarters at Pier 1, the city's downtown ferry terminals, and portions of San Francisco's Financial District.

The Financial District is the Bay Area's largest and densest job center, comprising large areas of high-density housing, commercial, and mixed-use space near The Embarcadero and Market Street. The piers and Ferry Building are identified as *Commercial,* with *Port Open Space & Public Access* uses. The gateway area between the Ferry Building and Downtown Office Commercial District is *Open Space*. The area also includes some *Residential* land use. The piers in this subarea are for fishing, ferry and water taxi, excursion, harbor services, water recreation, and temporary or ceremonial berthing. There are four public access locations. In addition to the ferry terminals, this area also contains significant city and regional transportation infrastructure and connection points, including underground Embarcadero BART/Muni stations, multiple Muni bus lines, historic streetcars, and cable cars. The Bay Trail also runs along the Embarcadero and the Financial District shoreline. *Commercial* and *Maritime* uses on Port property (piers and inland lots) generate revenues for capital repair and maintenance of Port marine infrastructure, buildings and public realm assets that support maritime use, visitor attractions and public enjoyment of the shoreline.

Public *Open Space* includes Sue Bierman Park, 4.4 acres of land that previously served as on- and off-ramps for the elevated Embarcadero Freeway that was demolished and converted into open space after being damaged by the 1989 Loma Prieta earthquake. Located to the north of the Ferry Building, Pier 1.5 includes a water taxi landing and public boat dock. Pier 7, located on the northernmost end of this subarea's shoreline, is a long, thin pier, lined with benches and panoramic views of both the Bay and the city. It is also popular for crab fishing, mainly at night, and for shark and perch fishing. At the southern end of this subarea, between the Ferry Building and Bay Bridge, Pier 14 serves as a breakwater that extends over 600 feet into the Bay, protecting the Downtown Ferry Terminal from wave and tidal forces. Pier 14 also includes several educational markers to help the public imagine future SLR protections. Adjacent to Pier 14, the Downtown San Francisco Ferry Terminal Expansion Project is expanding and enhancing the ferry landing area. The project includes the construction of new ferry gates that will be able to accommodate roughly three to four feet of anticipated SLR above a 100-year extreme tide event.

1.2.3.2 Land Use Profile - Mission Creek Reach (Reach 3)

The Mission Creek reach (see Land Use Sub-Appendix 1, Figures LU-1 through LU-11) covers the waterfront from the span of the Bay Bridge to Pier 80 and includes the area around the Mission Creek inlet. The SoMa and Mission Bay neighborhoods comprise developing mixed-use neighborhoods as well as large commercial buildings on both sides of Mission Creek. The subareas in this reach include *South Beach, Mission Creek, Mission Rock, Mission Bay,* and *Pier 70*.

The *South Beach Subarea* includes several different types of land uses. The piers, waterfront and the San Francisco Giants' baseball park are all zoned *Industrial*. Across the Embarcadero, the area is zoned mainly *Residential* and *Mixed Use*. At 4th Street, the area includes a portion of the Central SoMa Mixed Use District, which includes residential and office use. Between Mission Creek and Townsend Street, the area is *Mixed Use* and part of the Mission Bay Redevelopment Area. South Beach is home to historic buildings, piers, South Beach Harbor, parks, affordable housing developments, and city and regional assets key to disaster response. Along the shoreline, the South Beach waterfront has piers with a variety of berths to allow for temporary and longer-term docking and harbor services, water recreation visitor berths and the South Beach Marina, Bay excursions, a water-taxi landing, and inactive/reserve berths as well as four public access locations with water access. Oracle Park, the San Francisco Giants' baseball park, is a key community resource and economic generator. The China Basin Ferry Terminal in this location provides water-transit service on game days throughout the Bay Area.

The *Mission Creek Subarea* also has a diverse set of land uses dominated by *Mixed Use* and *Industrial* land uses around the Mission Creek inlet, especially between the Interstate-80 and 280 freeways. The areas surrounding Mission Creek are identified as the Mission Bay Redevelopment Area with some mixed-use residential and public spaces, including the areas along the freeway corridors.

This subarea includes the Mission Creek inlet, including its *Maritime* uses, encompassing houseboats, a kayak boat launch, ferry and water taxi piers, berths and harbor services. Old and new residential housing, grocery stores, and additional community services are also in this area. Interstate 80 freeway off-ramps (shown as *Mixed Use* land use) and the Caltrain King Street Station and Transit Hub (shown as *Commercial* land use) are all important regional transportation assets and are located within the area north of Mission Creek Channel.

The *Mission Rock Subarea* is primarily identified as *Mixed Use* and *Open Space*, with *Mixed Use* inland. It covers the area south of the Mission Creek inlet and includes China Basin Park (*Industrial*), Piers 48 and 50 (Mission Rock *Mixed Use* and *Industrial*, respectively), and Seawall Lot 337 (*Mixed Use*). Much of this area is planned for redevelopment under the Port's Mission Rock and Pier 48 project, which will provide new affordable housing, open space for public use, new living-wage jobs, and renovation of Pier 48. Currently, the historic Pier 48 is leased by several companies and serves a variety of maritime, commercial, environmental, and emergency response uses.

Originally an industrial district, the *Mission Bay Subarea* underwent a transformation in the last decade. The land uses of the *Mission Bay Subarea* are now predominantly *Mixed Use* including residential units, offices, and medical facilities including the central UCSF Mission Bay Campus. *Open Space* use is present along the waterfront. The subarea includes several landmarks, including the newly opened Chase Center, Bayfront Park, the Corinne Woods Pier 52 Boat Launch, and UCSF and Kaiser medical centers.

The *Pier 70 Subarea* is primarily *Industrial* (the seawall lots and piers) and *Mixed Use*, with a portion of Pier 70 having its own mixed-use designation. The subarea also includes the newly opened Crane Cove Park and other *Open Space* areas along and connecting to the waterfront. This subarea contains the Union Iron Works Historic District, encompassing Pier 68 and many buildings and structures near Pier 70. Pier 68 also provides *Maritime* uses, consisting of large ship dry docks, cranes, and industrial buildings. However, existing structures at the site have deteriorated over time and the pier itself is largely unused (numerous improvements would be needed to maintain shipyard services at this location). A Port-led effort referred to as the Pier 70 project is underway to create a new, mixed-use development in the area. The project will revitalize the area east of Illinois Street extending from Mariposa to 22nd Street. Plans include rehabilitation of historic resources, support for ongoing ship repair, new waterfront parks and shoreline access, and space for new residential, office, retail, and industrial land uses. While industrial uses will continue to be an important aspect of the Central Waterfront, including on this site, the City's Central Waterfront Area Plan has identified this area as a location for additional growth and a wider range of land uses, including residential, commercial, and waterfront parks. The Pier 70 project will include approximately 2,400 residential units, 1.2 to 1.9 million square feet for commercial use, and six acres of open space. Development will raise grades to accommodate SLR and include waterfront riprap and loose stone used to form a foundation for a breakwater to relieve the force of breaking waves.

1.2.3.3 Land Use Profile - Islais Creek Reach (Reach 4)

The Islais Creek reach stretches from Pier 80 to Heron's Head Park (see Land Use Sub-Appendix 1, Figures LU-1E through LU-11E). Located along the southeast edge of the city, it covers portions of the Bayview North/Islais Creek neighborhoods and includes the industrial areas surrounding Islais Creek, as well as residential areas and developments. Much of the city's *Industrial* land use is located within this reach. A portion is part of the former Industrial Protection Zone Special Use District, which was established to protect and preserve industrial land uses and activities from competing with higher priced land uses. Current uses include various industrial and automobile related businesses such as iron, metal, and chemical processing companies, gas stations, rental car facilities, automotive repair shops, and the home of the Yellow Cab Co-Op. There are also areas identified as *Public*, which are City and State facilities including a highway patrol office, a Public Works Yard, and the Southeast Wastewater Treatment Plant. The five subareas in this reach include *Pier 80, Islais Creek, Cargo Way, Piers 94-96,* and *Heron's Head*.

Most of the *Pier 80 Subarea* is zoned as Heavy *Industrial,* a land use designation that is the least restricted and usually separated from residential and commercial areas. Most of this land is controlled by the Port and includes *Maritime* functions; Pier 80 is a 60-acre working cargo pier handling automobile exports with two warehouses, four deepwater berths, and two cranes used to offload materials from ships. It is also the city's only pier that can unload materials from ships directly to railroad cars. Seawall Lot 356 and portions of the Potrero Hill neighborhood's southern industrial area, including a

Muni Metro East Maintenance Facility (zoned as *Public*) and Warm Water Cove Park and the Blue Greenway (*Port Open Space and Public Access*), are also part of the subarea. This subarea is also part of the Port of San Francisco Piers 80–96 Maritime Eco-Industrial Center (Maritime Eco-Industrial Strategy), which is generally bounded by 25th Street on the north, Illinois Street on the west, and Cargo Way on the south. It co-locates *Maritime and Industrial* uses to enable product exchange, optimize use of resources, incorporate green design and green technologies on-site, foster resource recovery and reuse, provide economic opportunities that employ local residents, minimize environmental impacts, and incorporate public open space for enjoyment and wildlife habitat.

Most of the project area in the *Islais Creek Subarea* is Light and Heavy *Industrial* with PDR and some *Commercial* land uses (along Third Street with some neighborhood commercial use). The project area includes the industrial area surrounding the western portion of Islais Creek, the Islais Creek Channel, and the northern section of the Bayview Hunters Point neighborhood north of Quesada Avenue. The area contains several key infrastructure assets, including the Southeast Wastewater Treatment Plant (shown as *Public* use) as well as multiple transportation storage, maintenance, and operation facilities that serve the entire city. *Islais Creek* is also part of the Port of San Francisco Piers 80–96 Maritime Eco-Industrial Strategy (Maritime Eco-Industrial Center).

The *Cargo Way Subarea*, which includes Pier 90-92 backlands (Seawall Lots 344 East and West) at the southern entrance of the Islais Creek, Third Street, and Illinois Street Bridges, is also Heavy *Industrial.* It is controlled by the Port. In addition to the Port's *Maritime* maintenance facility, *Industrial* land uses include construction material storage and processing facilities as well as an Intermodal Cargo Transfer facility operated by the San Francisco Bay Railroad, maritime services through dry bulk cargo ship loading, and two concrete batch plants that are the city's sole providers of concrete. It also includes a small wetland and adjacent upland area, known as Pier 94 wetlands (*Port Open Space)*.

The *Piers 94-96 Subarea* is an *Industrial* area located on Bay fill with buildings and aggregate, and construction material operations. Both piers have been identified by the Federal Emergency Management Agency as staging areas for goods as well as debris removal in the event of a disaster. *Industrial* and *Maritime* land uses include a dry-bulk cargo terminal, San Francisco Bay Railroad, the Recology Recycling Center (including sustainable crushing and concrete recycling facilities), and long term lay berths used for maritime, industrial, and emergency response services.

The *Heron's Head Subarea* is identified by the City as *Industrial* due to its past as a rock-fill breakwater to protect the south side of Pier 96. However, it is now home to the 22-acre Heron's Head Park and considered as *Port Open Space and Public Access* land use. Heron's Head Park provides public access to the waterfront in the otherwise industrial neighborhood and the park and its wetlands offer ecological value through salt marsh habitat. Infrastructure in this subarea relevant to the public include the

EcoCenter, an educational community center, and one of PG&E's nine San Francisco substations, the 110 – 161 kilovolt Hunters Point substation.

2.0 Environmental Consequences

2.1 Assessment Method

The context for land use will utilize the existing land use and anticipated developments in the Project Area. The existing land use refer to the City of San Francisco zoning maps (Planning San Francisco, 2023) to determine the different land uses along the waterfront. Anticipated developments will be included that appear to be reasonably foreseeable by 2040.

Planned developments have been identified within the Project area that will occur without the Project. These developments are described in Table 2-1 and any land use changes that occur from these developments will not be included in this analysis or considered land use changes as a result of this Project.

Table 2-1. Planned Developments

Name	Land Use	Reach	Acreage
Mission Bay Park P3	Mixed Use	3	2
Mission Rock	Mixed Use	3	43
P22 Bayfront Park	Mixed Use	3	9
Mission Bay Ferry Landing	Open Space	3	0
Agua Vista Park Improvements	Open Space	3	1
Mission Bay Water Taxi Landing*	Open Space	3	0
Crane Cove Park	Industrial Land Use	3	11
Pier 70	Mixed Use	4	58
Potrero Power Station	Mixed Use	4	47
Pier 94 Backlands Improvements	Industrial Land Use	4	81
Pier 70 Shipyard	Industrial Land Use	4	4

Note: *Mission Bay Water Taxi Landing is in the Open Water and does not change an existing land use.

2.2 Basis of Significance

The context for evaluating land use will include the adopted and publicly released draft land use plans for the San Francisco waterfront area.

The alternative could pose a significant impact to land use if implementation of an alternative would result in any of the following conditions:

- The degree to which the Project would alter planned land uses, patterns, types and densities and whether the project would physically divide an established community. Areas within the project footprint are considered highly likely to be modified and potentially change land use designations to accommodate the Project.
- The degree to which indirect changes from the Project would occur to land uses due to construction or operations of the measures. This includes the area within a 200-foot buffer for construction of measures. Construction is expected to be temporary but could continue at a given construction site for up to 10 years. All areas within the construction area are not expected to change land use during construction, however in areas of more intense construction, land uses may change with retreat and disruption of use. Operation conditions are not detailed sufficiently to evaluate at this time and operation impacts to land use will be considered with project-level environmental documents.
- Conflict with local or regional land use plans or policies addressing environmental effects. Existing land use plans were reviewed to determine if the current alternatives differ or conflict with established guidelines and policies. Modification of some plans will be required to accommodate the changing waterfront due to inundation, retreat, and construction disruptions.

2.3 Effects

Existing land use and anticipated changes are evaluated in this section for each of the alternatives.

2.3.1 Construction Impact Summary

Impacts to land uses during construction can result from residents and users experiencing the noise, dust, and increases in construction traffic, as well as changes to traffic and transit patterns and detours for cars, transit, and pedestrians and bicycles to keep people safe in construction zones. In any given area that disruption could last from days or weeks to years depending on the specific activity and construction and detour plans. These disruptions can cause only temporary changes to existing uses, or when for a longer duration can cause a longer term land use change that can affect a neighborhood or community. In some cases, new land uses will be introduced such as parks and trails that enhance a neighborhood and can make it more attractive to users. Retreat from areas that become more frequently flooded within an alternative can put additional pressure on adjacent areas that are protected, including commercial, residential, and industrial uses, as these are pushed out of retreat areas and replaced elsewhere.

Direct construction impacts to land use would result from demolishing existing buildings to construct flood-protection and retreat measures. The measures that would have the greatest impact are floodproofing and demolishing buildings, construction related to bay fill, soil improvements and seawall improvements which can cause disruption in the vicinity of construction from road closures, noise, and traffic impacts, deployable flood gates which can temporarily decrease movement into certain areas, and roadway impacts which can discourage movement into the area and diminish use of existing land uses in the area. These measures could alter the community and lead to land use changes. Areas that are proposed for retreat would be flooded with rising sea levels and the land use and structures would be abandoned at these locations. No plans currently exist to identify areas where uses would move or intensify to accommodate displaced uses from the retreat areas. These may cause land uses changes in other areas than the construction zones identified here, however at this point there is not enough known of the planning steps that would be taken to accommodate retreat, and is too speculative at this point for meaningful analysis.

Indirect impacts to land use could result in the division of communities from construction or rebuilding of important transportation corridors. The measures such as roadway impact and bridge elevations would be most disruptive to established transportation connections. Although construction impacts would be temporary, less than 10 years for each construction phase, the impacts may have long-term effects to land uses that are more dependent on transportation connections, such as, industrial or commercial facilities requiring access to the waterfront for transport of good or tourism.

Another potential indirect impact to land use could be as key facilities are relocated to another area or demolished, the surrounding existing land uses may shift to other land uses. For example, in Alternative G, the Chase Center will be demolished, and the nearby tourist facilities and retail business may no longer be in as great demand and convert to residential or other commercial uses. Where elements of the Kaiser or UCSF Medical Center at Mission Bay may be demolished or relocated, the nearby medical facilities would be less convenient to patients and health operators and may follow where the medical center would reestablish.

Land use plans and policies will need to be modified to acknowledge changes in certain areas for each of the alternatives, as land uses and transportation will be modified for retreat, modification of transit and transportation plans, intensification of some land uses, and new land uses are introduced.

2.3.2 Operations and Maintenance Impact Summary

Impacts from operations and maintenance would be minimal for most construction measures, except use of deployables and tide gates. Deployable flood gates would limit access to transportation corridors for hours to days during storm surges or high tide events. With this unpredictability for access, communities that rely on the bridges (proposed for flood gates) may become less valuable and shift land uses. The tide gates could indirectly impact the residents, such as houseboats, and industrial and commercial facilities that rely on reliable water access at Mission and Islais Creeks.

2.3.3 Total Benefits Plan (TNBP)

Impacts to land use from the TNBP are scored in Table 2-2.

Table 2-2. Summary of Land Use Impacts Associated with the TNBP

TNBP Land Use Impact Rating by Measure	**Bay Fill**	**Levee**	**Bulkhead wall/Seawall**	**Deployable Flood Gate**	**Roadway Impact**	**Sheetpile Wall**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint (1st Action)	1	2	4	3	4	1	4	1	4	1	1	1	1	1
Construction/Footprint (2nd Action)	1	2	4	1	4	1	1	1	4	1	1	1	1	1
O&M Assumptions	1	1	1	3	1	1	1	1	1	1	1	1	1	1
Mitigated Rating	1	2	3	3	3	1	3	1	3	1	1	1	1	1

In Reach 1, the initial actions under the TNBP include floodproofing around 20 buildings and installation of short floodwalls along the outer edges of piers. In Reach 2, the initial actions include performing ground improvements for seismic performance along the Embarcadero, raising the shoreline with a new higher seawall and raised wharves including fill and pile-driving of replacement or new piles, and installation of small flood walls along the edges of the piers.

In the subsequent actions for Reach 1, changes similar to the initial actions in Reach 2 will be implemented, including ground improvements along The Embarcadero, constructing a higher seawall, and raising wharves will take place. Construction along The Embarcadero will occur at different times in reaches 1 and 2, so that the entire corridor length is not in construction at once. Construction along the waterfront including the seismic ground improvements will cause land use disruption during construction. Though construction of the entire work may take 6 years, the construction will move along the waterfront and will be temporary in any given location.

For Reach 3, in Mission Creek/Mission Bay, key first actions involve raising the shorelines to 13.5 feet through levees, curbs, and floodwalls, performing ground improvement, installing deployable closure structures at Third and Fourth Street bridges across Mission Creek, and enhancing wildlife habitat. Subsequent actions include further elevation to 15.5 feet, maintenance of roadway capacity, and incorporation of engineering with nature features. Improvements are located near the shoreline, along Terry Francois Boulevard and the margins of Mission Creek. Bridges would be protected with use of deployable barriers when extreme events are predicted; this could result in closing of these corridors for hours to days. In subsequent actions the bridges would be raised.

Lastly, in Islais Creek/Bayview (Reach 4), initial actions involve elevating the shorelines, installing concrete curbs, performing ground improvement, and incorporating engineering with nature features. Deployable barriers would be used at Illinois Street Bridge for the initial period. Piers 90 and 92 would be rebuilt. Subsequent actions include additional shoreline elevation, construction of levees, and building adaptations, and would include raising the Illinois Street Bridge in later actions.

The TNBP construction measures would require alterations to residences and commercial and industrial businesses, including the demolition of 988,902 -square-feet of building footprints. By providing a bayward line of defense (LOD) and retaining much of the existing shoreline, this alternative requires minimal displacement of existing uses, and preserves more of the existing uses than other alternatives. The new LOD would not generate construction effects that would divide the community and these features would ensure that future flood events do not physically divide the waterfront neighborhoods. Implementation of project construction- and displacement-related measures under AMM LU-1 and LU-2 would be required to reduce land use and policy effects related to the TNBP. The TNBP compared to the No Action FWOP has less impact on planned land use, land use patterns, types, and densities. It also has fewer impacts long-term than Alternative F and G. The TNBP would result in a ***less than significant impact*** to land use along the waterfront with implementation of AMM LU-1 and LU-2.

TNBP construction would impact less land area and have fewer demolitions than other alternatives, as the footprint Is primarily along the waterfront and minimizes loss of usable land. Construction duration is expected to be 10 years. These indirect impacts have the potential to convert land use patterns, but less than under the No Action alternative, or the other action alternatives. The TNBP would have a ***less than significant impact*** from indirect land use changes due to construction with implementation of AMM LU-1 and 2.

This alternative would be consistent with existing land use plans and accommodate anticipated sea-level rise up to 7 feet in 2090. This alternative adapts to anticipated sea-level rise with less demolition and smaller construction area than other alternatives.

The TNBP would have ***less than significant impact*** on local or regional land use plans with implementation of AMM LU-2.

Table 2-3. Alternative TNBP – Potential Land Use Changes

Action	**1st Action**				**2nd Action**			
Land Use Designation	**Project Footprint**		**Construction Area**		**Project Footprint**		**Construction Area**	
	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels
Open Space	0.01	1	3.30	20	0.01	1	0.95	3
Commercial Land	36.22	57	81.82	140	7.99	34	50.55	101
Residential Land	-	-	4.90	21	-	-	7.08	23
Mixed Use	26.94	40	162.92	168	22.27	34	120.61	128
Industrial Land	40.79	57	212.24	73	45.86	35	98.74	43
Public Land Use	3.86	9	34.85	21	4.07	6	19.35	10
Total*	**107.82**	**164**	**500.05**	**443**	**80.20**	**110**	**297.29**	**308**

*Open Water does not include a land use designation and is not included in the total acres.

2.3.4 Alternative B: Nonstructural

Alternative B is a non-structural alternative and includes floodproofing, modifying, and planned abandonment and demolition of buildings and infrastructure once land uses are displaced to reduce flood risks. No flood protection structures such as levees of walls would be built. As sea levels rise, areas with higher flood risks could be managed for responsible retreat, while areas with lower risks could be floodproofed or modified. Policy changes may need to be implemented to allow for increased housing density and business relocations in inland areas. Essential utilities and major transportation and transit corridors would be relocated or modified to continue providing service.

Substantial displacement of residences, commercial and industrial businesses, and community and public facilities as inundation increases over time and areas flood frequently would lead to building acquisition and demolition. Alternative B would involve building demolition of 1.1 million square feet of buildings and pier/wharf removal. Implementation of project construction- and displacement-related measures under AMM-LU-1 and LU-2 would be required to reduce the effects on existing and planned land use. Similar to the FWOP, 237 publicly owned facilities would experience flooding under Alternative B by 2090 and many of these structures would be demolished. The Alternative B would have a ***significant and unavoidable impact*** on land use compared to the other action alternatives.

Implementation of Alternative B would provide the benefit of more reliable and predictable flood protection and retreat than No Action, reducing the risk of emergency events and flood damage and response. The planned protection of some and displacement of other land uses provided under this alternative would reduce the substantial adverse effect of increased flooding frequency and intensity over that anticipated under the No Action alternative which would have no concerted planning efforts to assist in managing inundation effects.

This is a high number of abandonments and will have significant effects on the existing land use types and patterns. This could lead to neighborhoods and major businesses along the San Francisco Waterfront being displaced and physically divide established communities. These effects would occur more slowly than would occur in the event of no action by the USACE and Port - the baseline for the analysis is the No Action FWOP. Compared to those no action effects which would allow flooding of areas with no planned protection, land uses under this scenario may remain in place longer than with no action, but would eventually become too expensive and likely unsustainable in place as sea level rises, changing land uses and causing potentially increased development pressures or land use changes in other parts of the City. Alternative B could delay these major changes compared to no action but would ultimately have similar results.

Alternative B would require floodproofing or retreat of buildings and critical infrastructure. Construction would involve floodproofing buildings, relocating critical systems, and demolition of abandoned buildings and infrastructure. A retreat from the flooding waters could be phased from repeated storm surges and high tides encroaching onto existing dry land. However, retreat or abandonment could occur after a single significant flooding event especially if a storm surge occurred during high tide and buildings were heavily damaged beyond repair. For building floodproofing, construction would be at a smaller scale and are anticipated to be a city block at the largest. This impact is considered ***too speculative for meaningful consideration*** to determine at this time and will be reevaluated during project-level analysis.

Alternative B has no major flood infrastructure that requires ongoing operations, and therefore ***no impacts*** due to Operations.

The existing land use plans and policies would not directly be affected by the Project. Floodproofing or retreating buildings that are vulnerable to flooding, which would meet the goals of the Waterfront Plan by allowing adaptation. This would also meet the policies in the General Plan to examining flooding and adapt to future climate flood hazards. Other land use plans would likely need to be modified to reflect the expected reality of increased flooding frequency and retreat of land uses that are currently anticipated in the existing land use plans. Without any information as to where new facilities, residences, or commercial and industrial uses will be relocated, additional modifications to land use plans outside the area to allow the relocation of these uses would be needed. Some existing plans will require modification to acknowledge the changed uses. The Project would have ***less than significant impact*** to existing land use plans or policies compared to taking no action and allowing unplanned retreat and ad-hoc floodproofing from flooding without accommodation in new or modified land use plans.

Table 2-4. Alternative B – Potential Land Use Changes (2040 and 2065)

Implementation Year	**2040**				**2065**			
Land Use Designation	**Project Footprint**		**Construction Area**		**Project Footprint**		**Construction Area**	
	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels
Open Space	2.81	2	2.09	13	3.64	X	1.67	X
Commercial Land	108.15	174	97.27	216	91.79	X	137.68	X
Residential Land	0	0	1.26	3	5.34	X	5.13	X
Mixed Use	250.72	310	113.67	190	89.63	X	159.21	X
Industrial Land	168.5	41	127.91	57	46.86	X	139.17	X
Public Land Use	11.10	25	31.46	16	10.01	X	29.50	X
Total*	**540.94**	**552**	**373.65**	**495**	**247.26**	**X**	**472.38**	**X**

*Open Water does not include a land use designation and is not included in the total acres.

Table 2-5. Alternative B – Potential Land Use Changes (2090 and 2115)

Implementation Year	**2090**				**2115**			
Land Use Designation	**Project Footprint**		**Construction Area**		**Project Footprint**		**Construction Area**	
	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels
Open Space	0.16	X	1.32	X	0	X	0.47	X
Commercial Land	94.03	X	165.55	X	42.03	X	194.01	X
Residential Land	12.71	X	18.18	X	7.87	X	27.13	X

Mixed Use	92.10	X	210.86	X	73.35	X	226.37	X
Industrial Land	79.97	X	141.55	X	45.07	X	157.01	X
Public Land Use	5.83	X	39.19	X	2.67	X	40.69	X
Total*	**284.81**	**X**	**576.65**	**X**	**168.33**	**X**	**645.67**	**X**

*Open Water does not include a land use designation and is not included in the total acres.

2.3.5 Alternative F: Manage the Water, Scaled for Higher Risk

Table 2-6 shows a summary of the land use impacts associated with Alternative F.

Table 2-6. Summary of Land Use Impacts Associated with Alternative F

Alternative F Land Use by Measure	**Bay fill**	**Levee**	**Bulkhead wall/Seawall**	**Roadway Impact**	**Tide Gate**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Marsh Enhancement***
Construction Footprint	4	3	3	4	1	1	1	4	1	1	1
O&M Assumptions	1	1	1	1	3	1	1	1	1	1	1
Mitigated Rating	3	2	3	3	3	1	1	3	1	1	1

Alternative F proposes a coastal flood defense infrastructure that would rely on the construction of tide gates, shoreline extensions into the Bay with associated bay fill, levees, raised roads, and floodwalls along the current Bay shoreline, following the “manage the water” strategy. The shoreline would be extended into the Bay along the Embarcadero Waterfront in Reaches 1 to 3 to make space for underground stormwater storage capacity and to minimize disruption to transportation facilities along The Embarcadero. Floodproofing for maritime and industrial facilities would also be included. Residual coastal and inland flood risks could be addressed through floodproofing. More than 1,000,000 cubic yards of fill would be used during construction in 2040, with more than 113,000 cubic yards in 2090. Flood-protection measures under Alternative F include tide gates in Mission Creek and Islais Creek to manage sea-level rise and cantilever pile walls along the northern waterfront, levees, and walls. Measures would be adaptable to additional sea-level rise in 2090. Tide gates would be installed at Mission Creek and Islais Creek to reduce inundation in those areas, and would be permanently closed in the second actions, with added pumps.

This alternative would accommodate retreat from frequently flooded areas including 1.5 million square feet of demolition and 15,790 linear feet of wharf replacement. Implementation of project construction- and displacement-related measures under AMM-LU-1 and LU-2 would be required to reduce effects related to Alternative F. These AMMs would be required for all future construction activity.

Alternative F does support more protection and preservation of existing structures and infrastructure relative to Alternative A, No Action and long-term supports a more aggressive timeline for sea-level-rise defense. By 2090 under Alternative F, 92 public facilities would experience flooding and would likely require demolition, however, this would be less impactful than the FWOP. Alternative F would preserve substantially more existing land uses relative to the FWOP. While Alternative F includes alterations to the existing community to support some managed retreat inland along the southern waterfront, the new LOD would not generate construction effects that would divide the community and these features would ensure that future flood events do not physically divide the waterfront neighborhoods. Long term, these protection measures would avoid the worse effects of the FWOP on land use and land use policy..

Alternative F would use an active system by relying heavily on machinery to manage flooding. This alternative would install flood-protection measures including tide gates in Mission Creek and Islais Creek, extend seawalls bayward along the northern waterfront, and levees and walls for the Project to manage flooding. Port operations and working lands in the coastal adaption zone would be raised and adapted to 3.5 feet in 2040 and 7 feet in 2090 for sea-level rise. Alternative F would be adaptable for 2090 conditions for sea-level rise.

Alternative F would protect inland flooding by installing a tide gates and cantilever pile walls in 2040 and add additional flood defense in 2090. The area outside the flood-protection measures would be raised or adapted to sea-level rise. Since most of the land would be protected or adapted to sea-level rise, there is a more limited direct impact to land use as shown in Table 2-6. The potential land use changes are lower than the established threshold for a significant impact for both 2040 and 2090. Alternative F would have a ***less than significant impact*** on land use.

Alternative F would construct flood-protection measures throughout the waterfront. A 200-foot buffer around the project footprint was established as the area were potential construction impacts could occur and lead to land use changes. Alternative F construction is expected to be 10 years long. Operations from tide gates were not included in this analysis and will be further developed during project-specific analysis. According to Table 2-6, the thresholds for land use for the Construction area are below the threshold for significant impact. Alternative F would have a ***less than significant impact*** for indirect land use changes.

This alternative would be consistent with existing land use plans and accommodate anticipated sea-level rise up to 7 feet in 2090. This alternative would adapt to sea-level rise by actively pumping floodwaters away from inland areas. Alternative F would extend the waterfront into the Bay in more northern reaches. This alternative would have ***less than significant impact*** on local or regional land use plans.

Table 2-7. Alternative F – Potential Land Use Changes

Implementation Year	**2040**				**2090**			
Land Use Designation	**Project Footprint**		**Construction Area**		**Project Footprint**		**Construction Area**	
	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels
Open Space	5.03	17	19.41	37	5.38	16	15.56	30
Commercial Land	18.81	32	69.99	118	13.80	37	85.09	132
Residential Land	0	0	10.56	21	0	0	10.38	21
Mixed Use	3.20	27	42.66	106	9.68	37	54.01	156
Industrial Land	81.56	62	163.56	91	65.41	73	173.25	98
Public Land Use	0	0	1.60	8	4.02	6	10.94	15
Total*	**108.60**	**138**	**307.78**	**381**	**98.30**	**169**	**349.23**	**452**

*Open Water does not include a land use designation and is not included in the total acres.

2.3.6 Alternative G: Partial Retreat, Scaled for Higher Risk

Table 2-8 shows a summary of the land use impacts associated with Alternative G.

Table 2-8. Summary of Land Use Impacts Associated with Alternative G

Alternative G Land Use Impact Rating by Measure	**Levee**	**Bridge raise**	**Bulkhead wall/Seawall**	**Roadway Impact**	**T-wall**	**Vertical Wall/Curb Extension**	**Wharf**	**Ecological Armoring***	**Ecotone Levee***	**Embankment Shoreline***	**Naturalized Shoreline***	**Marsh Enhancement***
Construction/Footprint	5	5	3	5	3	1	4	1	1	1	1	1
O&M Assumptions	1	1	1	1	1	1	1	1	1	1	1	1
Mitigated Rating	4	4	3	4	1	1	3	1	1	1	1	1

Alternative G proposes to build levees and walls in some areas, while initially floodproofing and then as water levels rise, retreat from inundation, eventual result in demolition in the second action of residences, businesses and community and public facilities particularly in Mission Bay and Islais Creek areas. By 2090 under this alternative, 111 public facilities would experience inundation and likely require demolition which is an improvement compared to the FWOP impacts. This alternative would also require alterations to commercial and industrial businesses along wharf structures. Bridges over Islais Creek would be raised, which would require demolition of existing bridges and building of truss bridges at a higher elevation to adapt to sea level change.

Retreat and required demolition under this alternative would remove approximately 8.4 million square feet of structure footprints, including the area of Mission Bay from Sixteenth Street on the south side of Mission Bay to King Street on the north side, a substantial land use change.

Compared to the No Action Alternative, Alternative G supports the preservation of many existing structures and infrastructure that would otherwise be lost but does have more effects on land uses and results in more retreat and building demolition than any of the retained alternatives to allow for more natural watersheds. Alternative G includes extensive alterations to the existing communities and land uses to support the managed retreat of the shoreline inland along the southern waterfront rather than defending at the existing shoreline. This preventive retreat would fundamentally alter the community connectivity and character in their respective neighborhoods but would also ensure that flood events do not physically divide the waterfront neighborhoods. With Alternative G, community isolation would occur as retreating from the waterfront intensifies, however, this retreat would result in less disruption and impacts from isolation than the FWOP since the retreat is planned and impacts can be minimized or mitigated. Alternative G would be more severe than other build alternatives for disruptions to communities and access. Overall, this impact would have less effect on land use and policy when compared with the FWOP.

To accommodate retreat of the uses around Mission Bay, policy changes would be required to allow for redevelopment at higher densities in other areas of the city or region Implementation of project construction- and displacement-related measures AMM LU-1 and AMM LU-2 would be required to reduce the land sue and policy effects of Alternative G).

Alternative G would adapt to natural flooding by building levees in flood-prone areas and relocating buildings, transportation systems, and public assets. This alternative would accommodate sea-level rise at 3.5 feet in 2040 and 7 feet in 2090. The Port working lands would be adapted to flooding.

Alternative G would change Port working lands to flooding as sea-levels rise by 2090. This would result in a substantial change to the land use over the next century. For industrial lands this would be a significant change in land use for 2040 and 2090. As an overall total change in land use, this would result in a significant change as well. In addition to industrial lands in 2090, commercial and mixed use lands would have a significant impact. Alternative G would result a *significant and unavoidable impact* to direct land use along the waterfront.

Alternative G construction would impact a larger area of land since the shoreline would be raised further inland and bayside areas would be abandoned or adapted to flooding. Construction duration is expected to be 10 years. These indirect impacts have the potential to convert land use patterns especially for industrial parcels. The significance threshold was exceeded for industrial lands in 2040, mixed use land in 2090, and total overall land use for both 2040 and 2090. This exceedance demonstrates the impact that this alternative would have on land use in San Francisco. Indirect land use impacts due to operations will be evaluated in a project-specific level analysis. Alternative G would have a ***significant and unavoidable impact*** from indirect land use changes due to construction.

This alternative would be consistent with existing land use plans and accommodate anticipated sea-level rise up to 7 feet in 2090. This alternative adapts to anticipated sea-level rise and accommodates flooding in low-lying areas. Alternative G would have ***a less than significant impact*** on local or regional land use plans.

Table 2-9. Alternative G – Potential Land Use Changes

Alternative Year	**2040**				**2090**			
Land Use Designation	**Project Footprint**		**Construction Area**		**Project Footprint**		**Construction Area**	
	Acres	Parcels	Acres	Parcels	Acres	Parcels	Acres	Parcels
Open Space	8.84	27	30.76	67	1.57	5	28.74	61
Commercial Land	72.87	141	168.96	274	107.66	134	153.29	262
Residential Land	6.31	18	15.75	27	0	0	10.83	22
Mixed Use	14.42	75	123.87	258	136.61	328	209.97	510
Industrial Land	111.06	84	238.57	93	212.56	39	154.07	116
Public Land Use	2.40	13	11.42	21	14.41	8	9.36	23
Total*	**215.90**	**358**	**589.33**	**740**	**472.81**	**514**	**566.26**	**994**

*Open Water does not include a land use designation and is not included in the total acres.

2.3.7 Independent Measures

Construction of the independent measures would primarily be limited and coastal in nature, with minimal land uses displacement only required for the Inland Coastal Flood Defense at Southwest Islais Creek measure. Implementation of project construction- and displacement-related measures under the land use AMMs listed below would be required to reduce effects related to the independent measures. These AMMs would be required for all future construction activity.

Based on the location of construction activity including demolition, pile driving and other actions, and with the application of identified AMMs equally throughout the study area, there would be no significant land use effect of the independent measures (Effect CIA-EJ-2) as shown in Table 2-10.

Table 2-10. Summary of Land Use Impacts Associated with the Independent Measures

Independent Measures Air Quality Impact Rating	**2A**	**2B**	**3A**	**3B**	**3C**	**4A**	**Vertical Shoreline***
Construction/Footprint	2	2	2	2	2	2	2
O&M Assumptions	1	1	1	1	1	1	1
Mitigated Rating	1	1	1	1	1	1	1

2A. Robust Coastal Defense of Ferry Building and Agriculture Building: This measure would be designed to realign the coastal flood defense structure adjacent to the bayside edge of the Ferry Building and possibly the Agriculture Building. Fill would be extended under the building, with either solid fill or possible addition of a basement under the Ferry Building. This type of alteration would not affect land use, divide a community, or affect land use policy and long-term would have ***no significant effect*** on land use.

2B. Coarse Beach at Rincon Park connecting to Pier 14: This measure would be designed to reduce wave hazards, support nearshore ecology, and provide public water access. New Bay fill is required for this measure so as to address space constraints of the transportation network at this site. This would add a beneficial recreational land use at the site. Use of additional Bay fill would need to be evaluated for consistency with local and regional policies. This impact would be ***less than significant with mitigation*** using AMM-LU-1**.**

3A. Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves From Bay Bridge to the mouth of Mission Creek, raises the current shoreline rather than extending the shoreline into the Bay. This will require redesign of the northbound lanes of the Embarcadero roadway and the approach is intended to be designed to avoid reconstruction of the light rail track. This measure would have a ***less than significant*** effect on land use and policy.

3B. McCovey Cove North Curb Extension: Raises the shoreline in line with the current shoreline edge on the north side of McCovey Cove (along the ballpark), rather than adding fill and extending the shoreline into the creek. This measure would have a ***less than significant effect*** on land use and policy.

3C. Planted Levee on Mission Bay south of Pier 50. This measure adds a planted levee designed to reduce wave hazards, support nearshore ecology, and provide public water access. This measure would have a ***less than significant effect*** on land use and policy.

4A. Inland Coastal Flood Defense at Southwest Islais Creek. This would include conversion of some industrial lands and public facilities to provide public water access, open space, and ecological benefits. It would also result in more permanent flood risk reduction due to a small area of gradual retreat along the creek. This measure would have a ***less than significant effect*** on land use and policy with implementation of AMM LU-1 and LU-2.

Living Seawalls (Vertical Shorelines): Use of living seawall methods such as textured concrete on a vertical seawall) would be designed to reduce wave hazards while supporting nearshore ecology wherever current maritime uses and pier configurations allow. Use of pile-driven cofferdams during construction may have limited, less than significant effects on land uses. Use of this material will have ***no effect on land use***.

Table 2-11. Independent Measures – Potential Land Use Changes

Land Use Designation	**Project Footprint**		**Construction Area**	
	Acres	Parcels	Acres	Parcels
Independent Measure 2A				
Commercial Land	7.77	6	2.69	15
Open Space Land	0	0	0.77	8
Public Land Use	0	0	0.19	2
Total* for 2A	**7.77**	**6**	**3.66**	**25**
Independent Measure 2B				
Commercial Land	2.69	1	2.01	11
Public Land Use	0.99	1	2.02	6
Industrial Land Use	0	0	0.16	1
Total* for 2B	**2.88**	**2**	**5.18**	**19**
Independent Measure 3A				
Commercial Land	1.04	4	1.18	3
Public Land Use	0.03	1	0.03	1
Industrial Land Use	6.03	18	16.30	19
Residential Land Use	0	0	5.50	21

Land Use Designation	Project Footprint		Construction Area	
	Acres	Parcels	Acres	Parcels
Total* for 3A	**8.28**	**23**	**23.01**	**44**
Independent Measure 3B				
Industrial Land Use	6.03	3	16.30	3
Mixed Use Land	0	0	0.52	1
Total* for 3B	**6.03**	**3**	**16.82**	**4**
Independent Measure 3C				
Mixed Use Land	2.18	1	7.26	19
Public Land Use	0.01	1	0.72	2
Industrial Land	0	0	0.72	1
Open Space Land	0	0	0.90	1
Total* for 3C	**2.19**	**2**	**9.59**	**23**
Independent Measure 4A				
Industrial Land	0.25	4	0.71	1
Commercial Land	28.27	48	14.67	31
Total* for 4A	**28.52**	**52**	**15.38**	**32**

*Open Water does not include a land use designation and is not included in the total acres.

3.0 Mitigation

The following avoidance, minimization, and mitigation measures would be required for all alternatives. AMMs in other sections including Noise, Air Quality, Socioeconomics and Environmental Justice, and Transportation will minimize effects on land uses during project construction.

AMM-LU-1: Planning Agency Coordination and Plan Revisions

The USACE and Port would coordinate with SF Planning and appropriate agencies such as BCDC to coordinate plan revisions and public outreach regarding any land uses that will be changed as a result of the project. This would include planning for parcels or portions of parcels that are planned for retreat and inundation by San Francisco Bay waters and may be removed from the City of San Francisco's plans or plans modified to acknowledge the foreseen changes in zoning areas or to modify current designations.

AMM-LU-2: Public Outreach and Communication

Outreach and communication with the public will be required throughout the life of the project, in particular as construction approaches and during construction. Preparation of a living Communication Plan to coordinate public outreach and communication of project activities including construction schedules and attendant road, lane, or sidewalk closures, and identification of community liaisons for contact during construction will be coordinated with USACE, Port and City.

4.0 Cumulative and Other Impacts

As described in previous sections, all alternatives are anticipated to convert land uses either direct or indirectly to different land uses. One area that could have a cumulative impact would be industrial land uses, especially in the alternatives with a significant and unavoidable impact to industrial lands.

Reduction of industrial lands could lead to an overall decline of industrial businesses and specifically maritime industrial businesses on or near the San Francisco Waterfront. These would be businesses such as boat repair and rebuilding, shipping, and fisheries on Port working lands. But this could also include industrial companies located more inland that are impacted by the Project and its construction.

Industrial facilities can be difficult neighbors for residential buildings, commercial areas, schools and parks due to typically generating higher levels of noise and air pollution compared to residential or commercial facilities. Industrial operations generally need larger lot sizes to move, transport, and process materials. It is anticipated that a limited number of new industrial lands could be created from the conversion of existing land uses to industrial land since finding large lots or assembling several smaller lots away from residences is difficult in an urban environment.

San Francisco Planning did have an Industrial Protection Zone Special Use District that limited development of industrial lands into non-industrial uses. This special use district was within Reach 4 for the Project. However, the Planning Department has recommended to remove this special use district outside of Port lands. This resolution was adopted by San Francisco Planning Commission (SF Planning, 2022).

The decline of industrial land use through potential abandonment from flooding or demolition, and the decline in pool of trained industrial workers could overall result in a cumulative decline of industry in San Francisco that will not be recoverable.

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Land Use
Sub-Appendix 1

Neighborhoods

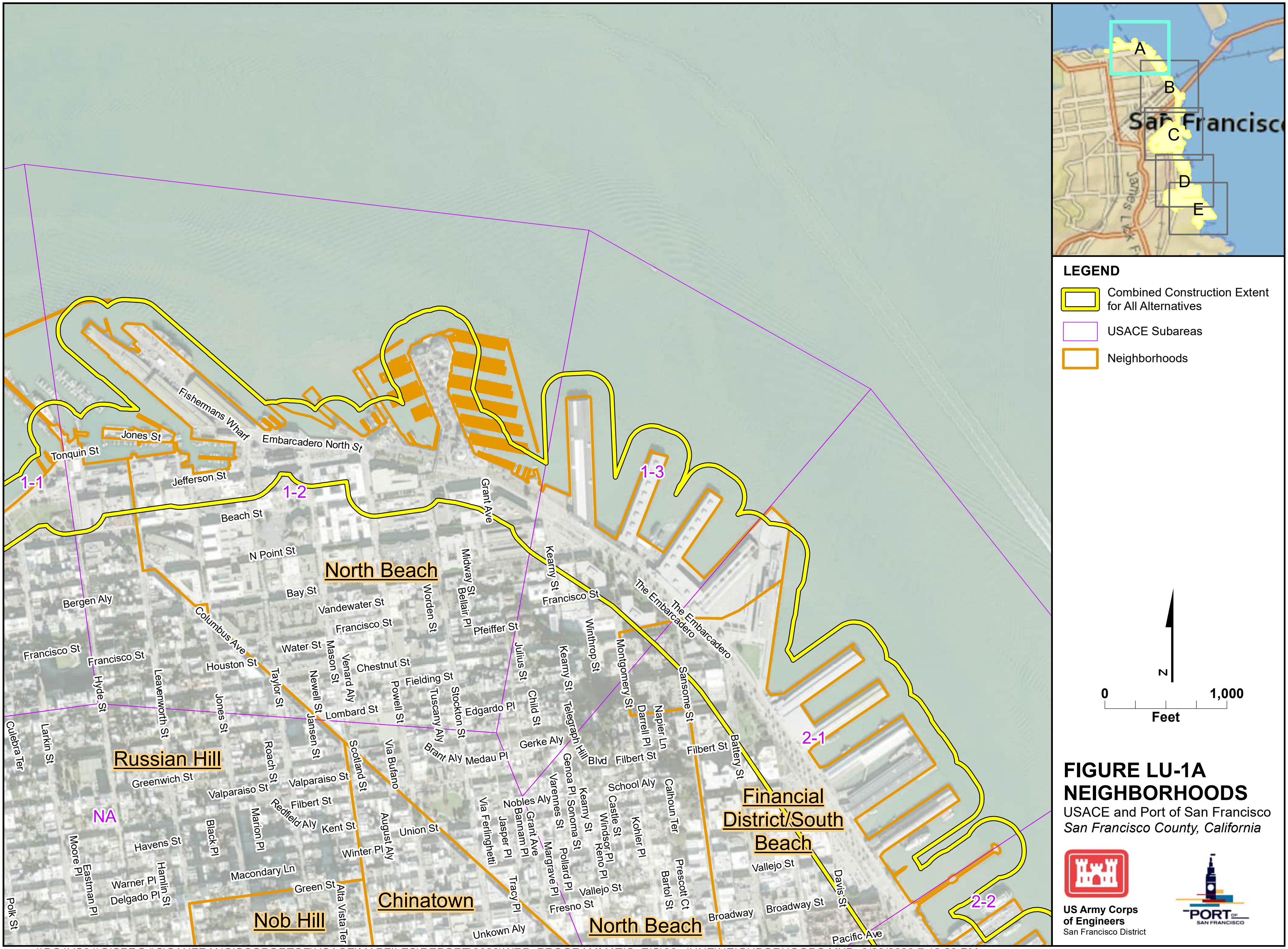

FIGURE LU-1A NEIGHBORHOODS

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

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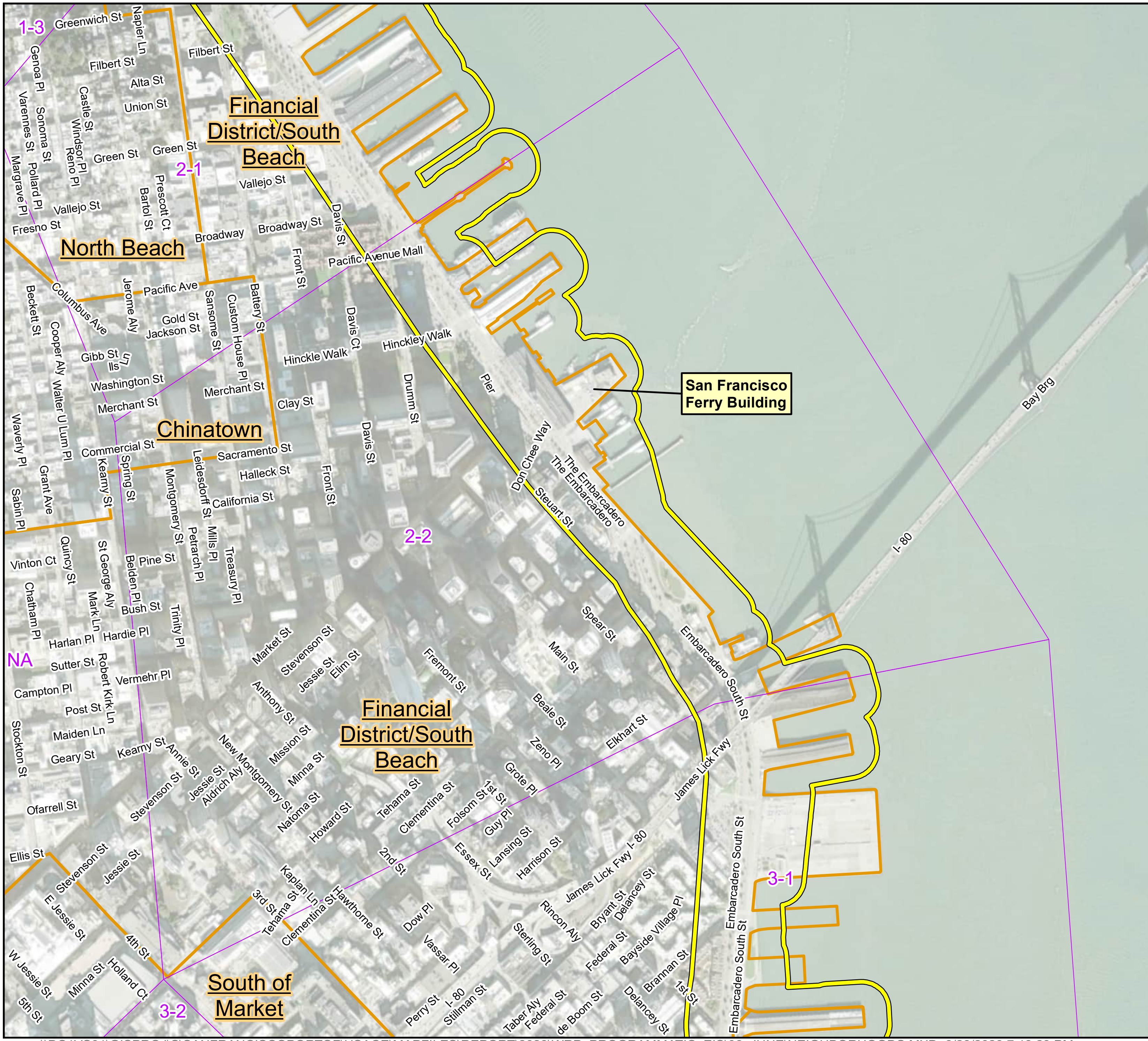

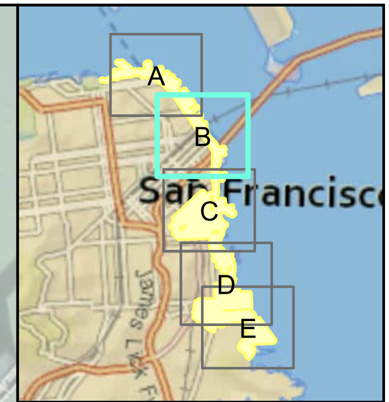

LEGEND

- Combined Construction Extent for All Alternatives
- USACE Subareas
- Neighborhoods

N

0 1,000

Feet

FIGURE LU-1B NEIGHBORHOODS

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

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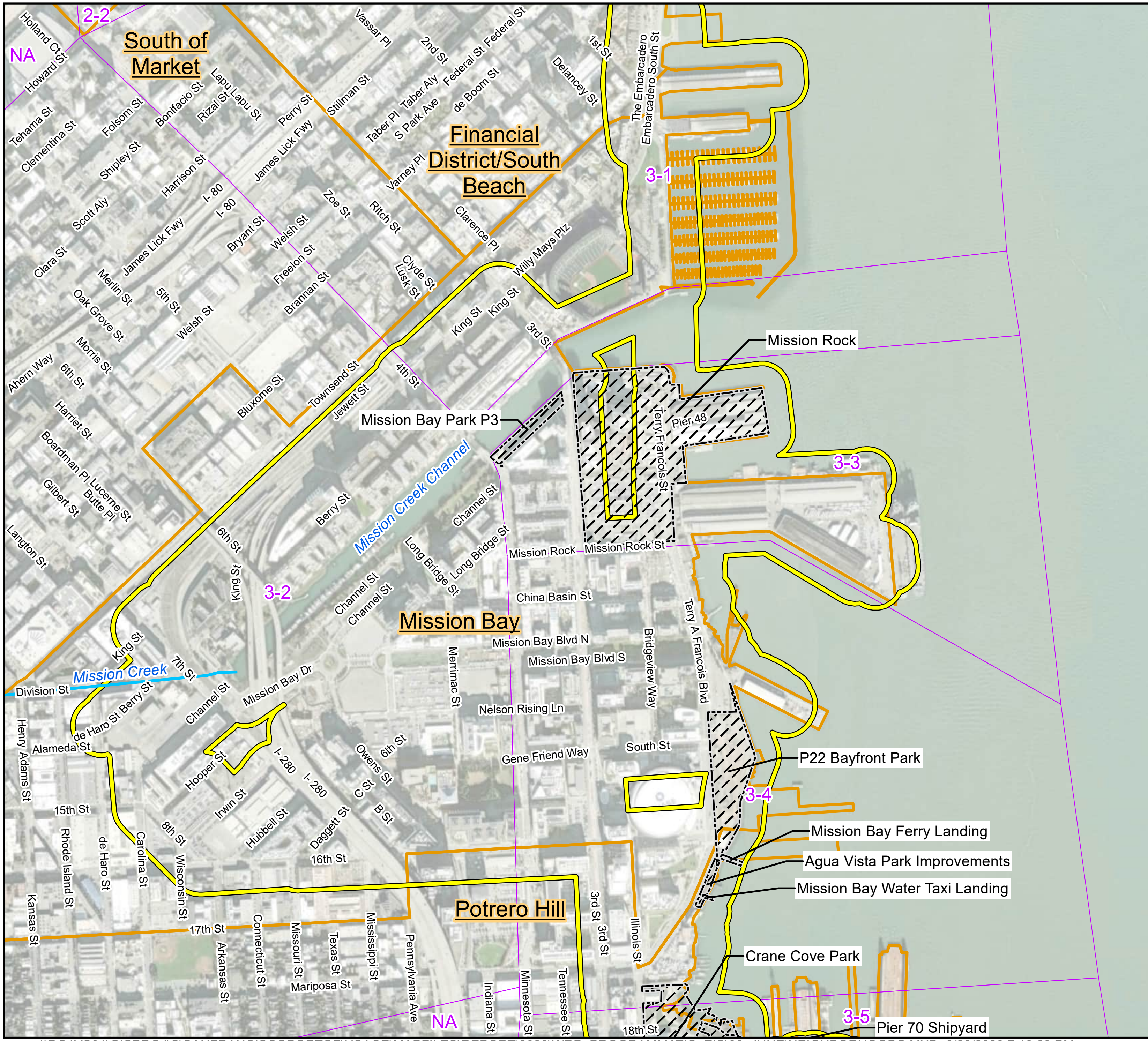

LEGEND

Combined Construction Extent for All Alternatives

USACE Subareas

Planned Development

Neighborhoods

N

0 1,000

Feet

FIGURE LU-1C
NEIGHBORHOODS

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers San Francisco District

PORT OF SAN FRANCISCO

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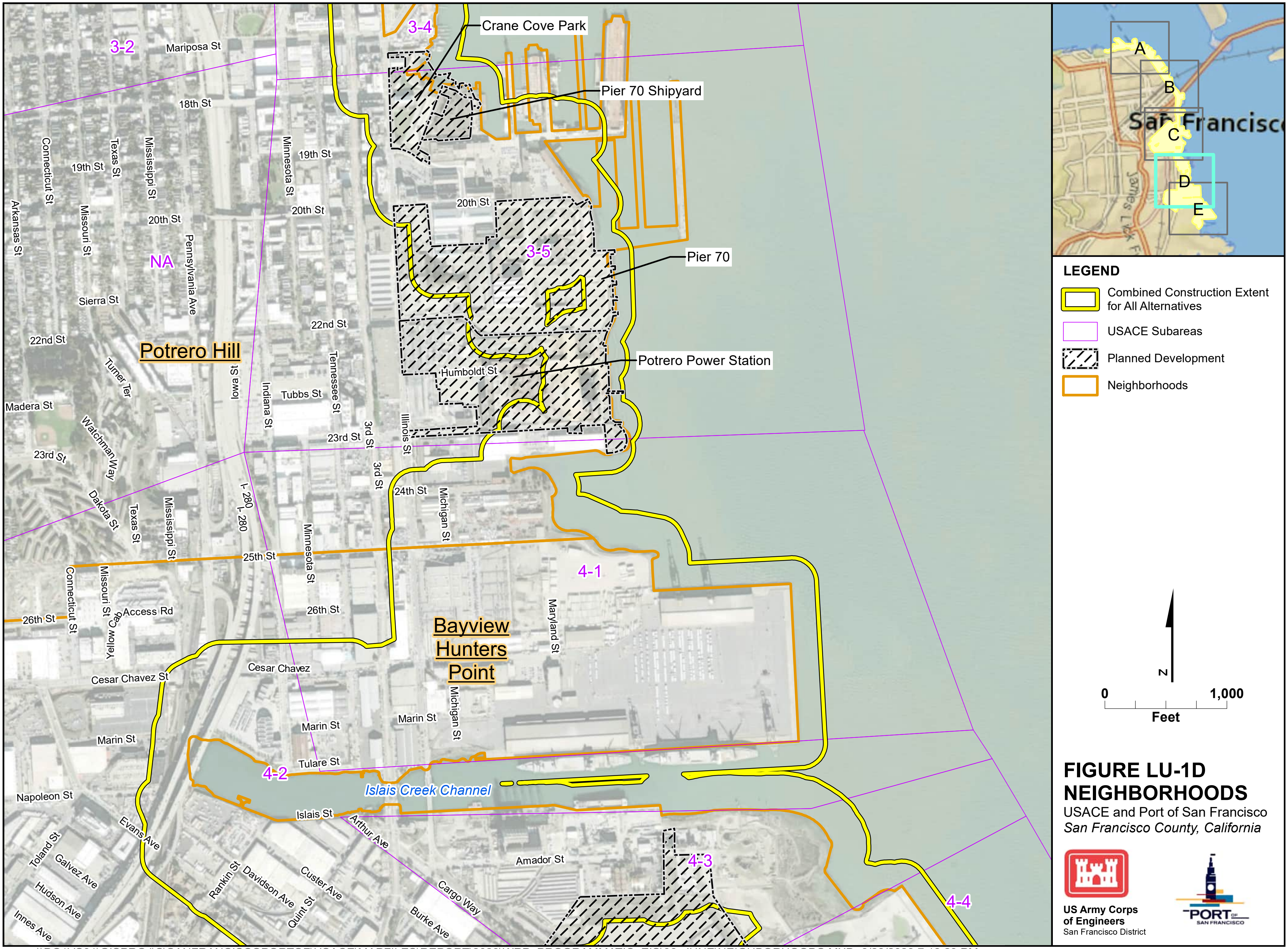

LEGEND

- Combined Construction Extent for All Alternatives
- USACE Subareas
- Planned Development
- Neighborhoods

FIGURE LU-1D NEIGHBORHOODS

USACE and Port of San Francisco

San Francisco County, California

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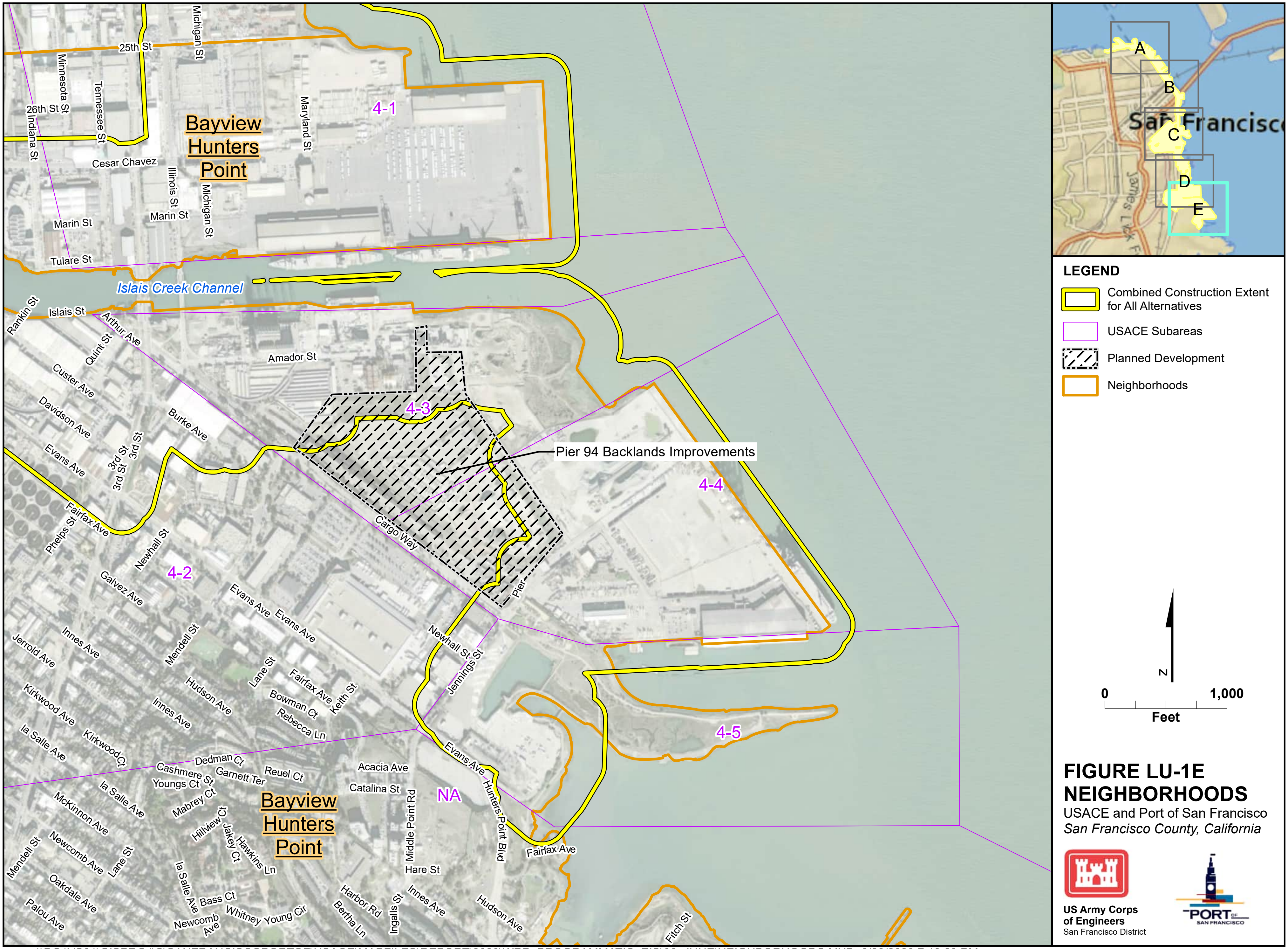

LEGEND

- Combined Construction Extent for All Alternatives
- USACE Subareas
- Planned Development
- Neighborhoods

N

0 1,000

Feet

FIGURE LU-1E NEIGHBORHOODS

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT OF SAN FRANCISCO

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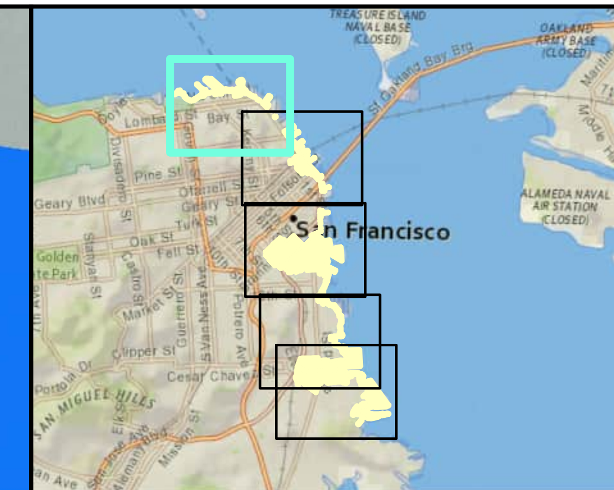
Alternative B 2040



LEGEND

Alternative B 2040
- Project Footprint
- 200 foot buffer
- USACE Subareas
- Parcels

Commercial Land
- Community Business, C-2
- Downtown Office, C-3-O

Industrial Land
- Light Industrial, M-1

Mixed Use Land
- Residential Commercial High Density, RC-4

Open Space
- Open Space, OS

Public Land
- Public, P

Water
- Water, W

0 750 1,500
Feet

N

FIGURE LU-2A
LANDUSE

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO

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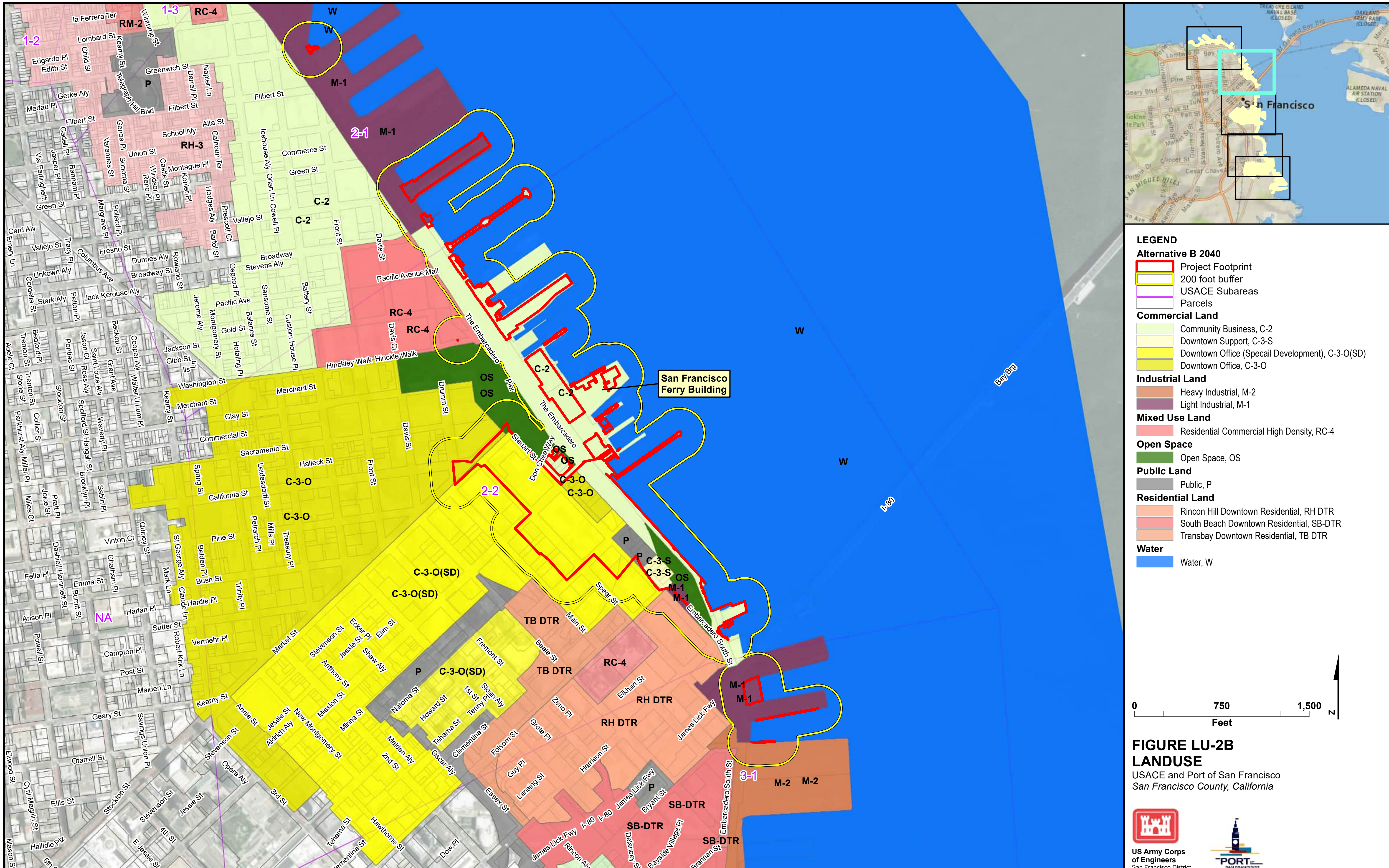

FIGURE LU-2B
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO

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FIGURE LU-2C
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_B_2040.MXD 10/25/2023 9:13:17 AM

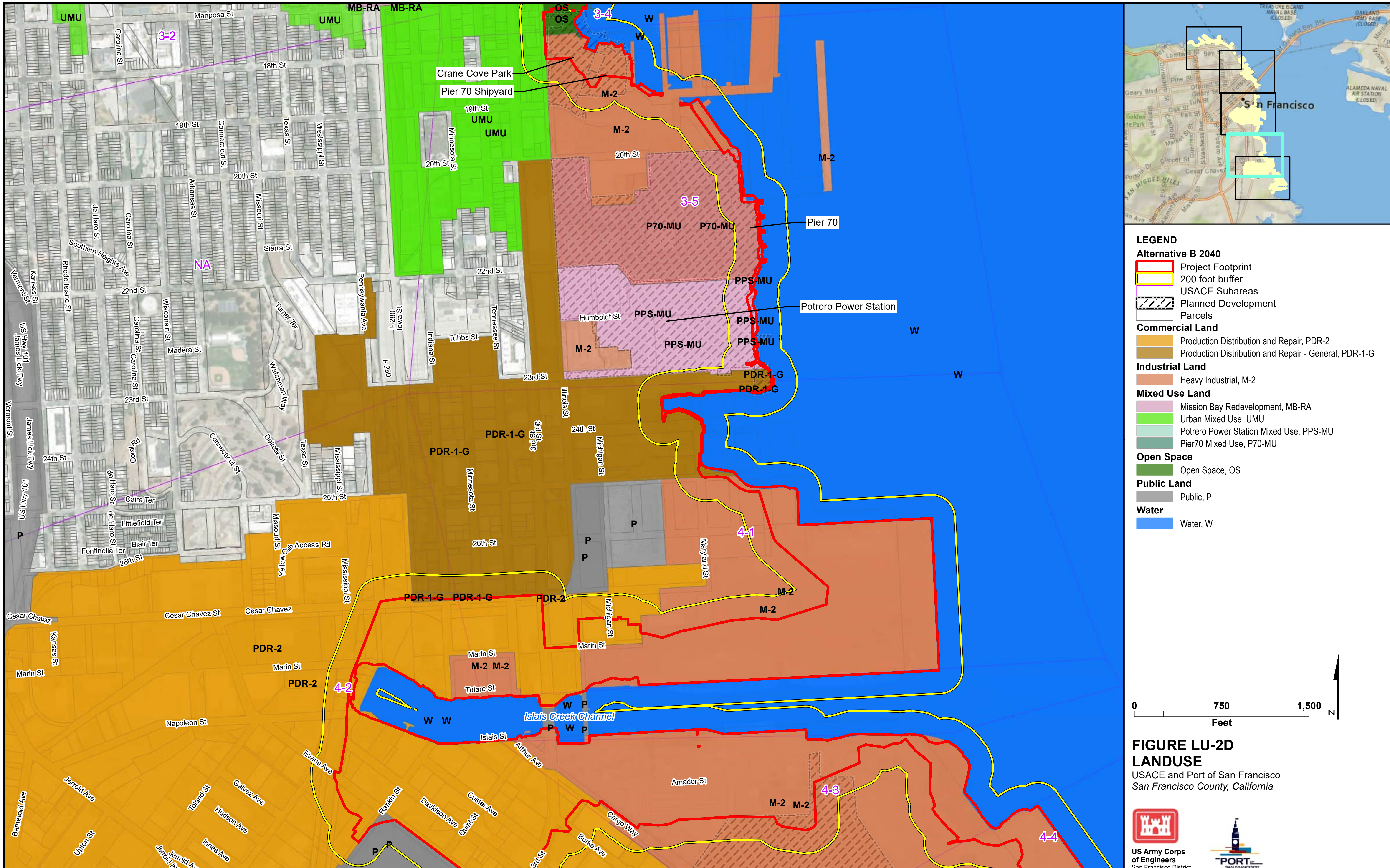
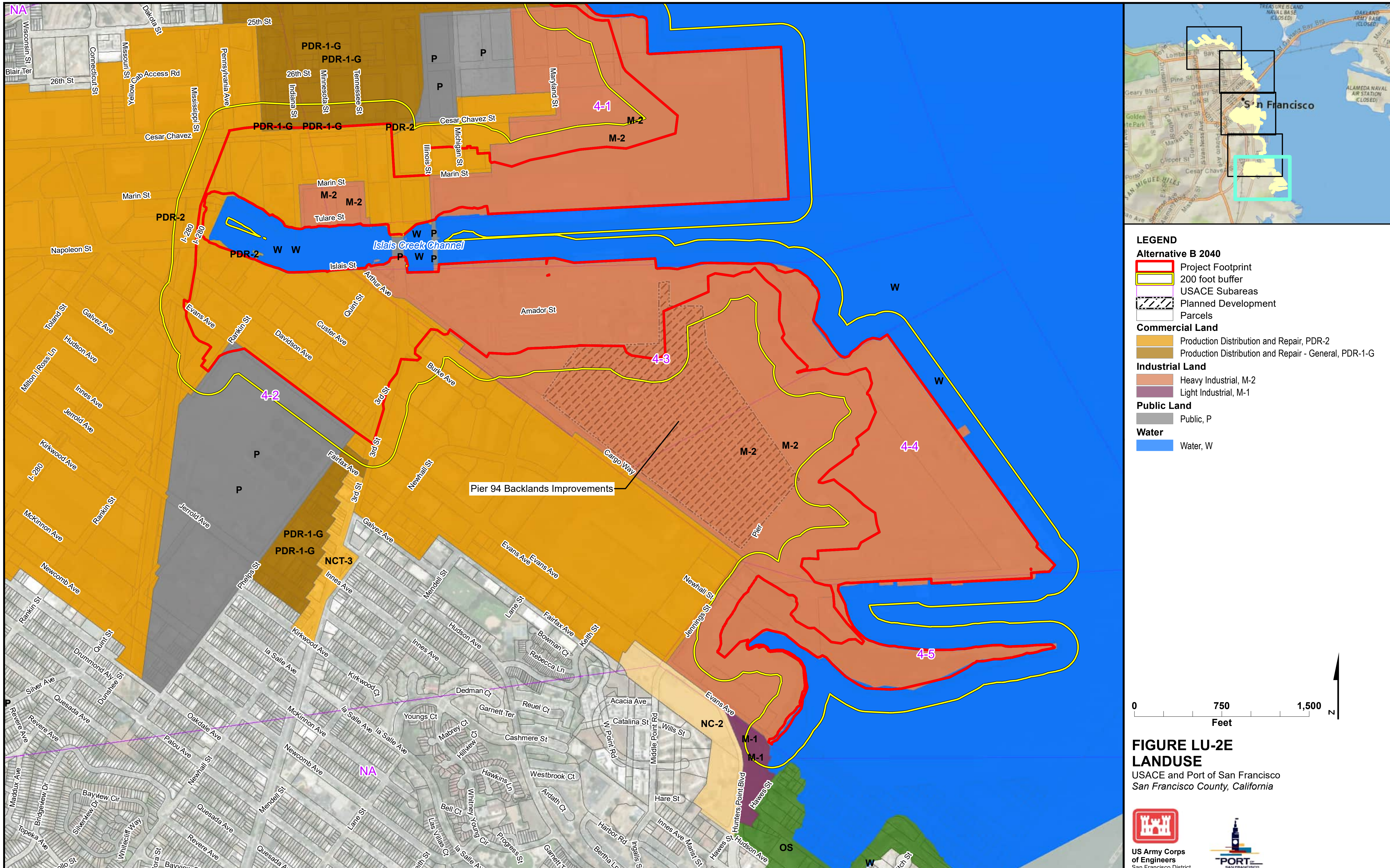


FIGURE LU-2D
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_B_2040.MXD 10/25/2023 9:13:17 AM



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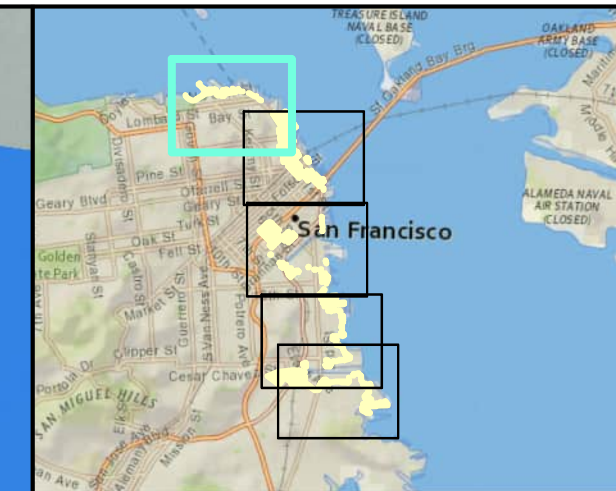
Alternative B 2065



LEGEND

Alternative B 2065
- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Parcels

Commercial Land
- Community Business, C-2
- Downtown Office, C-3-O

Industrial Land
- Light Industrial, M-1

Mixed Use Land
- Residential Commercial High Density, RC-4

Open Space
- Open Space, OS

Water
- Water, W

0 750 1,500
Feet

N

FIGURE LU-3A LANDUSE

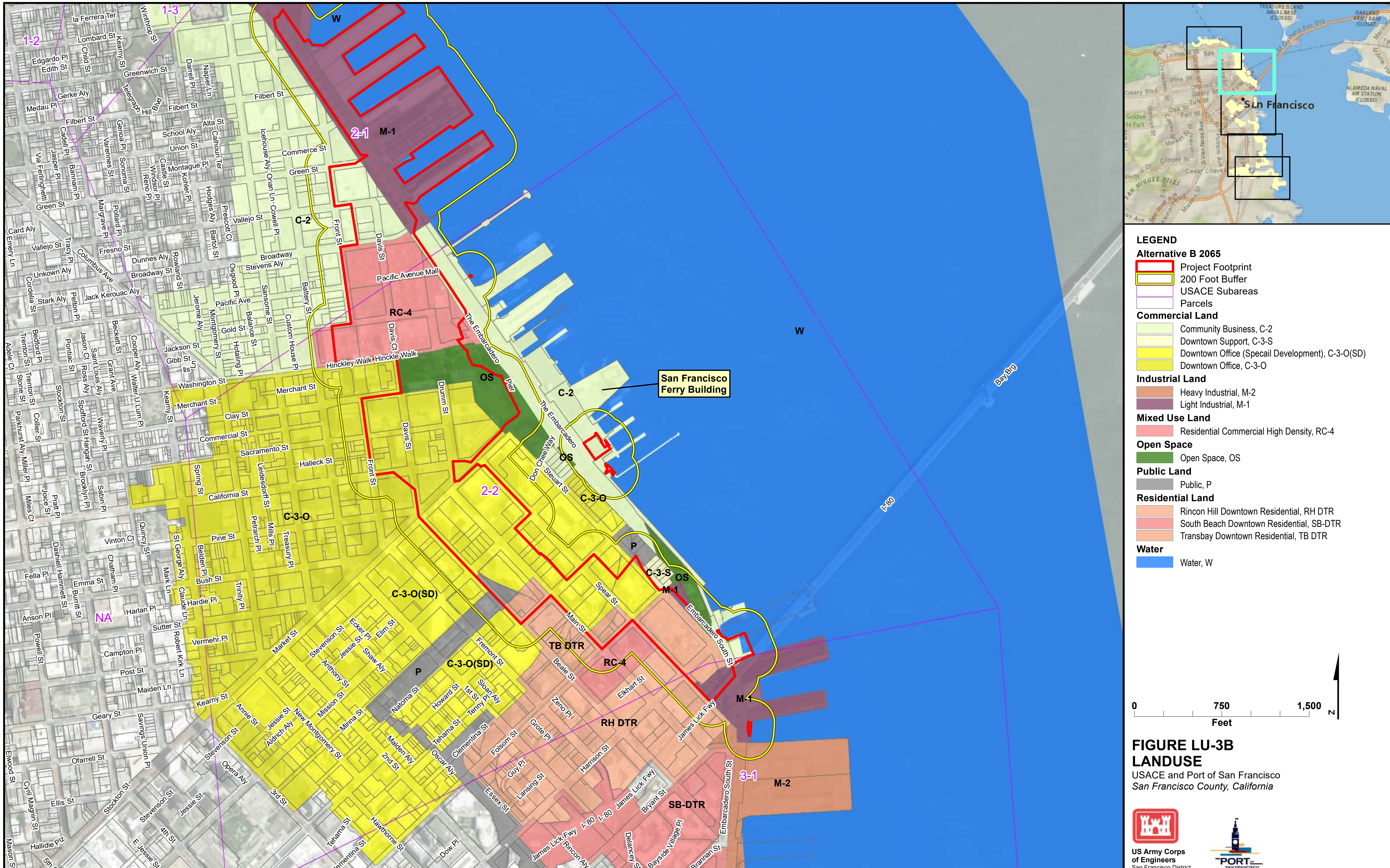
USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_B_2065.MXD 10/25/2023 9:18:40 AM



LEGEND
Alternative B 2065
Project Footprint
200 Foot Buffer
USACE Subareas
Parcels
Commercial Land
Community Business, C-2
Downtown Support, C-3-S
Downtown Office (Specail Development), C-3-O(SD)
Downtown Office, C-3-O
Industrial Land
Heavy Industrial, M-2
Light Industrial, M-1
Mixed Use Land
Residential Commercial High Density, RC-4
Open Space
Open Space, OS
Public Land
Public, P
Residential Land
Rincon Hill Downtown Residential, RH DTR
South Beach Downtown Residential, SB-DTR
Transbay Downtown Residential, TB DTR
Water
Water, W
0
750
1,500
Feet
N
FIGURE LU-3B
LANDUSE
USACE and Port of San Francisco
San Francisco County, California
US Army Corps of Engineers
San Francisco District
PORT SAN FRANCISCO
San Francisco
San Francisco Ferry Building
W
M-1
2-1
1-2
1-3
C-2
RC-4
OS
C-3-O
C-3-O(SD)
2-2
P
C-3-S
TB DTR
RH DTR
SB-DTR
M-2
3-1
NA
I-80
Bay Brg
The Embarcadero
Embarcadero South St

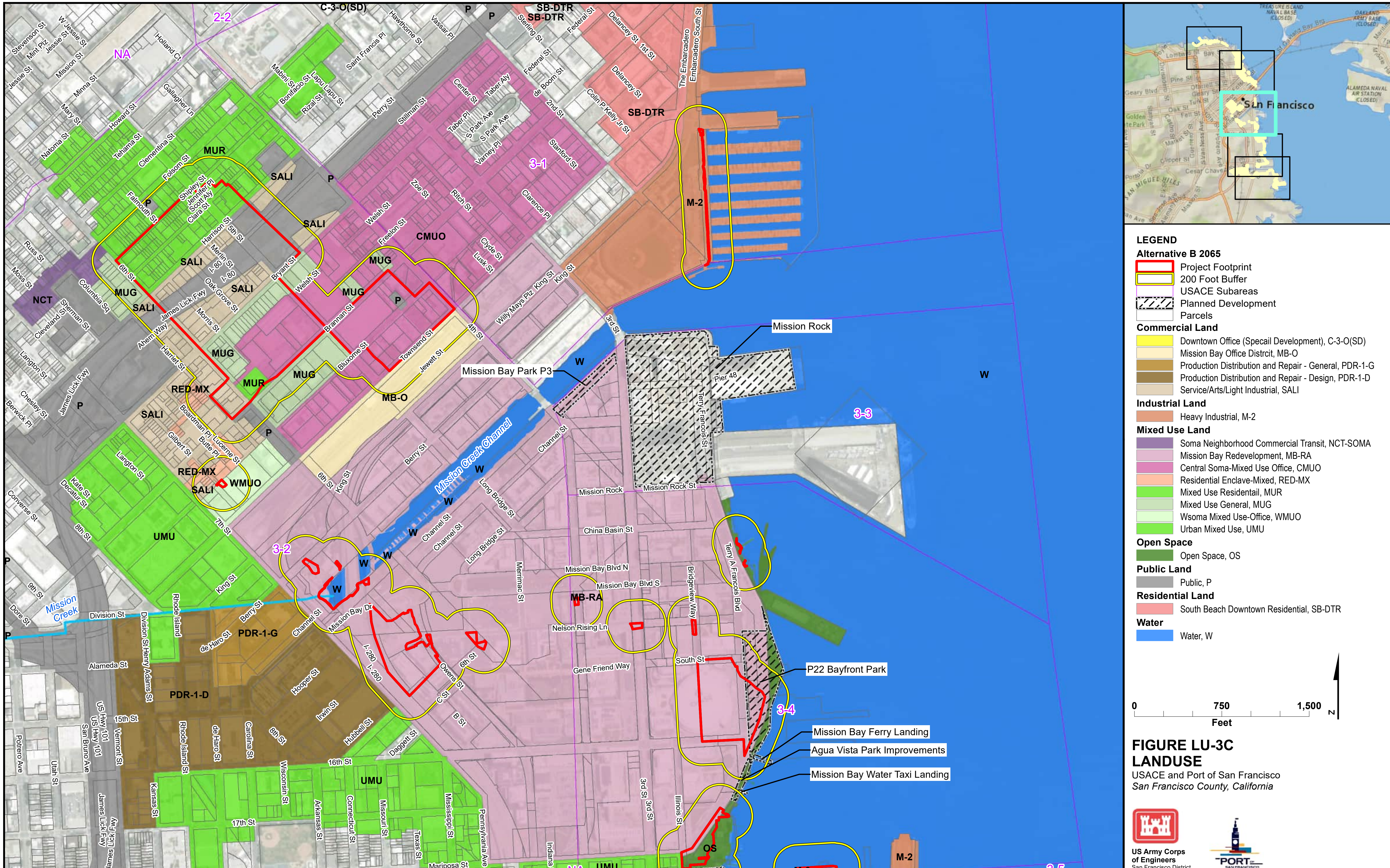


FIGURE LU-3C
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_B_2065.MXD 10/25/2023 9:18:40 AM

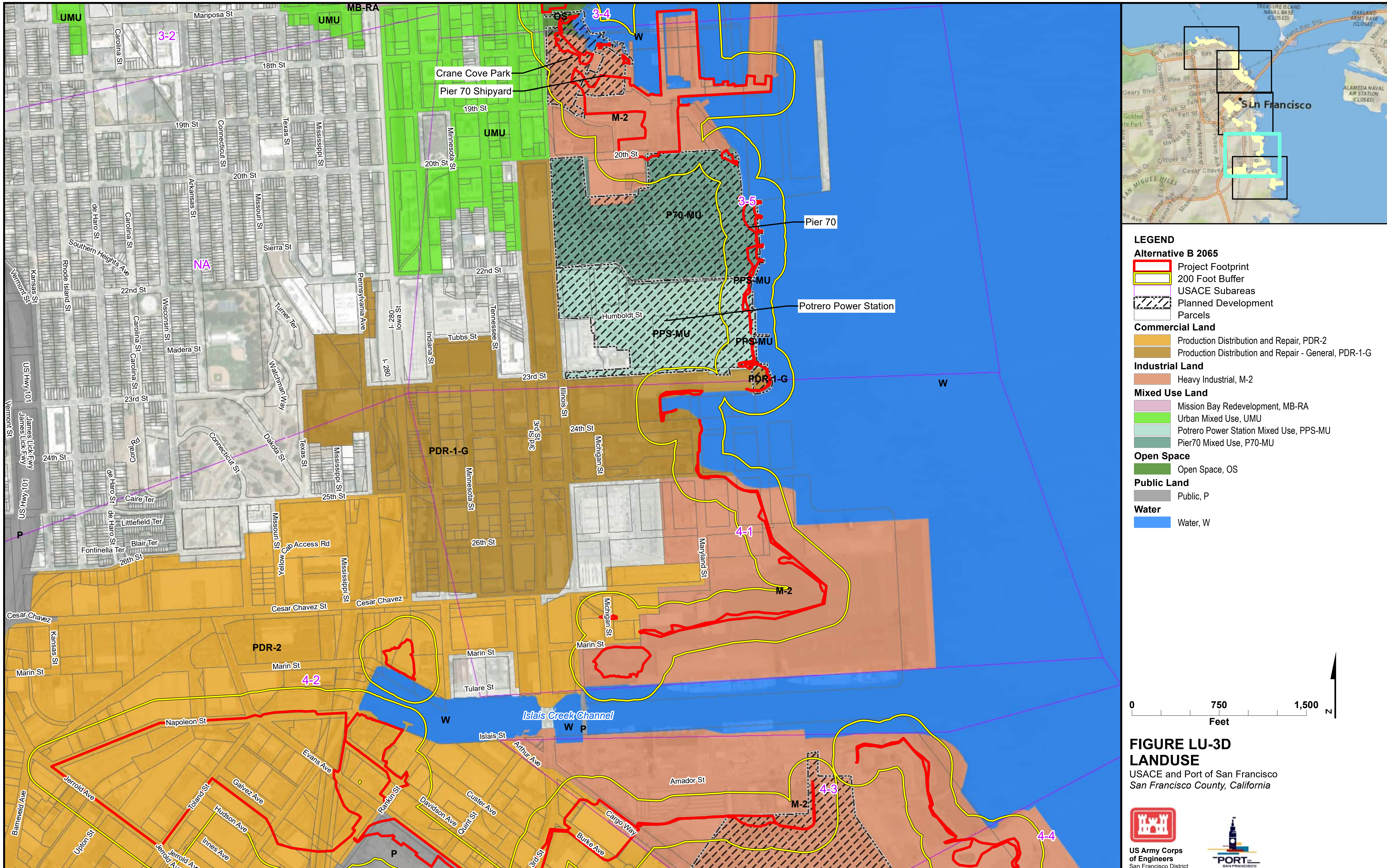


FIGURE LU-3D
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

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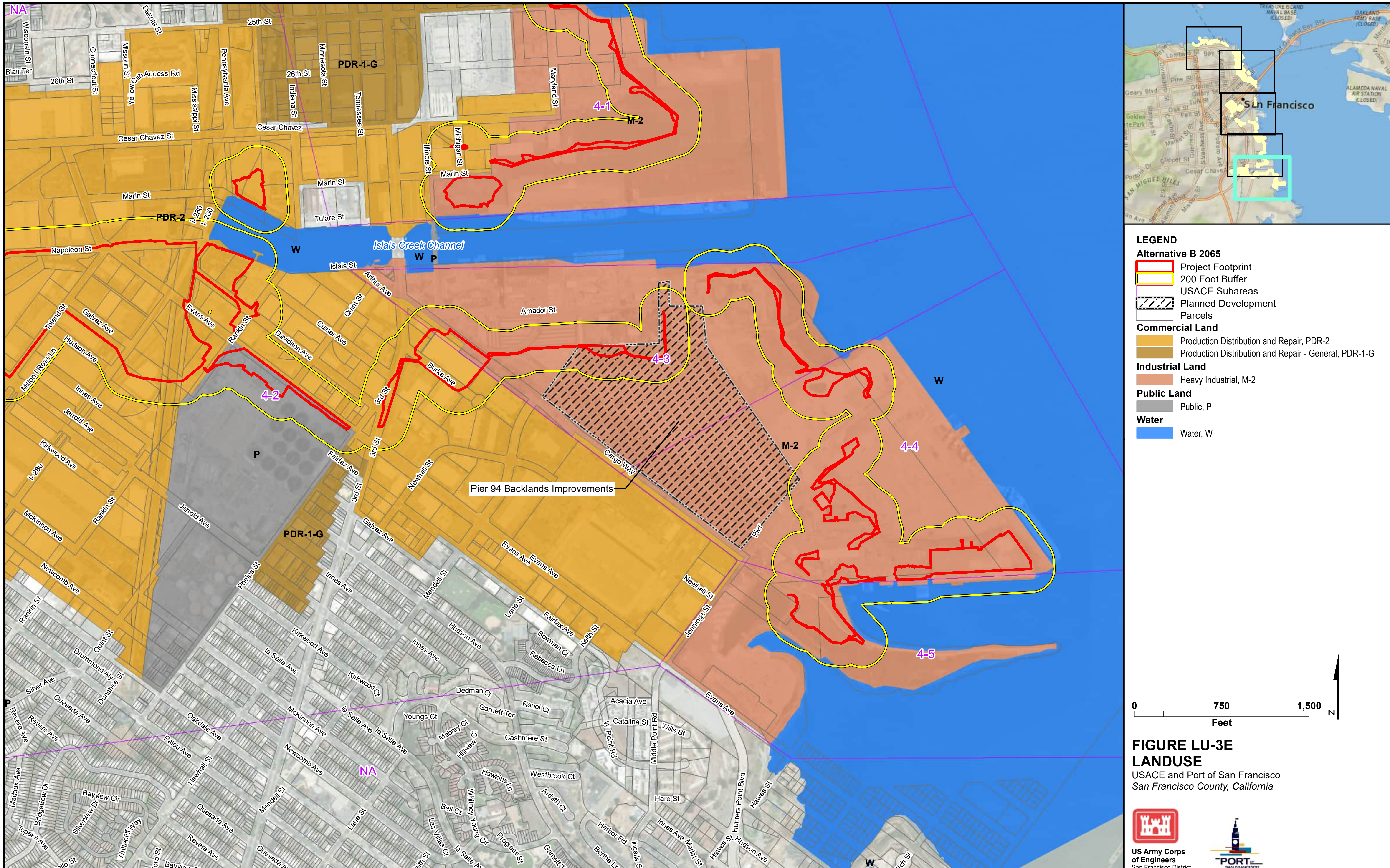
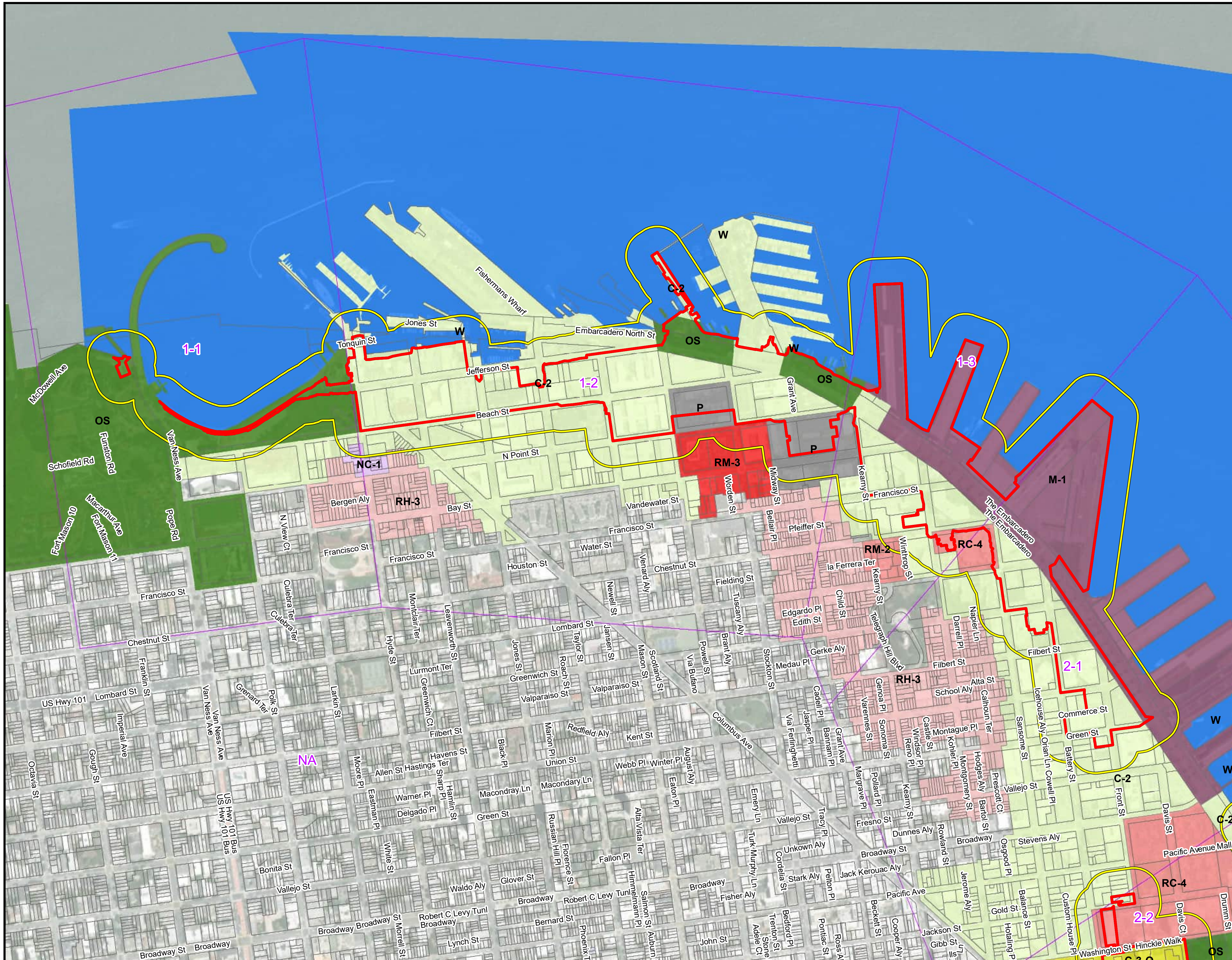
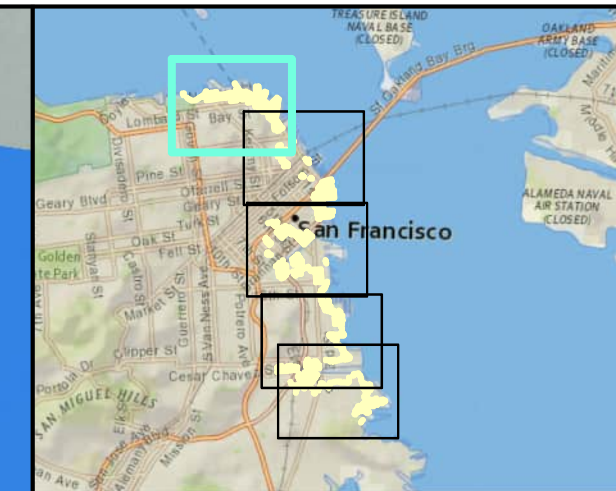

PDR-1-G
PDR-2
M-2
W
P
NA
4-1
4-2
4-3
4-4
4-5
Islais Creek Channel
Pier 94 Backlands Improvements
San Francisco
LEGEND
Alternative B 2065
Project Footprint
200 Foot Buffer
USACE Subareas
Planned Development
Parcels
Commercial Land
Production Distribution and Repair, PDR-2
Production Distribution and Repair - General, PDR-1-G
Industrial Land
Heavy Industrial, M-2
Public Land
Public, P
Water
Water, W
0 750 1,500
Feet
N
FIGURE LU-3E
LANDUSE
USACE and Port of San Francisco
San Francisco County, California
US Army Corps of Engineers San Francisco District
PORT SAN FRANCISCO

Alternative B 2090





LEGEND

Alternative B 2090
- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Parcels

Commercial Land
- Community Business, C-2
- Downtown Office, C-3-O

Industrial Land
- Light Industrial, M-1

Mixed Use Land
- Residential Commercial High Density, RC-4
- Neighborhood Commercial Cluster, NC-1

Open Space
- Open Space, OS

Public Land
- Public, P

Residential Land
- Residential - House Three Family, RH-3
- Residential - Mixed Moderate Density, RM-2
- Residential - Mixed Moderate Density, RM-3

Water
- Water, W

0 750 1,500
Feet
N

FIGURE LU-4A LANDUSE

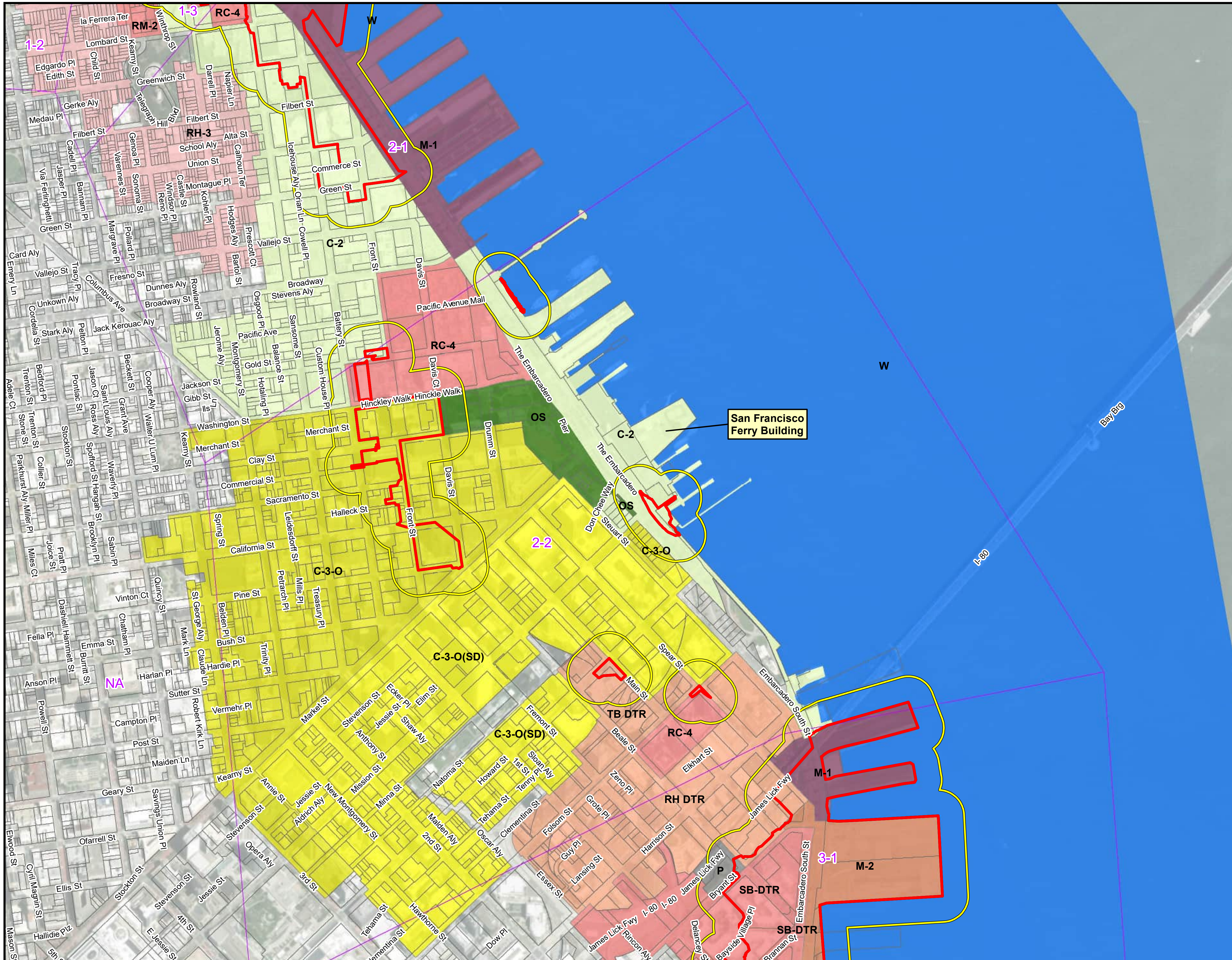
USACE and Port of San Francisco

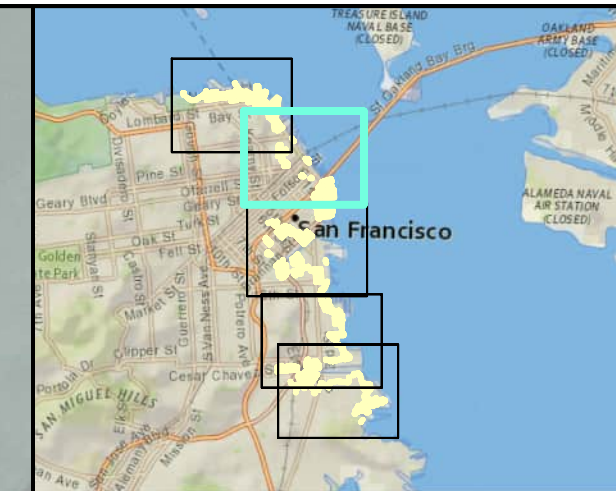
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_B_2090.MXD 10/25/2023 9:20:03 AM





LEGEND

Alternative B 2090

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Parcels

Commercial Land

- Community Business, C-2
- Downtown Office (Specail Development), C-3-O(SD)
- Downtown Office, C-3-O

Industrial Land

- Heavy Industrial, M-2
- Light Industrial, M-1

Mixed Use Land

- Residential Commercial High Density, RC-4

Open Space

- Open Space, OS

Public Land

- Public, P

Residential Land

- Residential - House Three Family, RH-3
- Rincon Hill Downtown Residential, RH DTR
- South Beach Downtown Residential, SB-DTR
- Transbay Downtown Residential, TB DTR
- Residential - Mixed Moderate Density, RM-2

Water

- Water, W

0 750 1,500
Feet
N

FIGURE LU-4B
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District
PORT SAN FRANCISCO

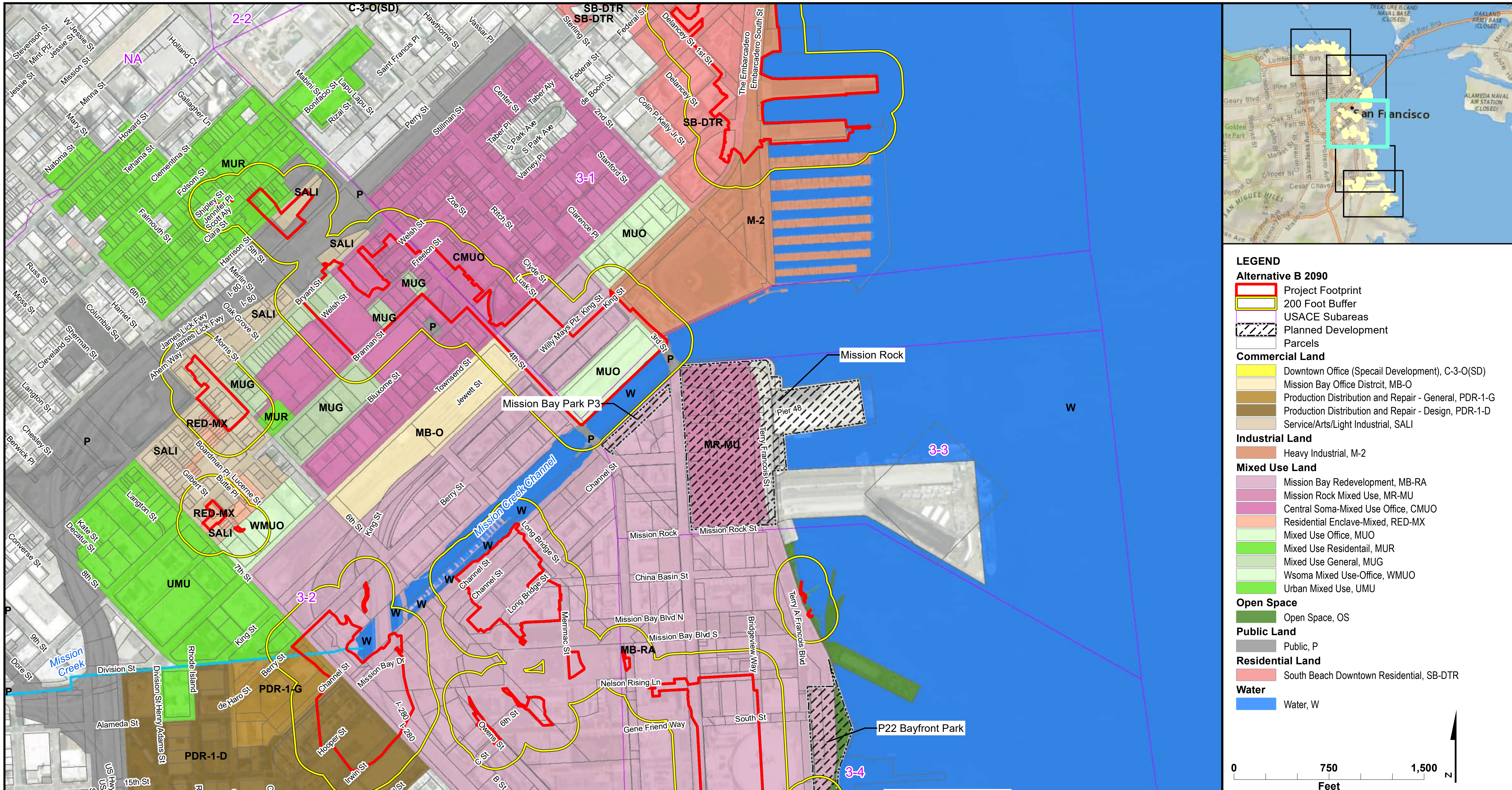


FIGURE LU-4C
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_B_2090.MXD 10/25/2023 9:20:03 AM

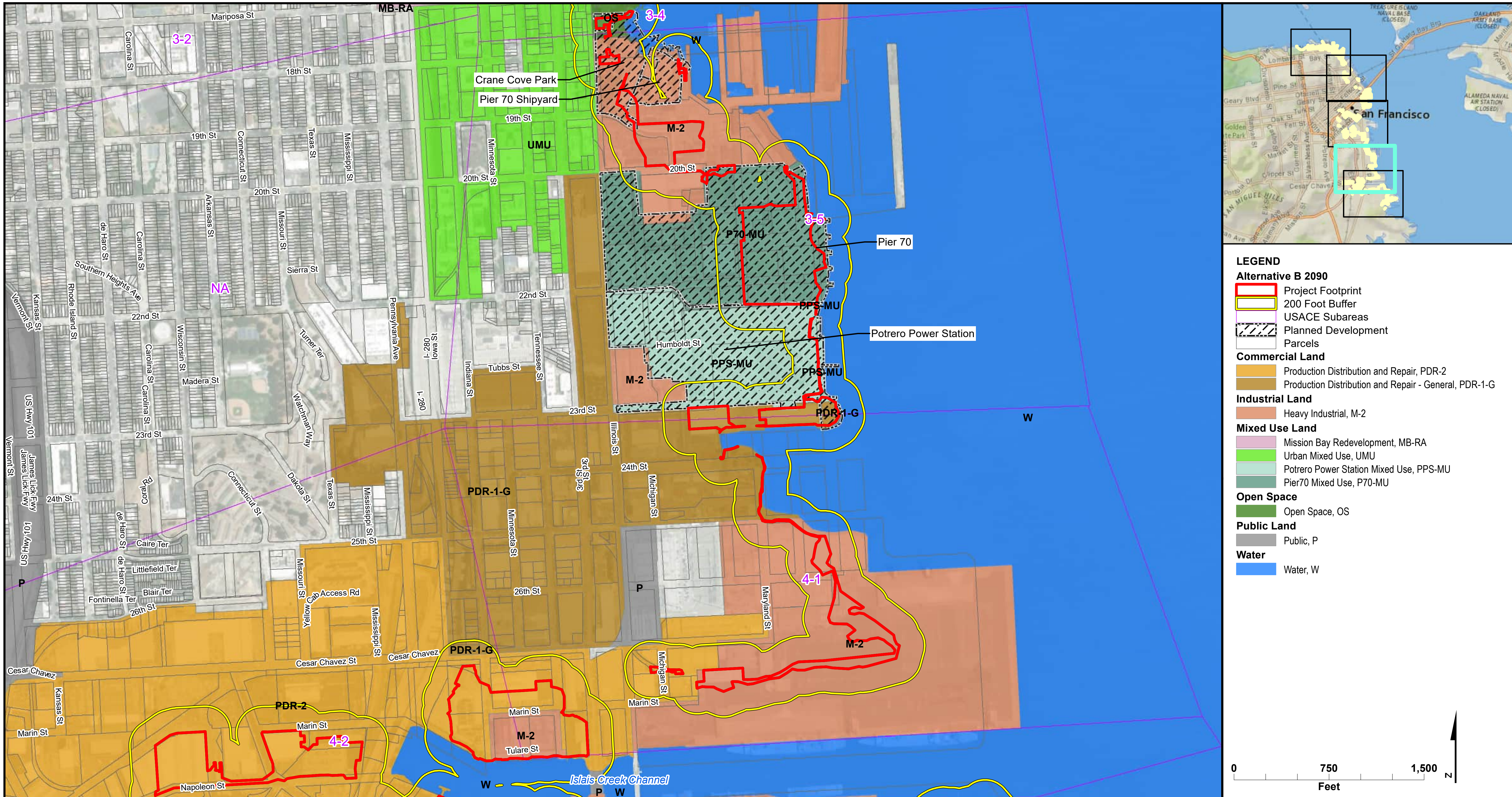


FIGURE LU-4D
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

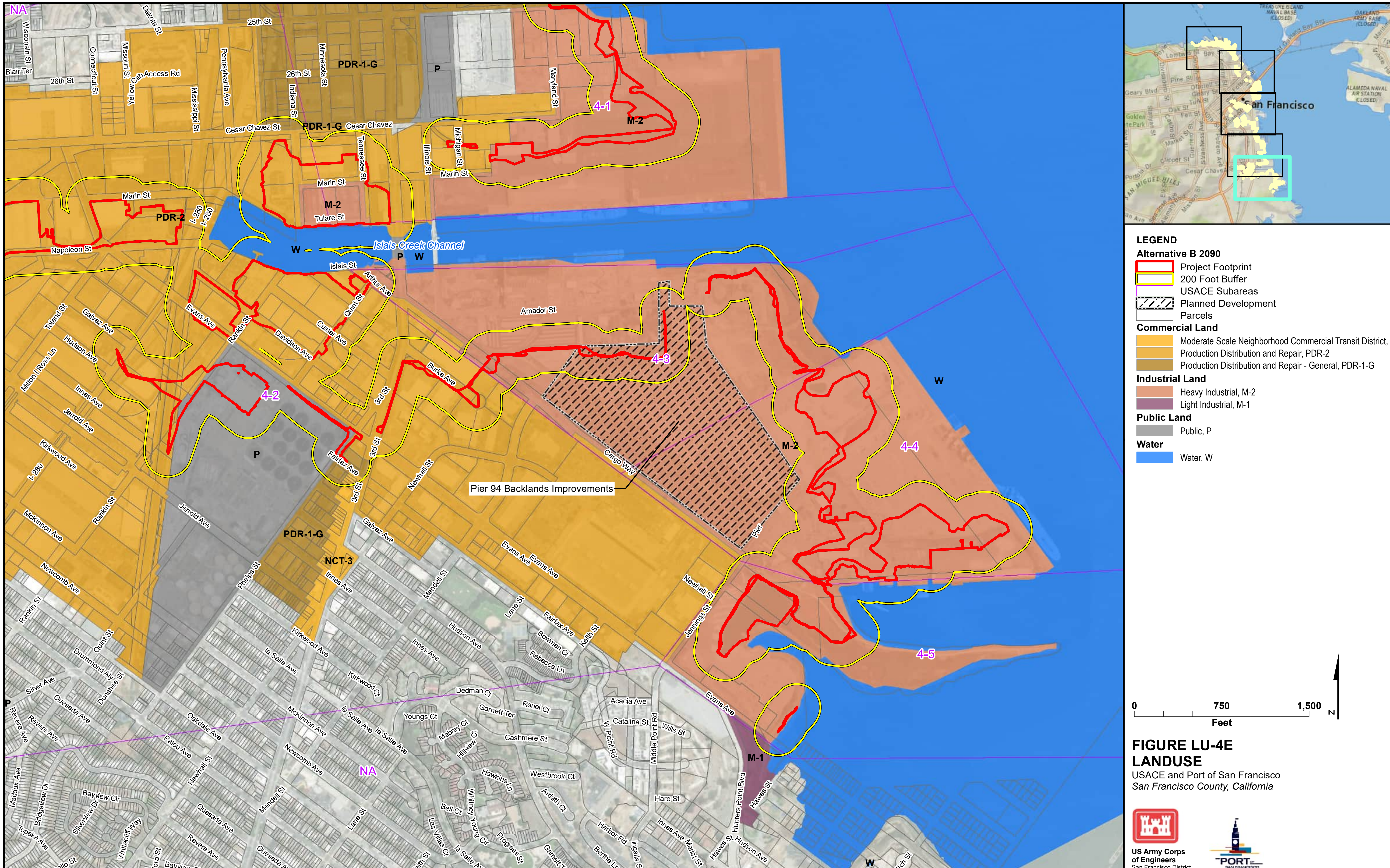
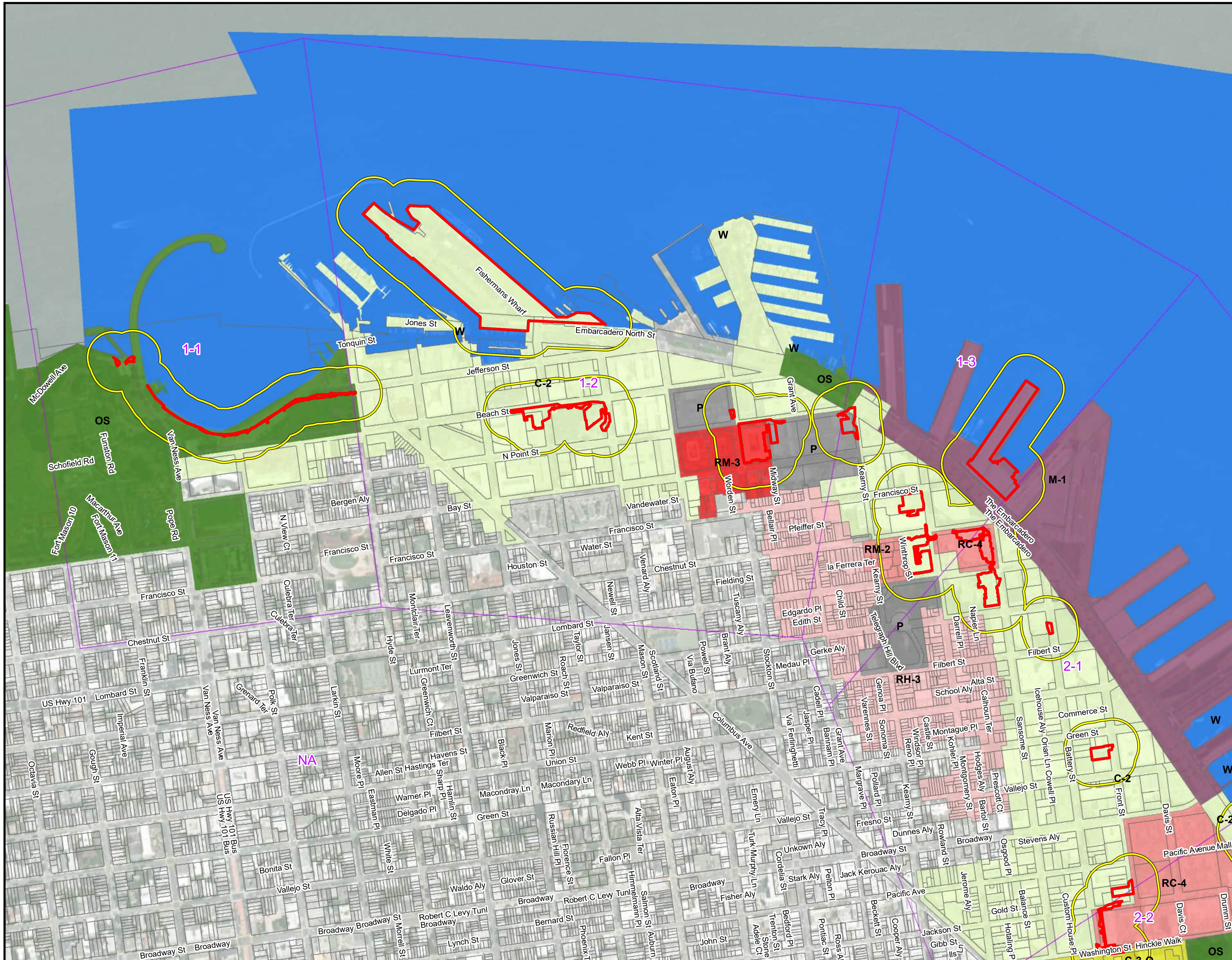
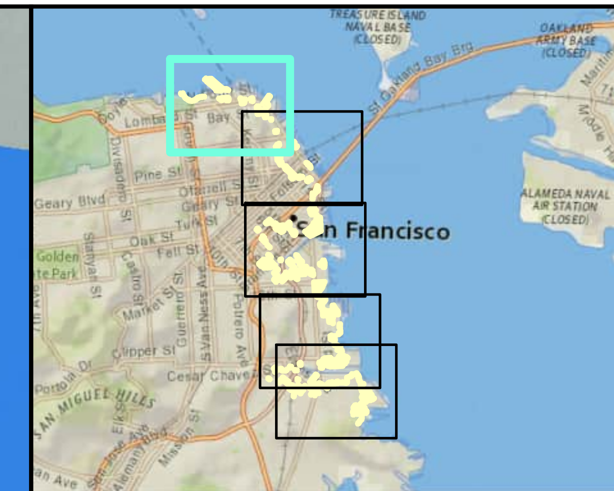


FIGURE LU-4E
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

Alternative B 2115





LEGEND

Alternative B 2115

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Parcels

Commercial Land

- Community Business, C-2
- Downtown Office, C-3-O

Industrial Land

- Light Industrial, M-1

Mixed Use Land

- Residential Commercial High Density, RC-4

Open Space

- Open Space, OS

Public Land

- Public, P

Residential Land

- Residential - House Three Family, RH-3
- Residential - Mixed Moderate Density, RM-2
- Residential - Mixed Moderate Density, RM-3

Water

- Water, W

0 750 1,500
Feet

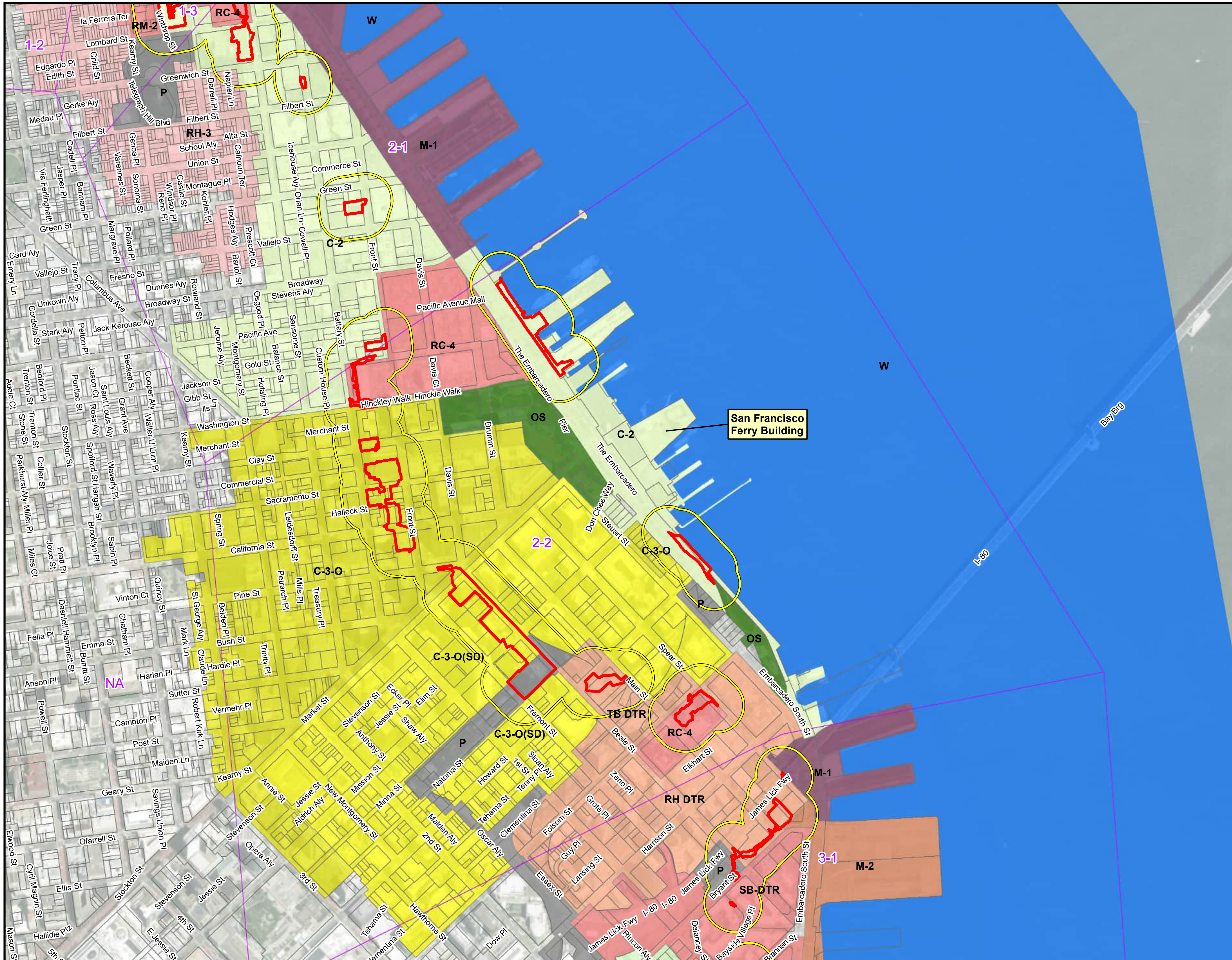
N

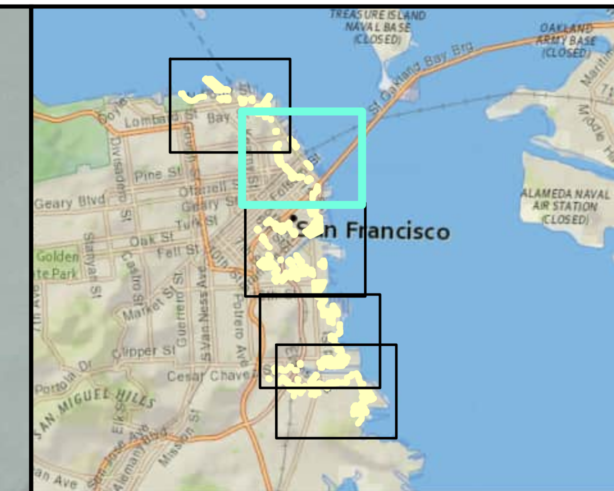
FIGURE LU-5A LANDUSE

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO





LEGEND

Alternative B 2115

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Parcels

Commercial Land

- Community Business, C-2
- Downtown Office (Specail Development), C-3-O(SD)
- Downtown Office, C-3-O

Industrial Land

- Heavy Industrial, M-2
- Light Industrial, M-1

Mixed Use Land

- Residential Commercial High Density, RC-4
- Mixed Use Office, MUO

Open Space

- Open Space, OS

Public Land

- Public, P

Residential Land

- Residential - House Three Family, RH-3
- Rincon Hill Downtown Residential, RH DTR
- South Beach Downtown Residential, SB-DTR
- Transbay Downtown Residential, TB DTR
- Residential - Mixed Moderate Density, RM-2

Water

- Water, W

0 750 1,500
Feet
N

FIGURE LU-5B
LANDUSE

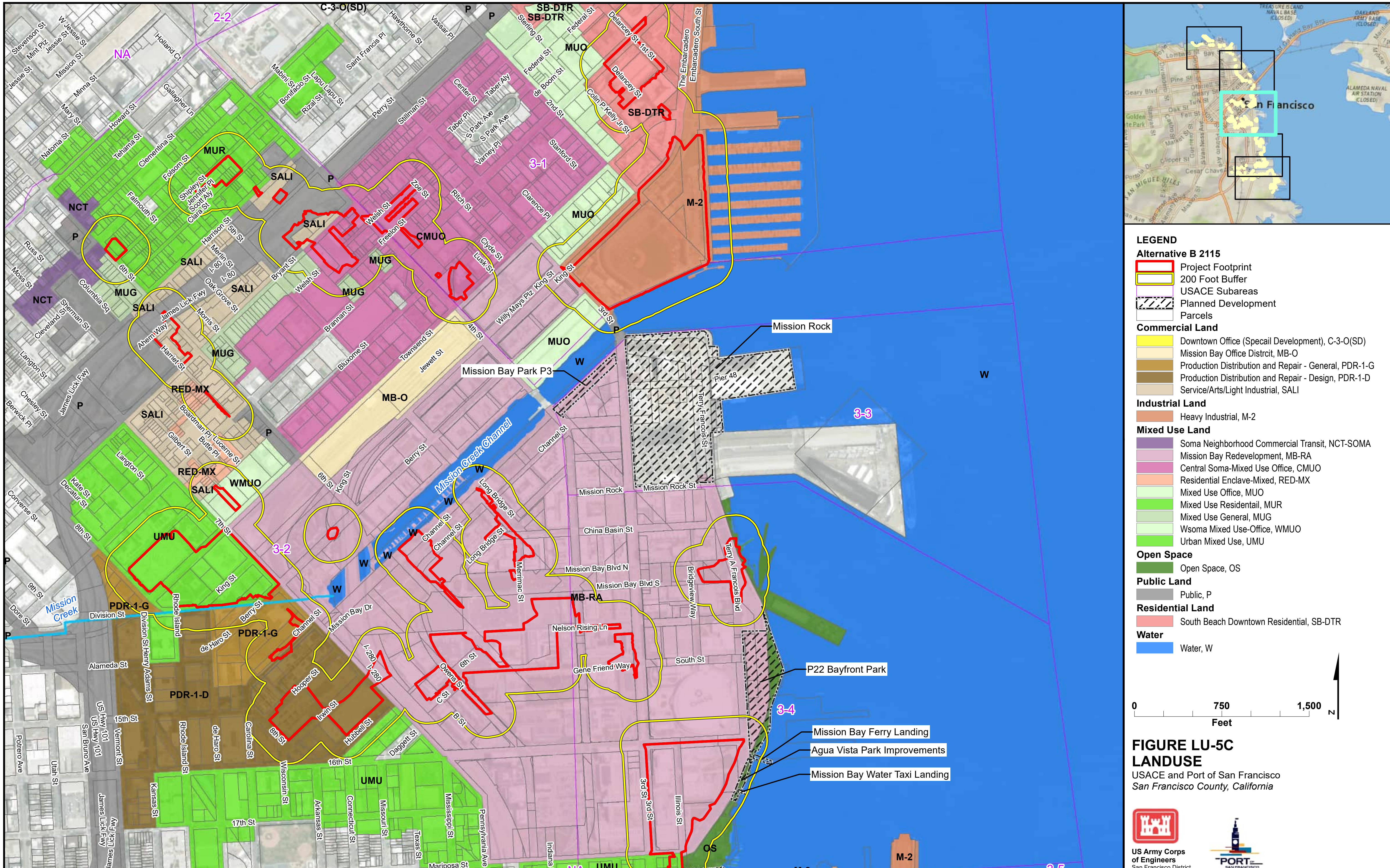
USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_B_2115.MXD 10/25/2023 9:23:39 AM



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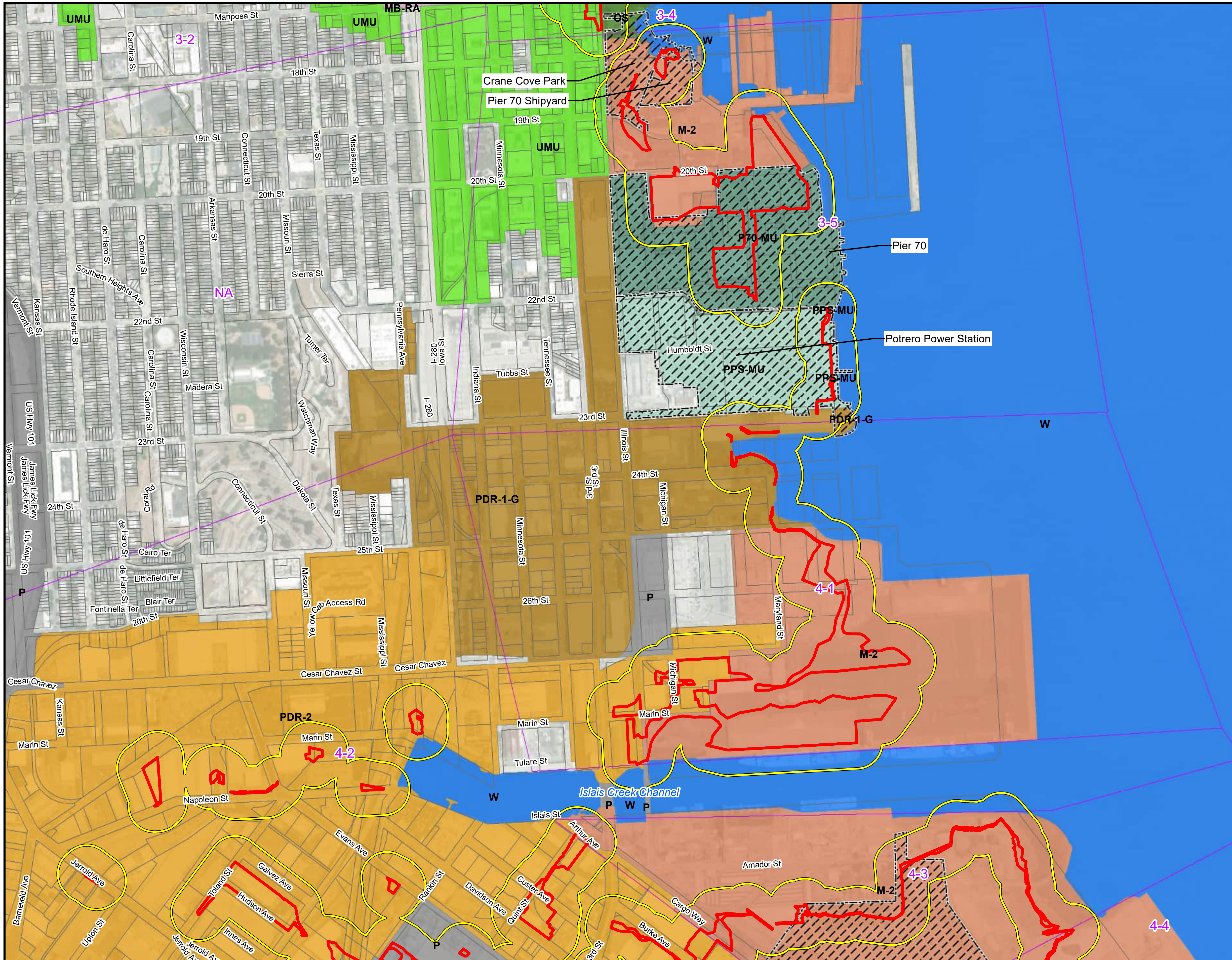
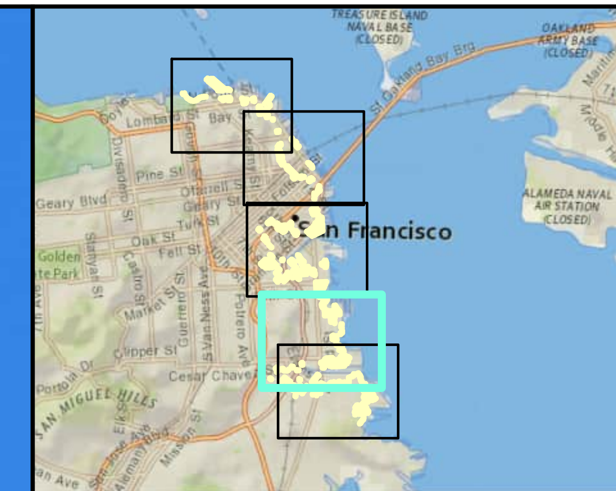




LEGEND

Alternative B 2115

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Planned Development
- Parcels

Commercial Land

- Production Distribution and Repair, PDR-2
- Production Distribution and Repair - General, PDR-1-G

Industrial Land

- Heavy Industrial, M-2

Mixed Use Land

- Mission Bay Redevelopment, MB-RA
- Urban Mixed Use, UMU
- Potrero Power Station Mixed Use, PPS-MU
- Pier70 Mixed Use, P70-MU

Open Space

- Open Space, OS

Public Land

- Public, P

Water

- Water, W

0 750 1,500
Feet

N

FIGURE LU-5D LANDUSE

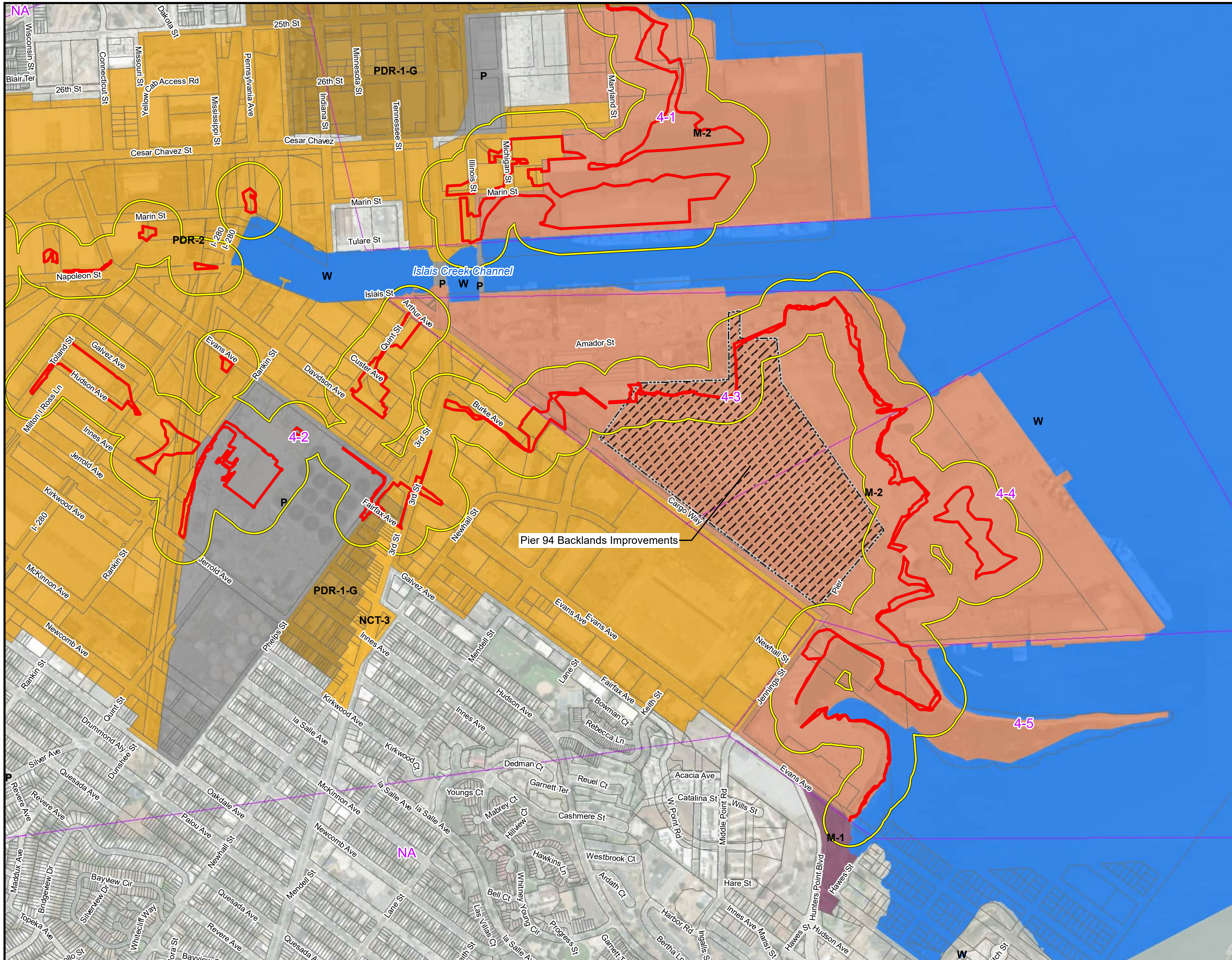
USACE and Port of San Francisco

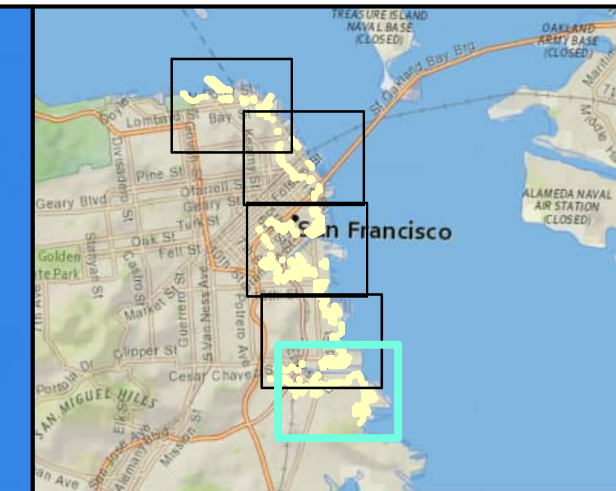
San Francisco County, California

US Army Corps of Engineers San Francisco District

PORT SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_B_2115.MXD 10/25/2023 9:23:39 AM





LEGEND

Alternative B 2115

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Planned Development
- Parcels

Commercial Land

- Moderate Scale Neighborhood Commercial Transit District, NCT-3
- Production Distribution and Repair, PDR-2
- Production Distribution and Repair - General, PDR-1-G

Industrial Land

- Heavy Industrial, M-2
- Light Industrial, M-1

Public Land

- Public, P

Water

- Water, W

0 750 1,500
Feet

N

FIGURE LU-5E
LANDUSE

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_B_2115.MXD 10/25/2023 9:23:39 AM

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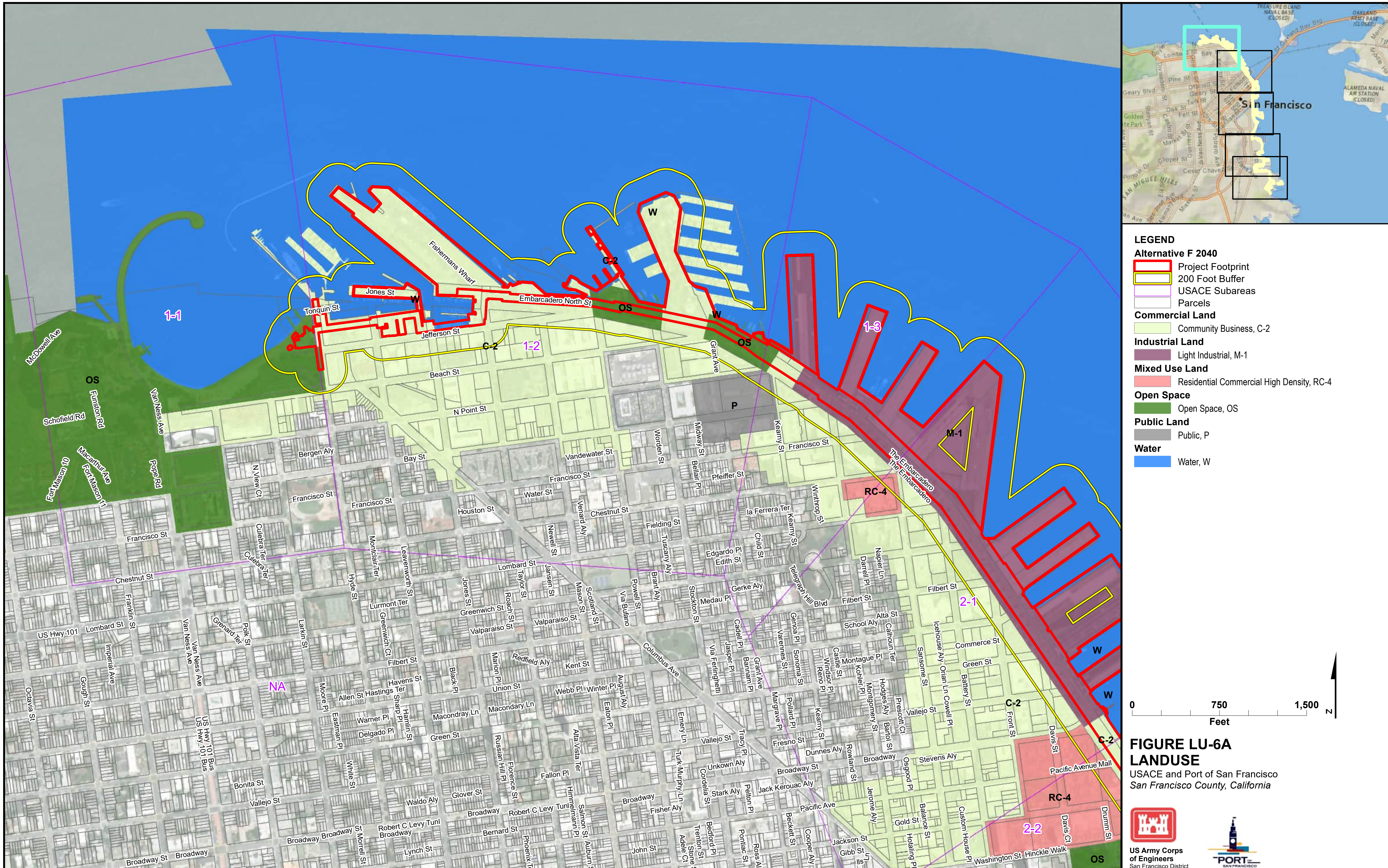
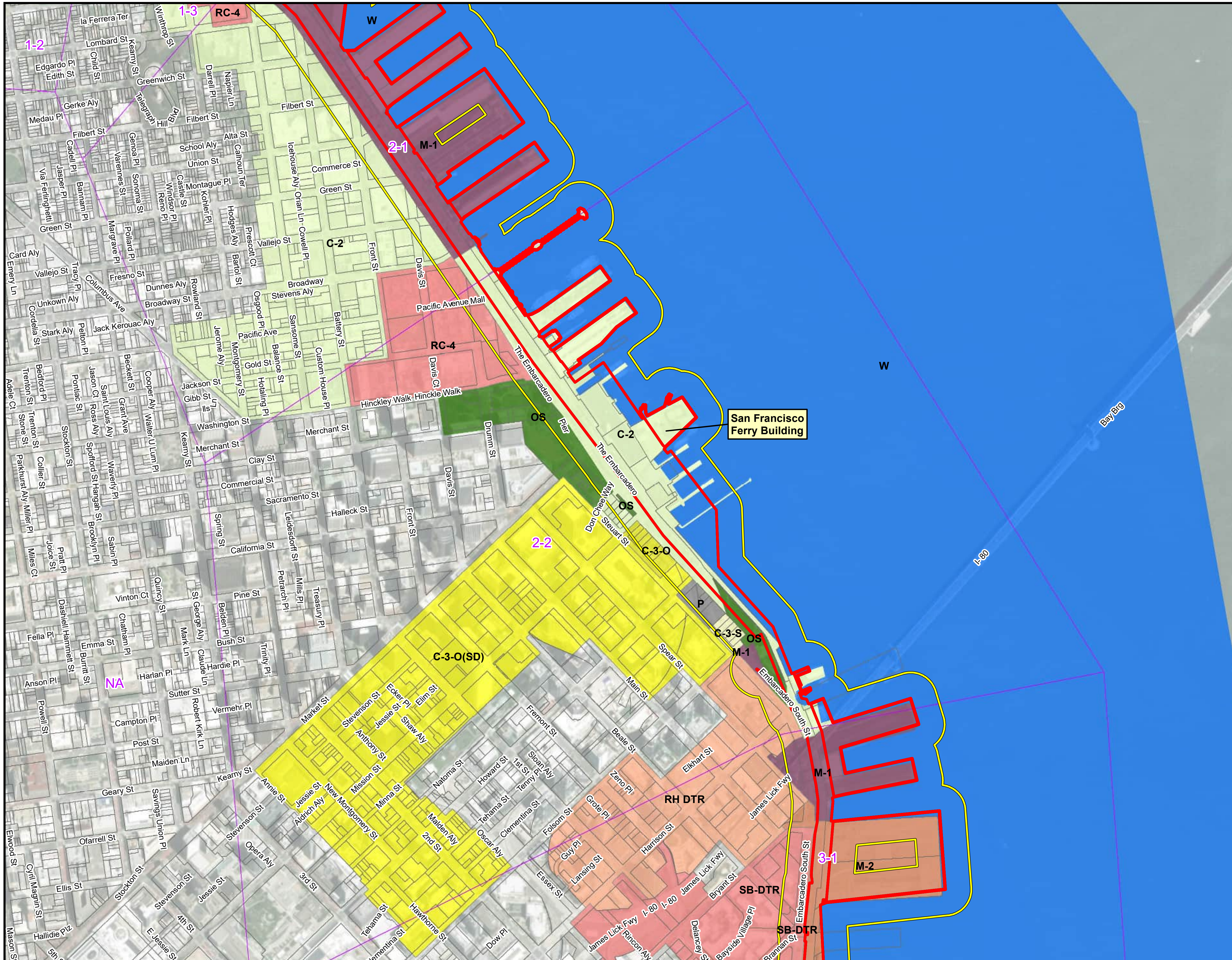
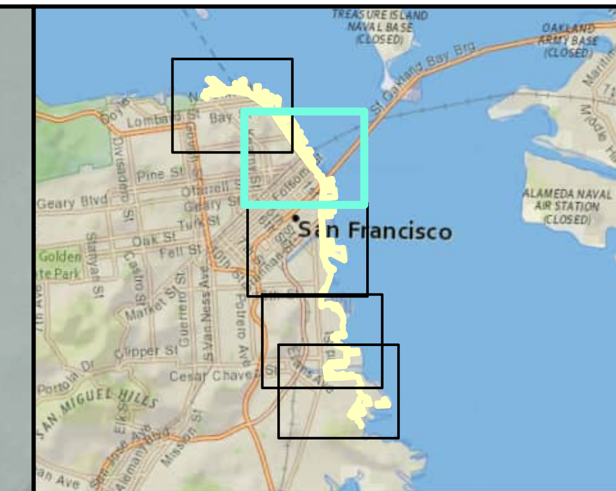


FIGURE LU-6A
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_F_2040.MXD 10/25/2023 9:29:45 AM





LEGEND

Alternative F 2040

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Parcels

Commercial Land

- Community Business, C-2
- Downtown Support, C-3-S
- Downtown Office (Specail Development), C-3-O(SD)
- Downtown Office, C-3-O

Industrial Land

- Heavy Industrial, M-2
- Light Industrial, M-1

Mixed Use Land

- Residential Commercial High Density, RC-4

Open Space

- Open Space, OS

Public Land

- Public, P

Residential Land

- Rincon Hill Downtown Residential, RH DTR
- South Beach Downtown Residential, SB-DTR

Water

- Water, W

0 750 1,500
Feet

N

FIGURE LU-6B
LANDUSE

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_F_2040.MXD 10/25/2023 9:29:45 AM

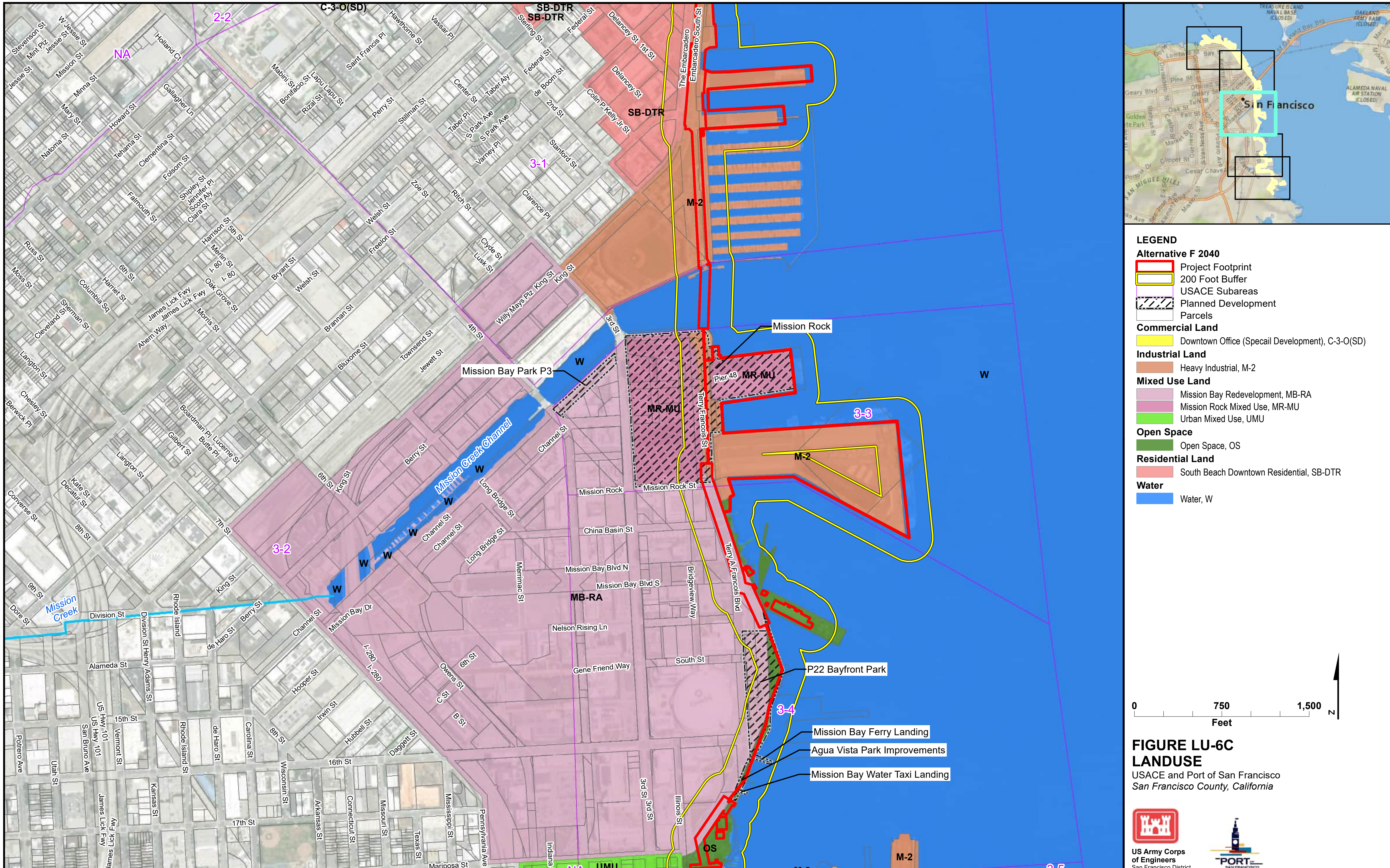


FIGURE LU-6C
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_F_2040.MXD 10/25/2023 9:29:45 AM

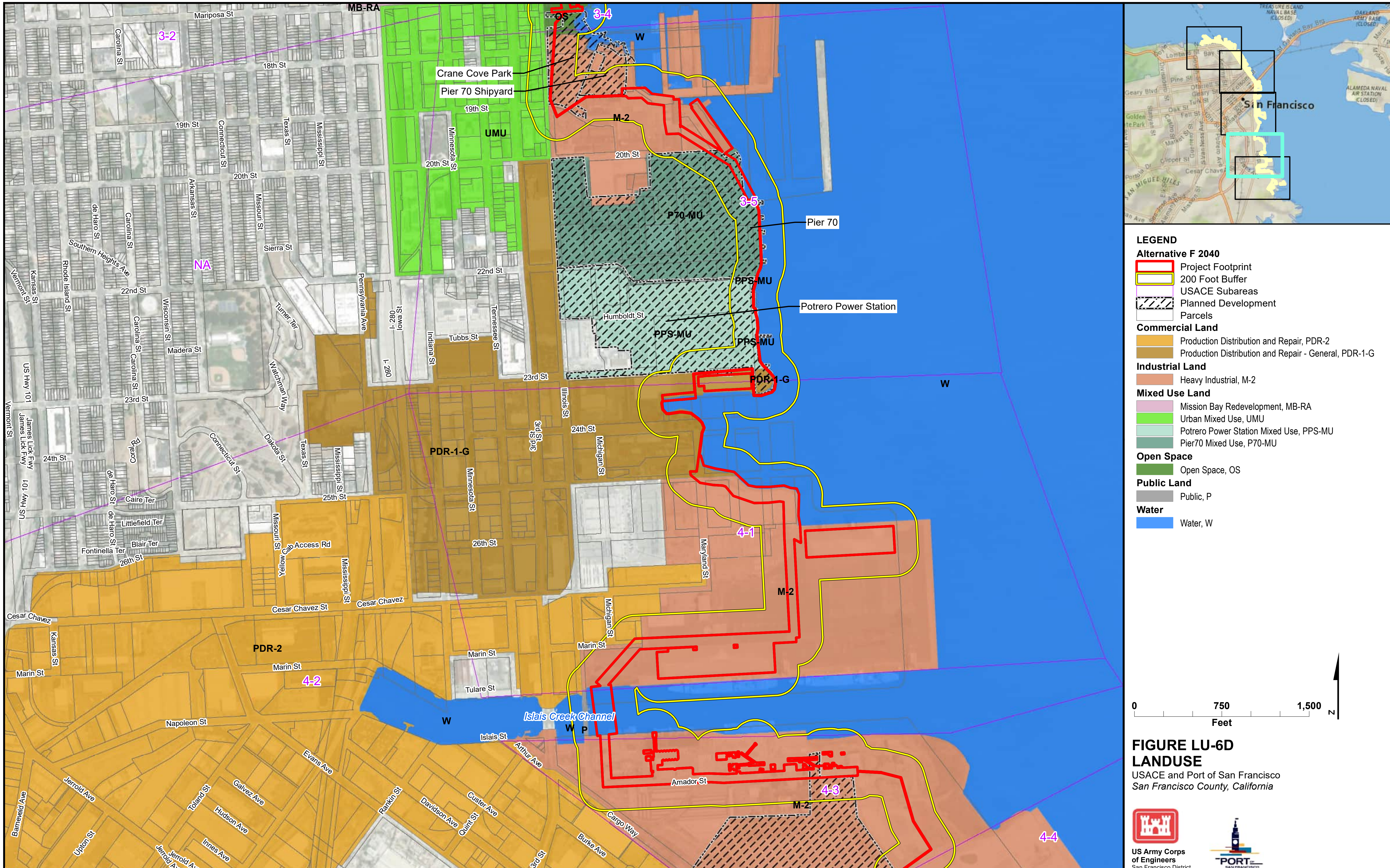


FIGURE LU-6D
LANDUSE

USACE and Port of San Francisco

San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_F_2040.MXD 10/25/2023 9:29:45 AM

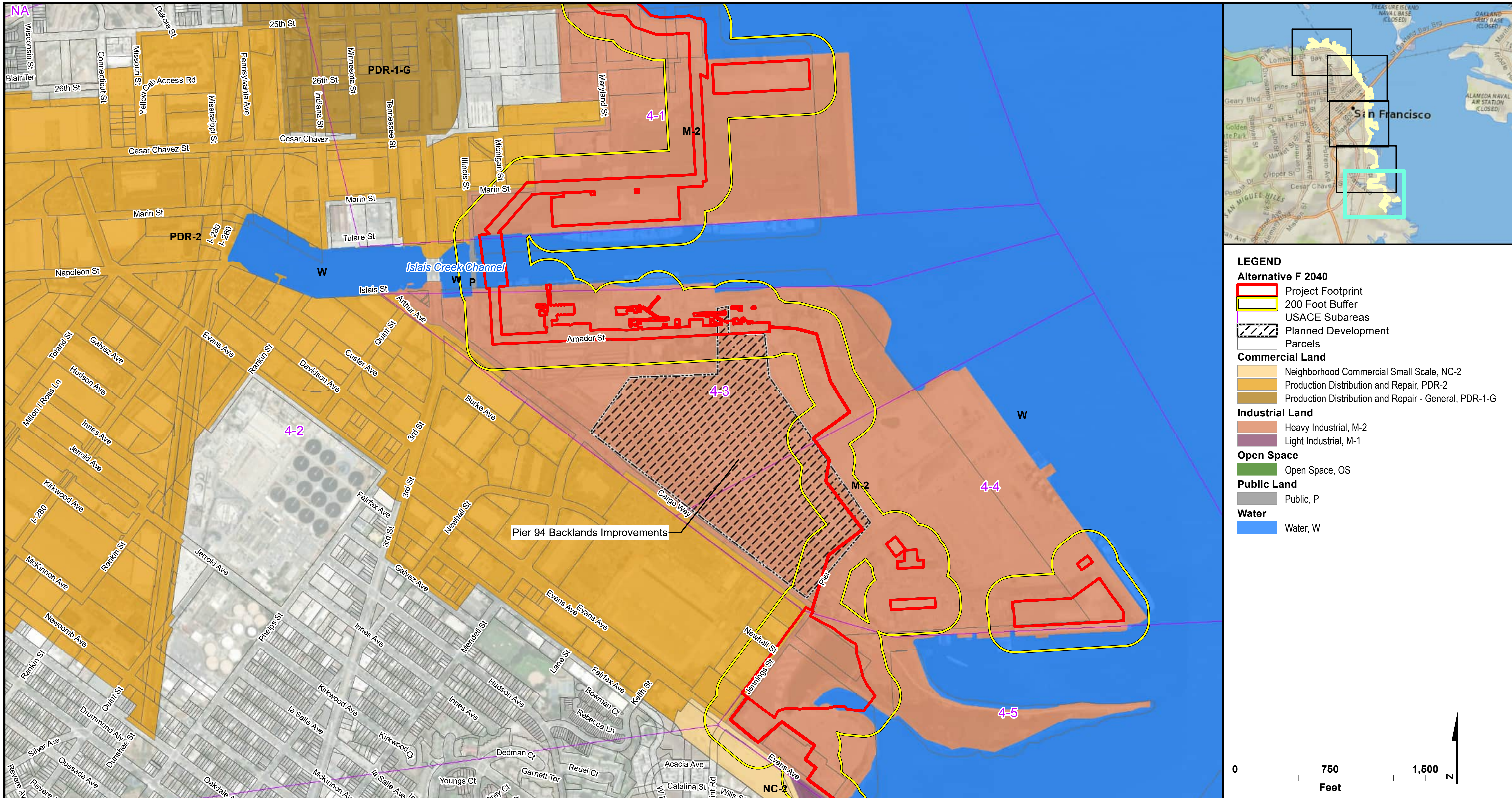


FIGURE LU-6E
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_F_2040.MXD 10/25/2023 9:29:45 AM

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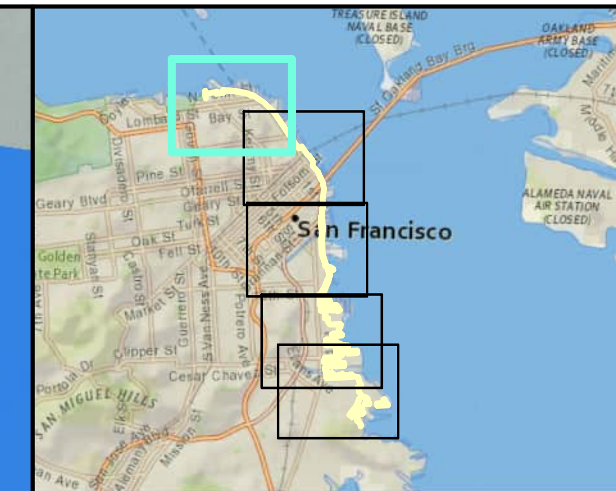


LEGEND

Alternative F 2090

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Parcels

Commercial Land

- Community Business, C-2

Industrial Land

- Light Industrial, M-1

Open Space

- Open Space, OS

Public Land

- Public, P

Water

- Water, W

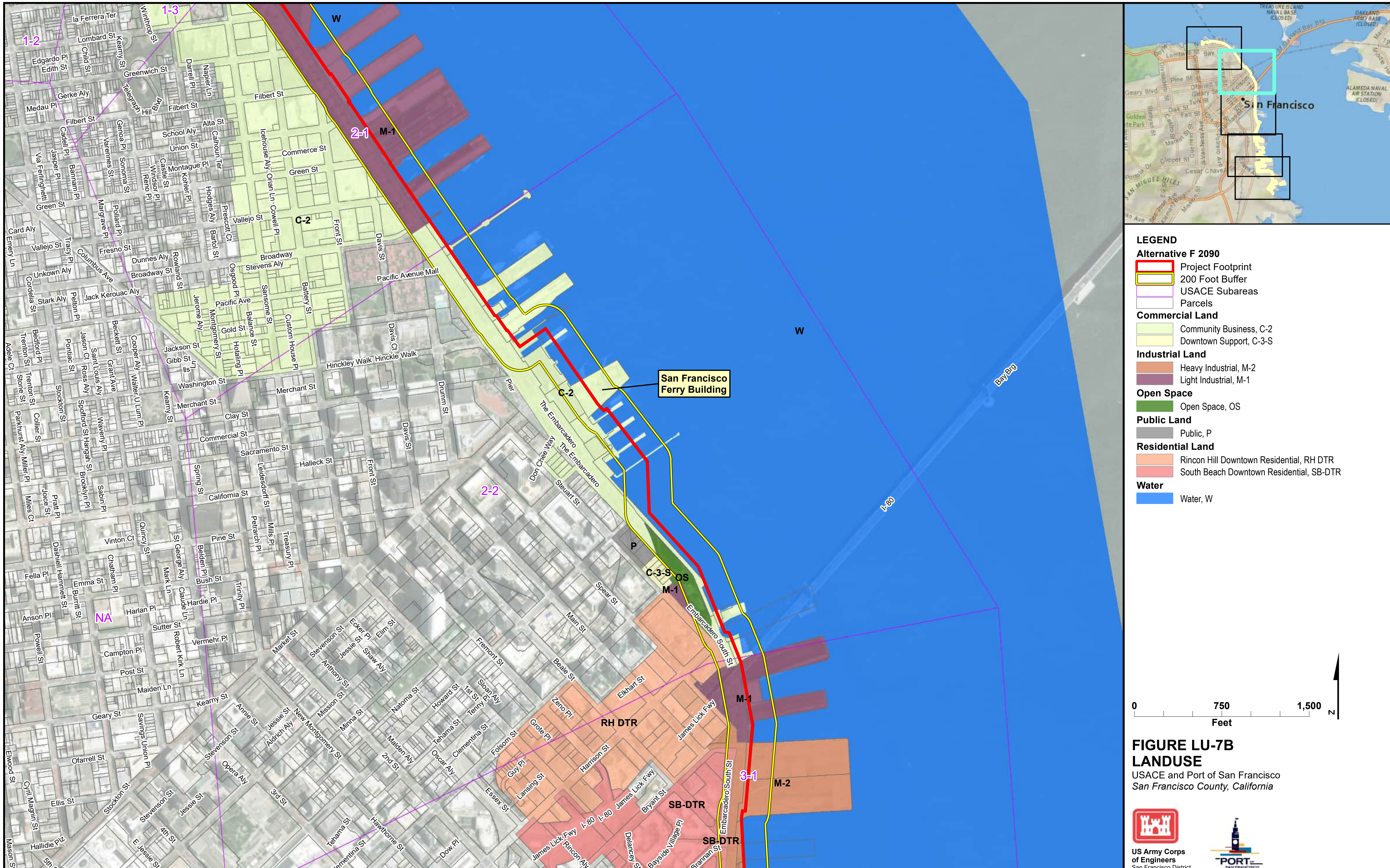
0 750 1,500
Feet
N

FIGURE LU-7A
LANDUSE

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO



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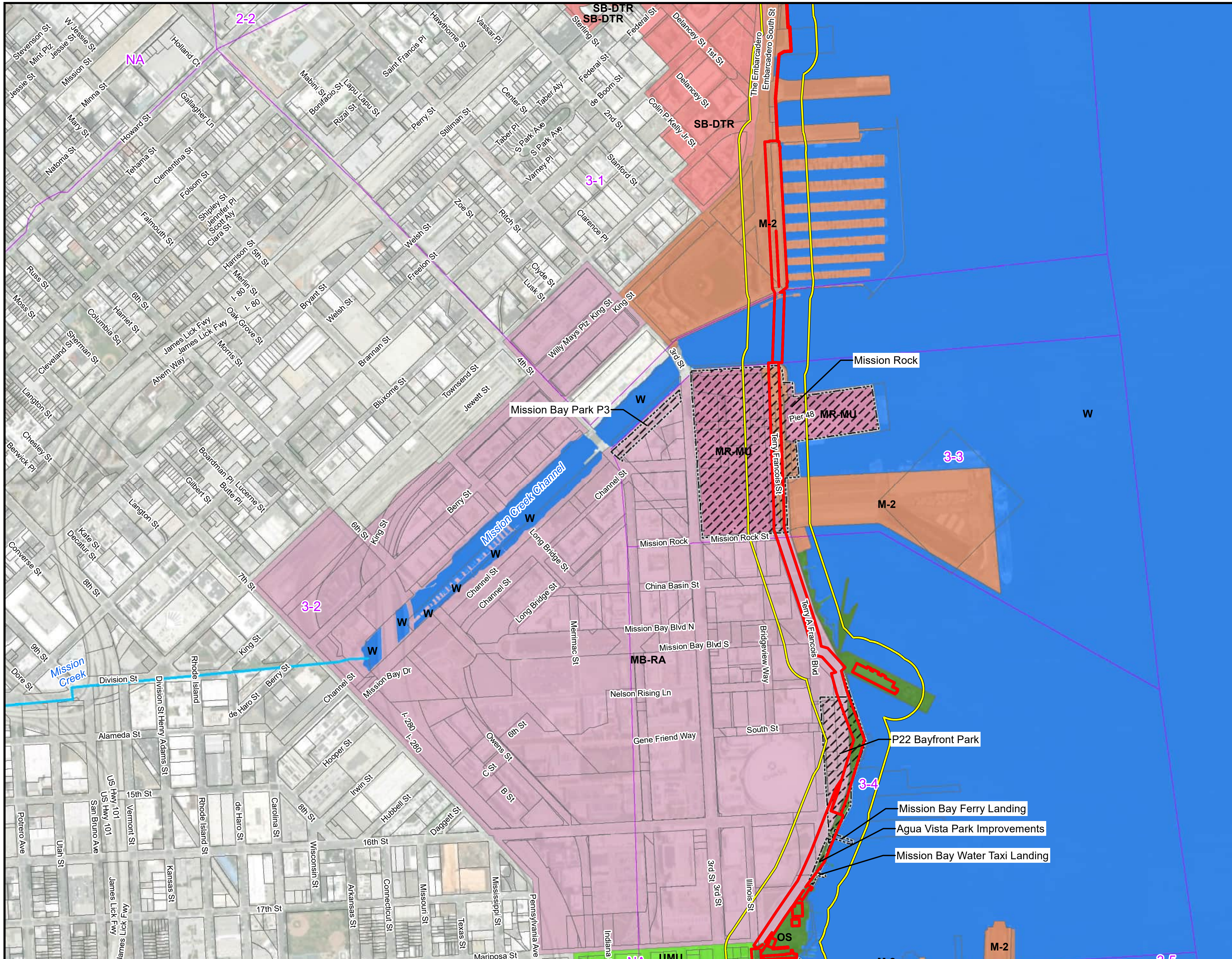
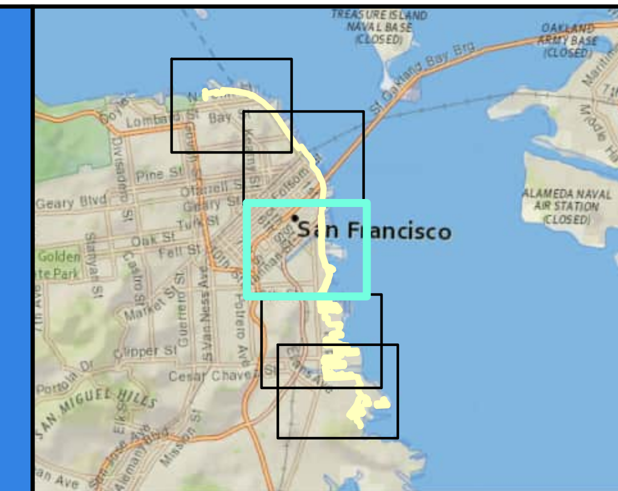




LEGEND

Alternative F 2090

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Planned Development
- Parcels

Industrial Land

- Heavy Industrial, M-2

Mixed Use Land

- Mission Bay Redevelopment, MB-RA
- Mission Rock Mixed Use, MR-MU
- Urban Mixed Use, UMU

Open Space

- Open Space, OS

Residential Land

- South Beach Downtown Residential, SB-DTR

Water

- Water, W

0 750 1,500
Feet
N

FIGURE LU-7C
LANDUSE

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO

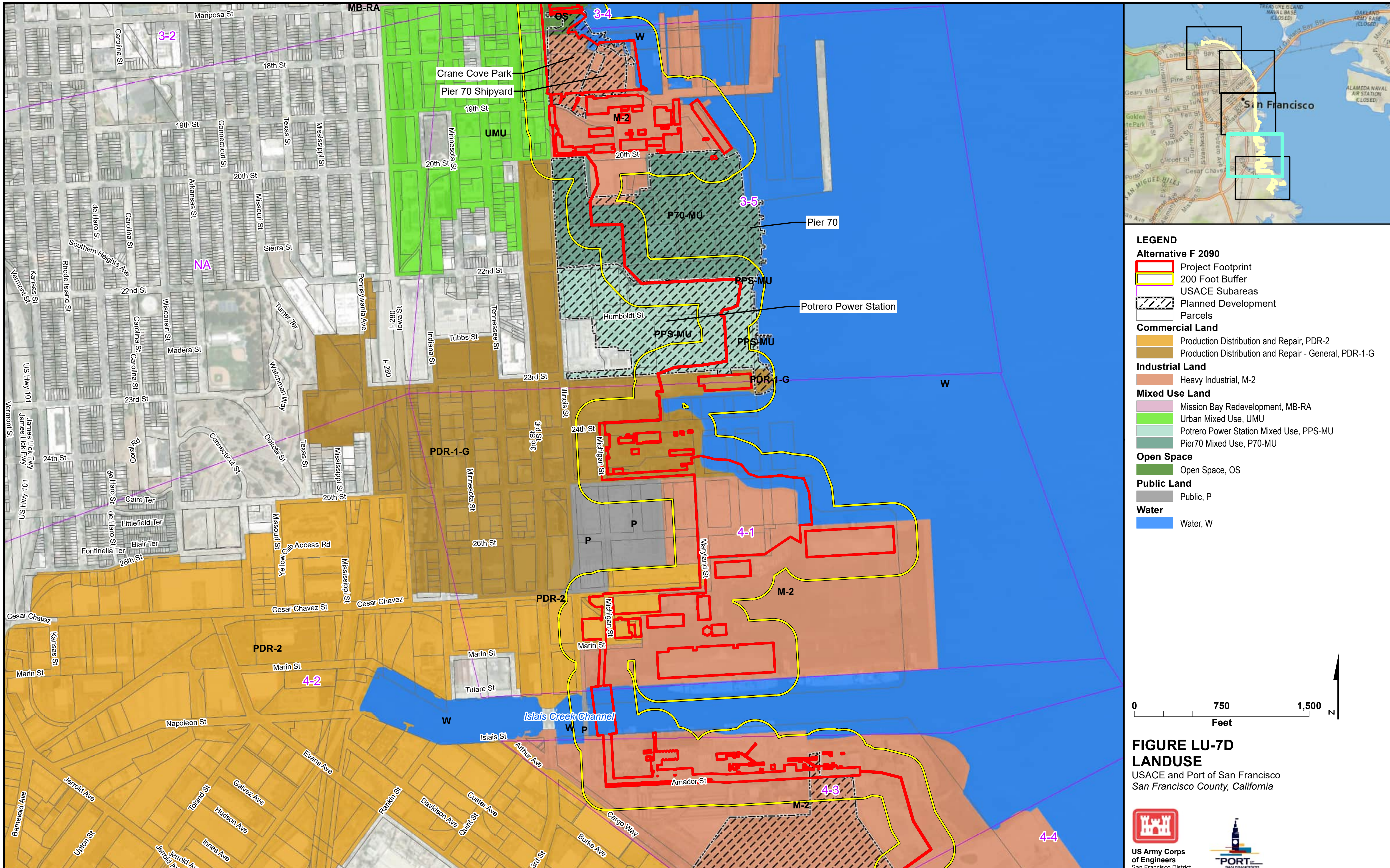


FIGURE LU-7D
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOFUSACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_F_2090.MXD 10/25/2023 9:41:47 AM

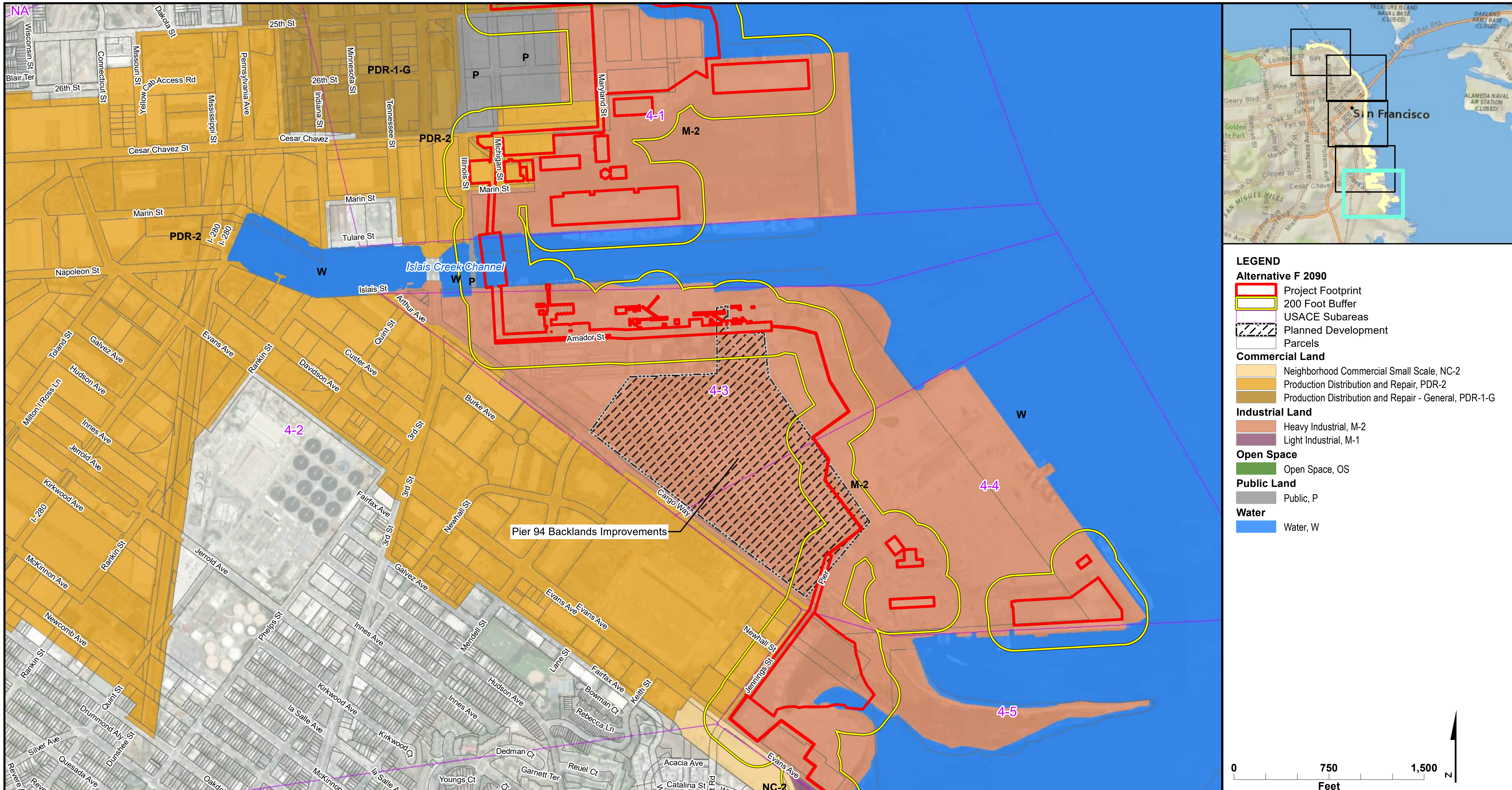


FIGURE LU-7E
LANDUSE

USACE and Port of San Francisco

San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_F_2090.MXD 10/25/2023 9:41:47 AM

Alternative G 2040

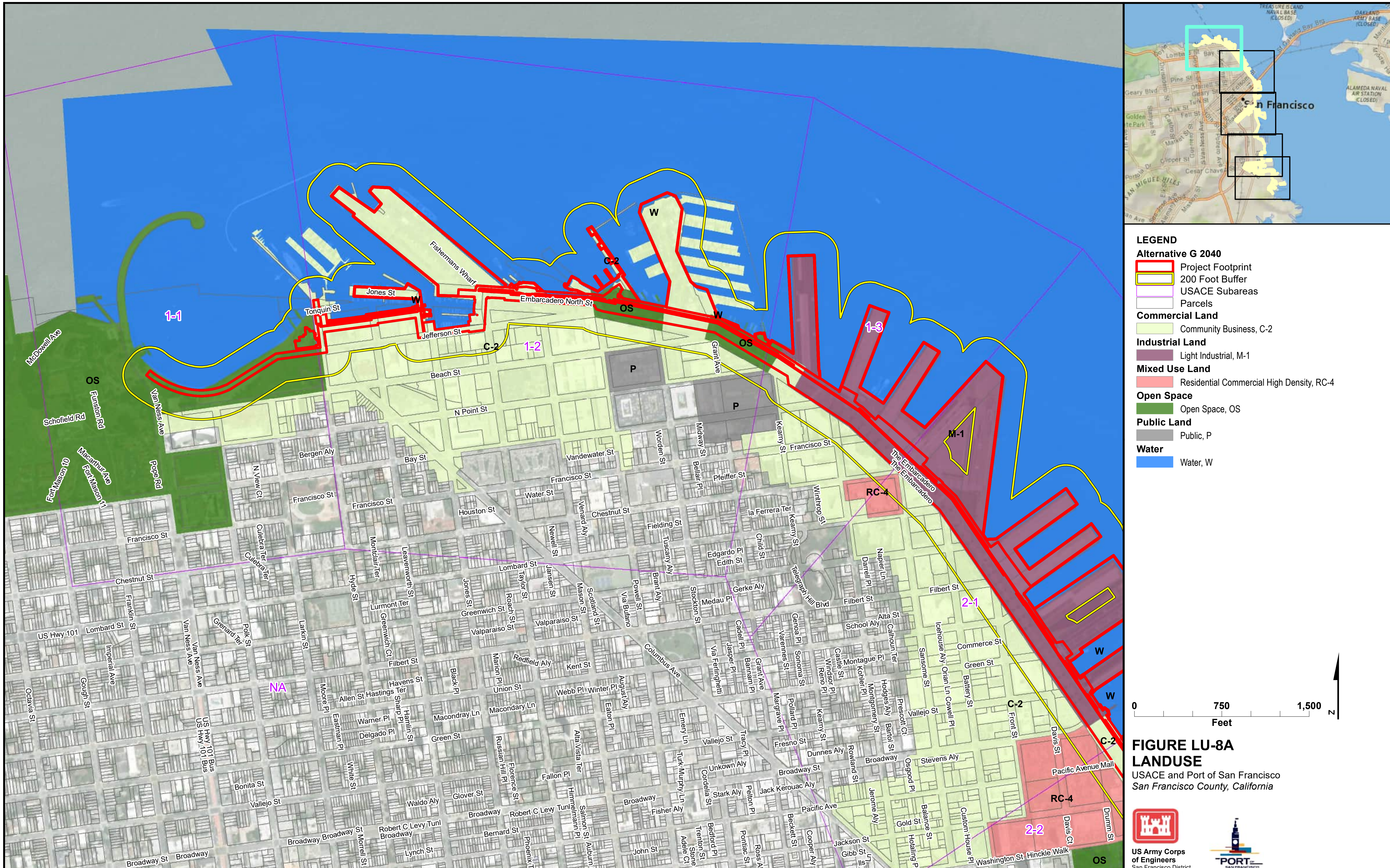
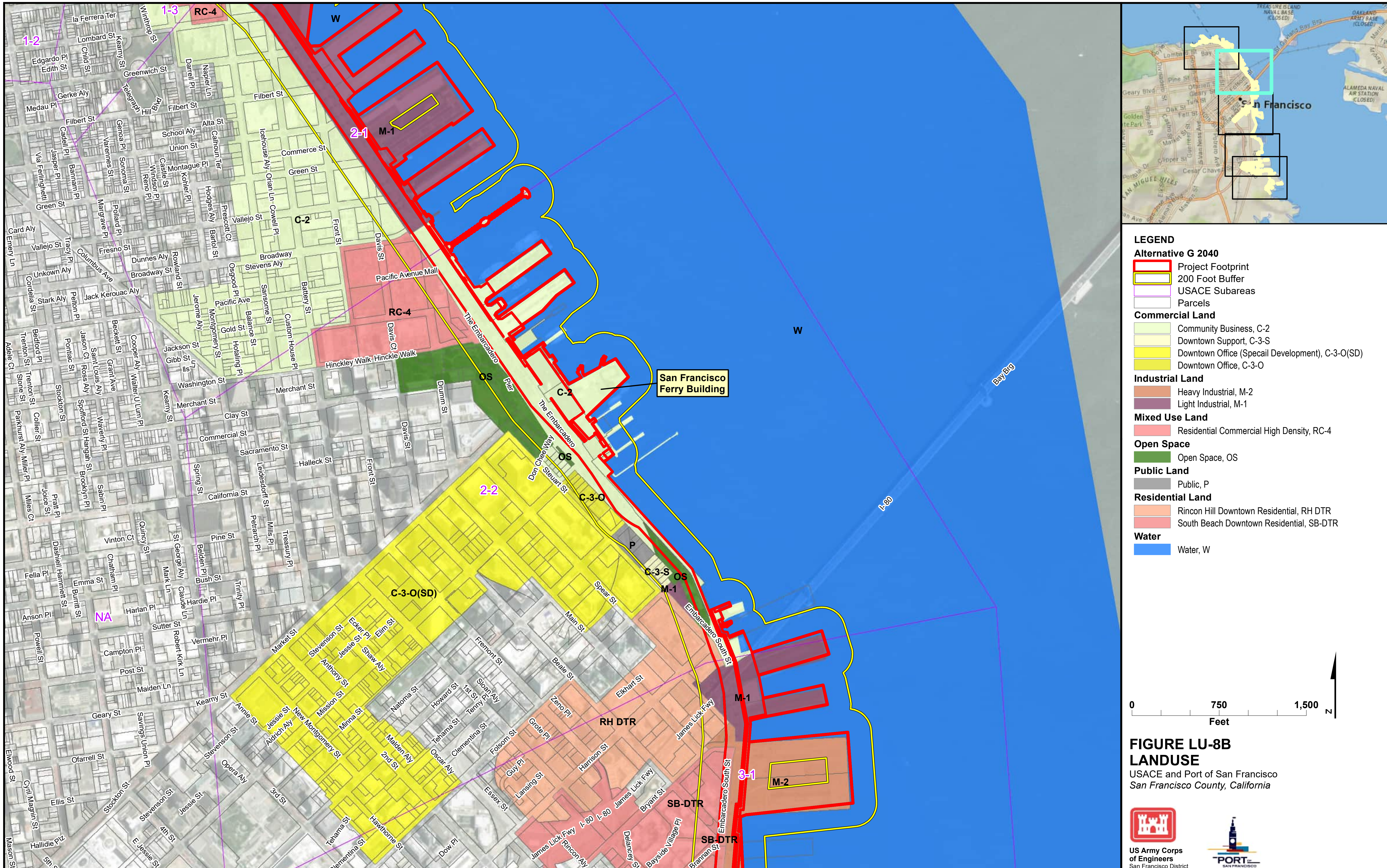


FIGURE LU-8A
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_G_2040.MXD 10/25/2023 9:40:57 AM



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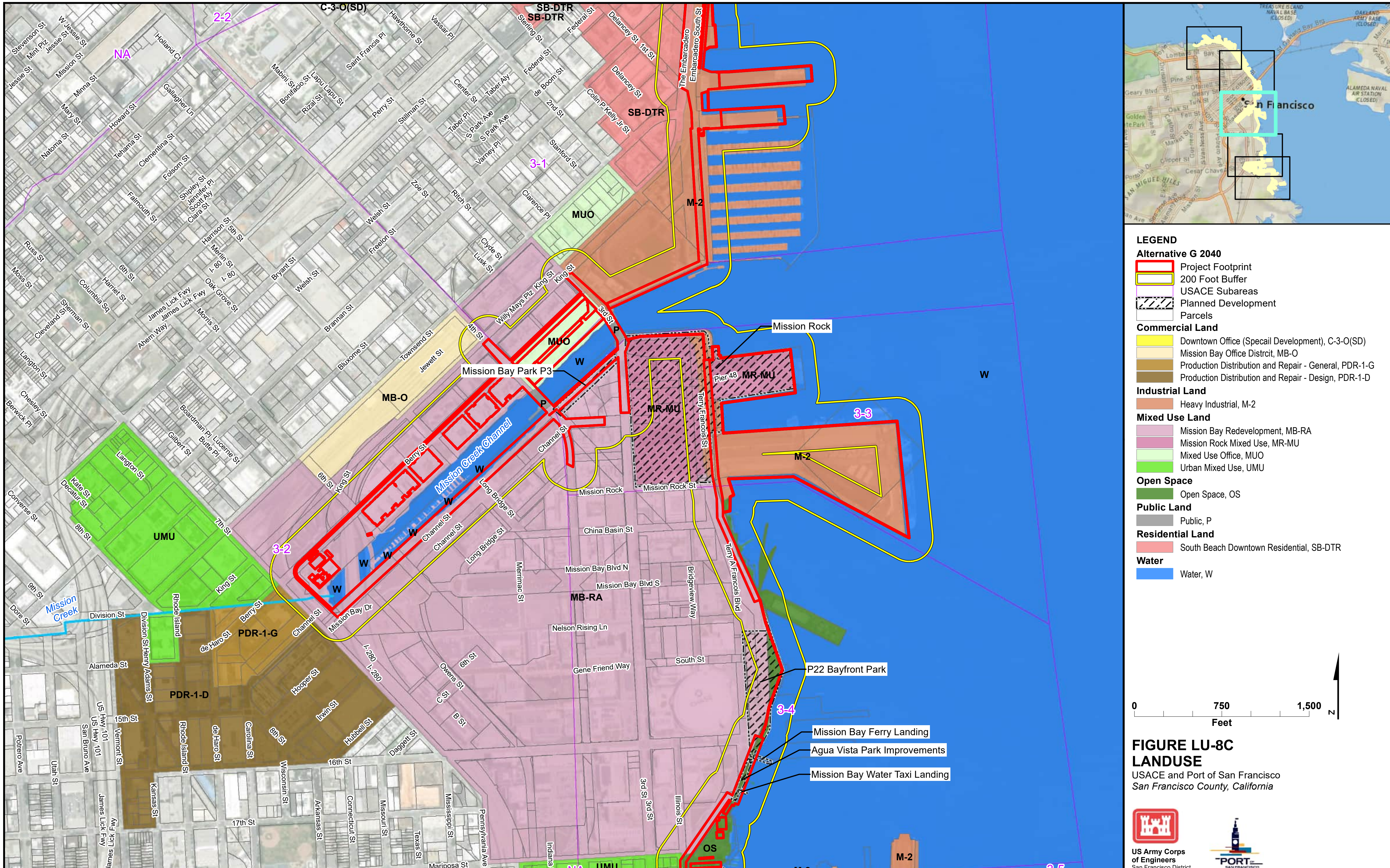

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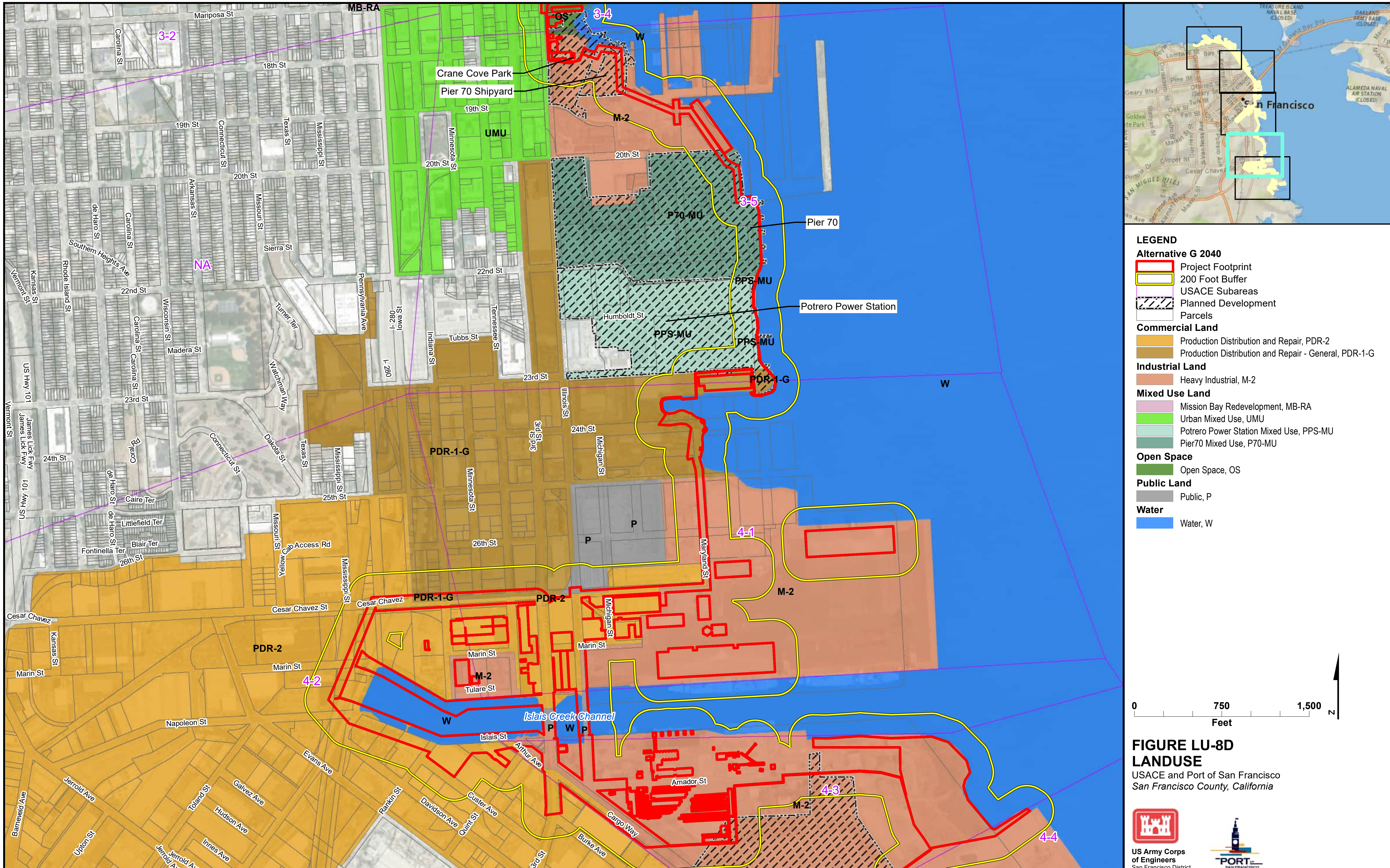

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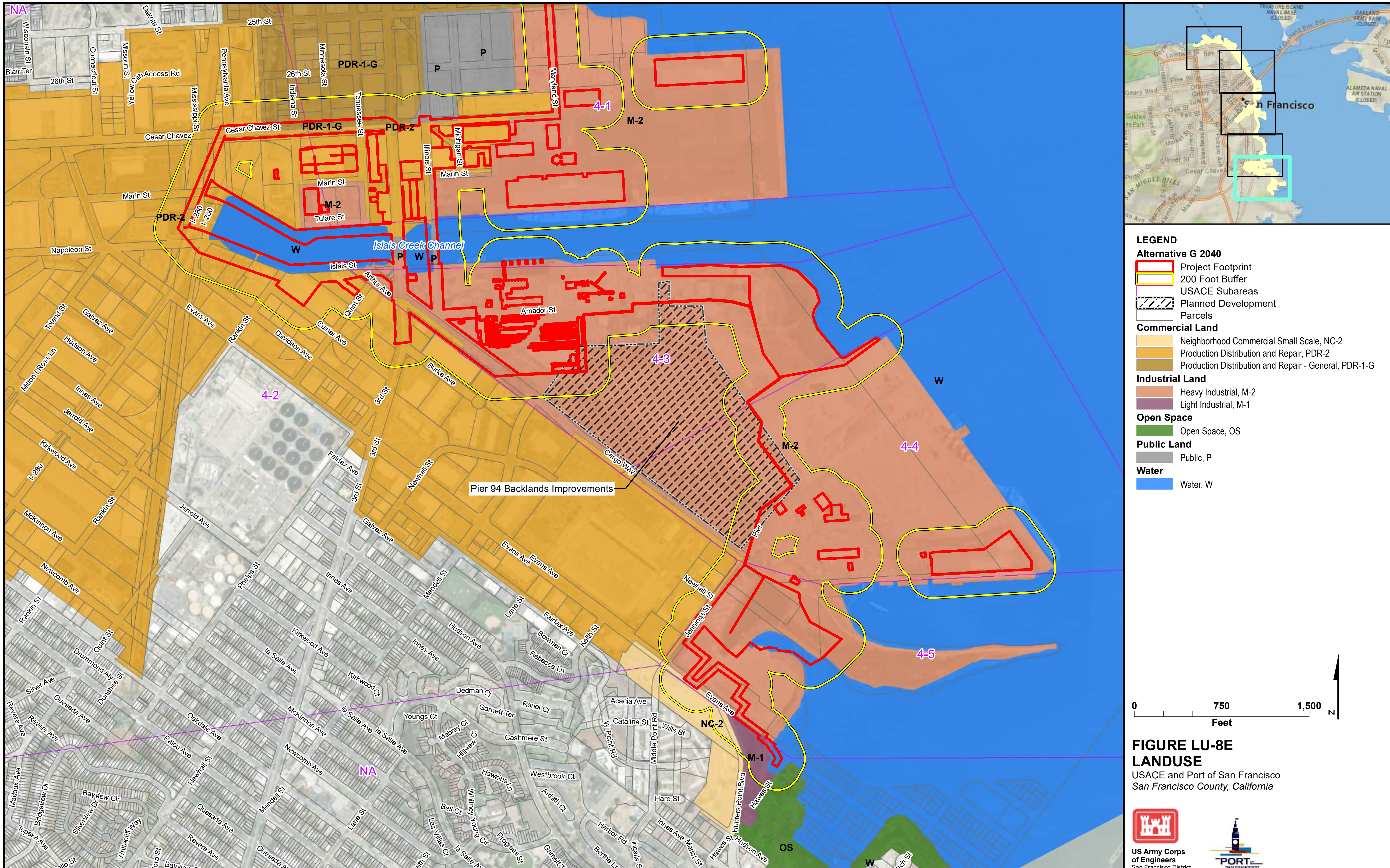

FIGURE LU-8E LANDUSE

USACE and Port of San Francisco

San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_G_2040.MXD 10/25/2023 9:40:57 AM

Alternative G 2090

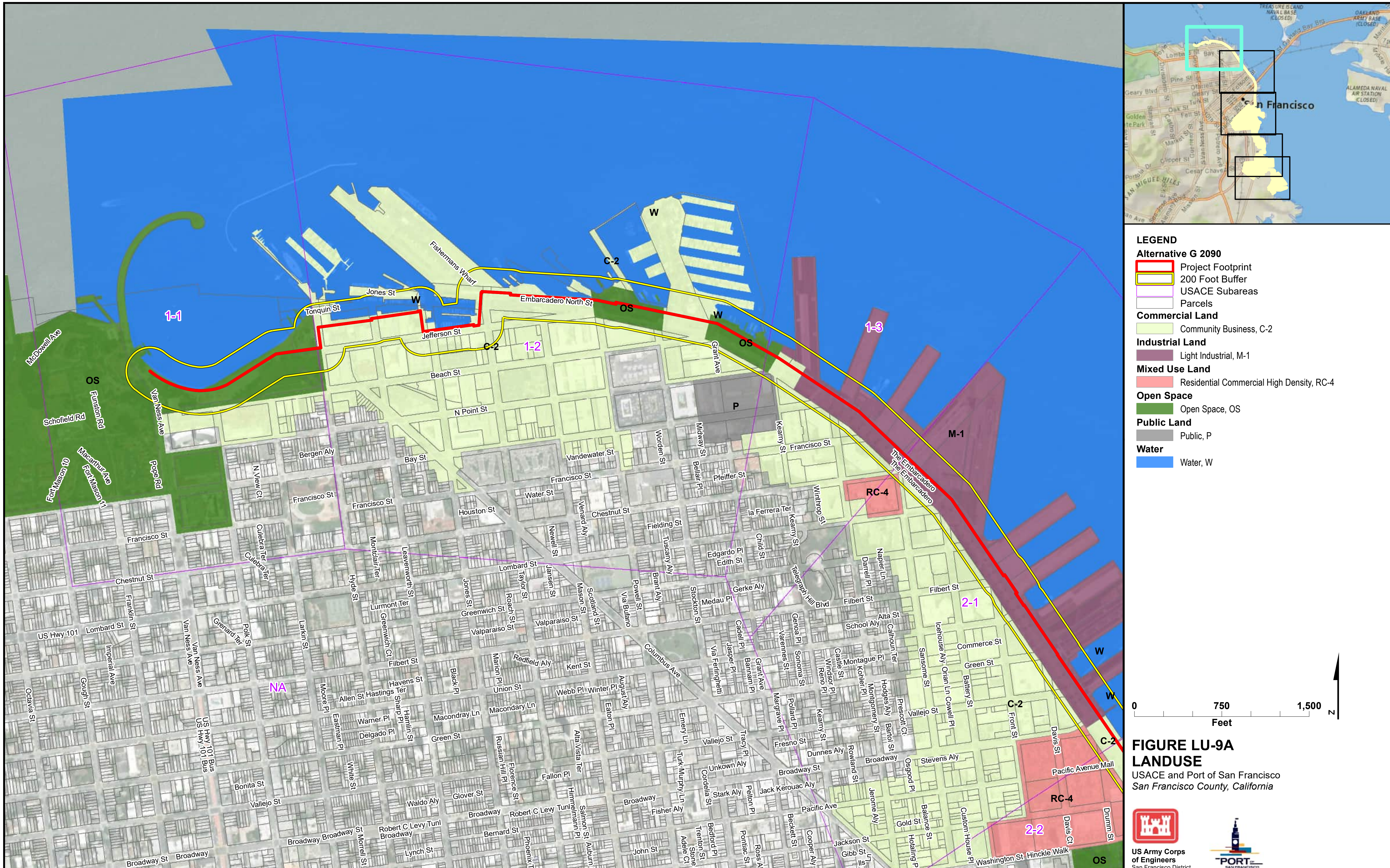

FIGURE LU-9A
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

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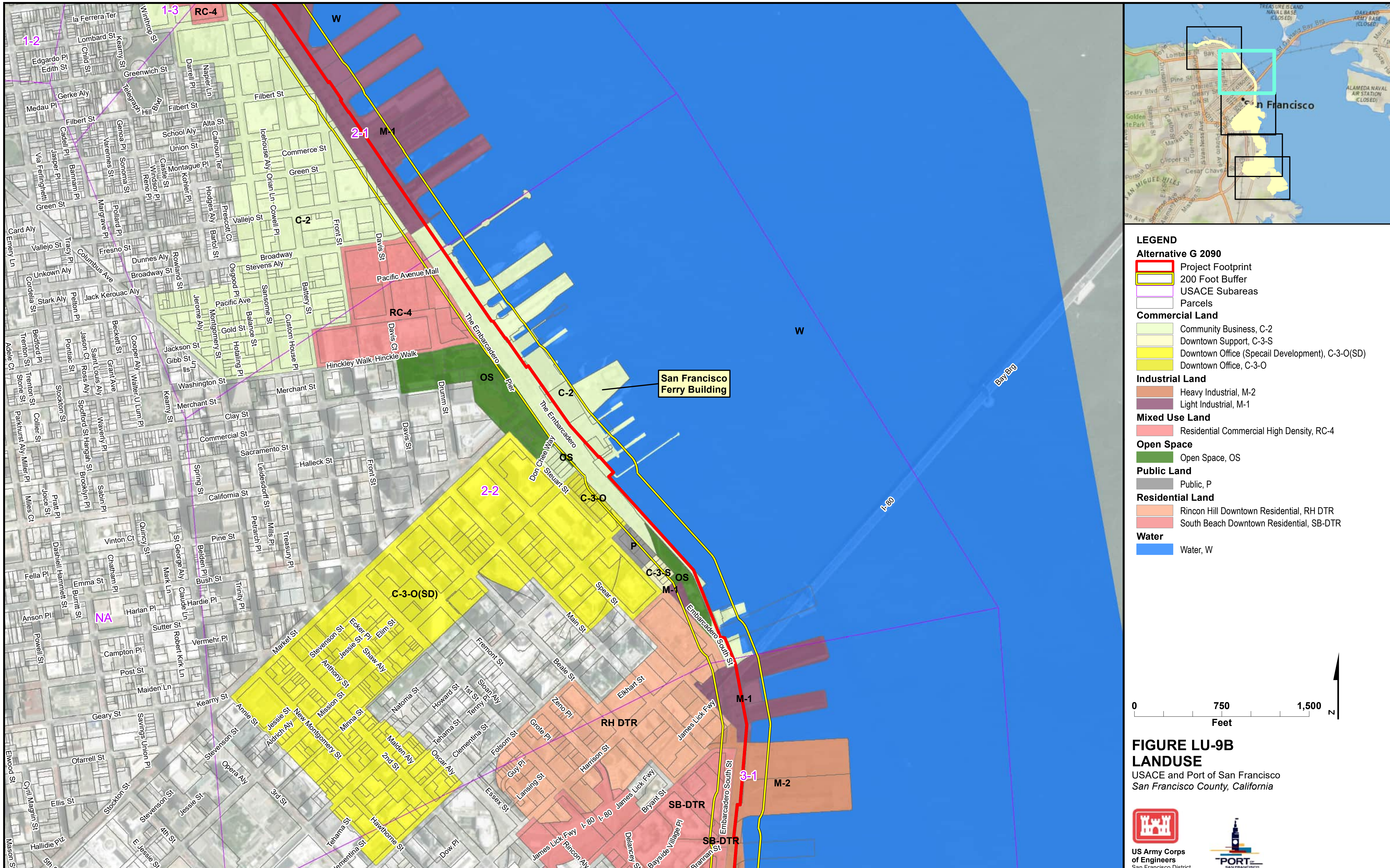

FIGURE LU-9B LANDUSE

USACE and Port of San Francisco

San Francisco County, California

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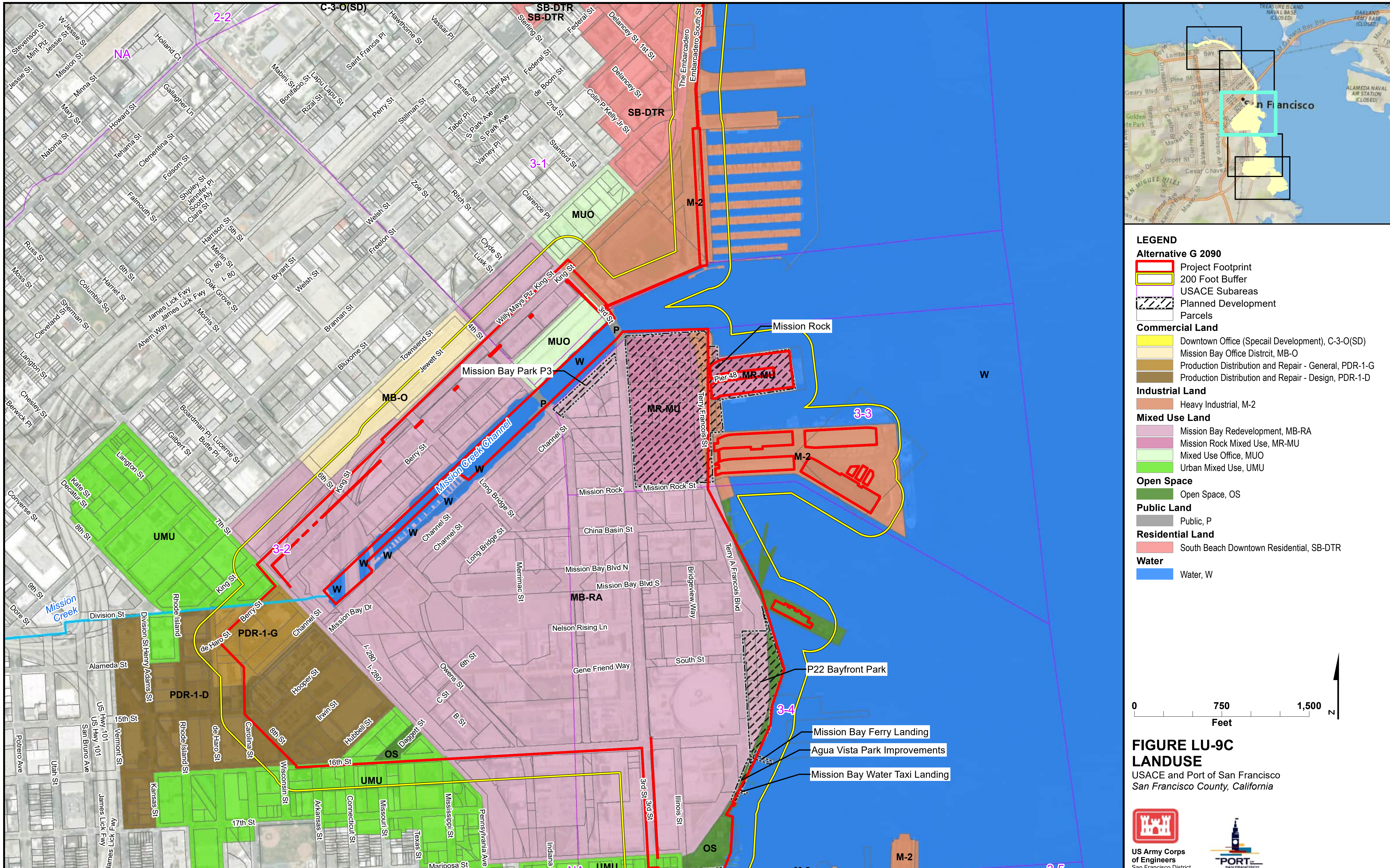

FIGURE LU-9C
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

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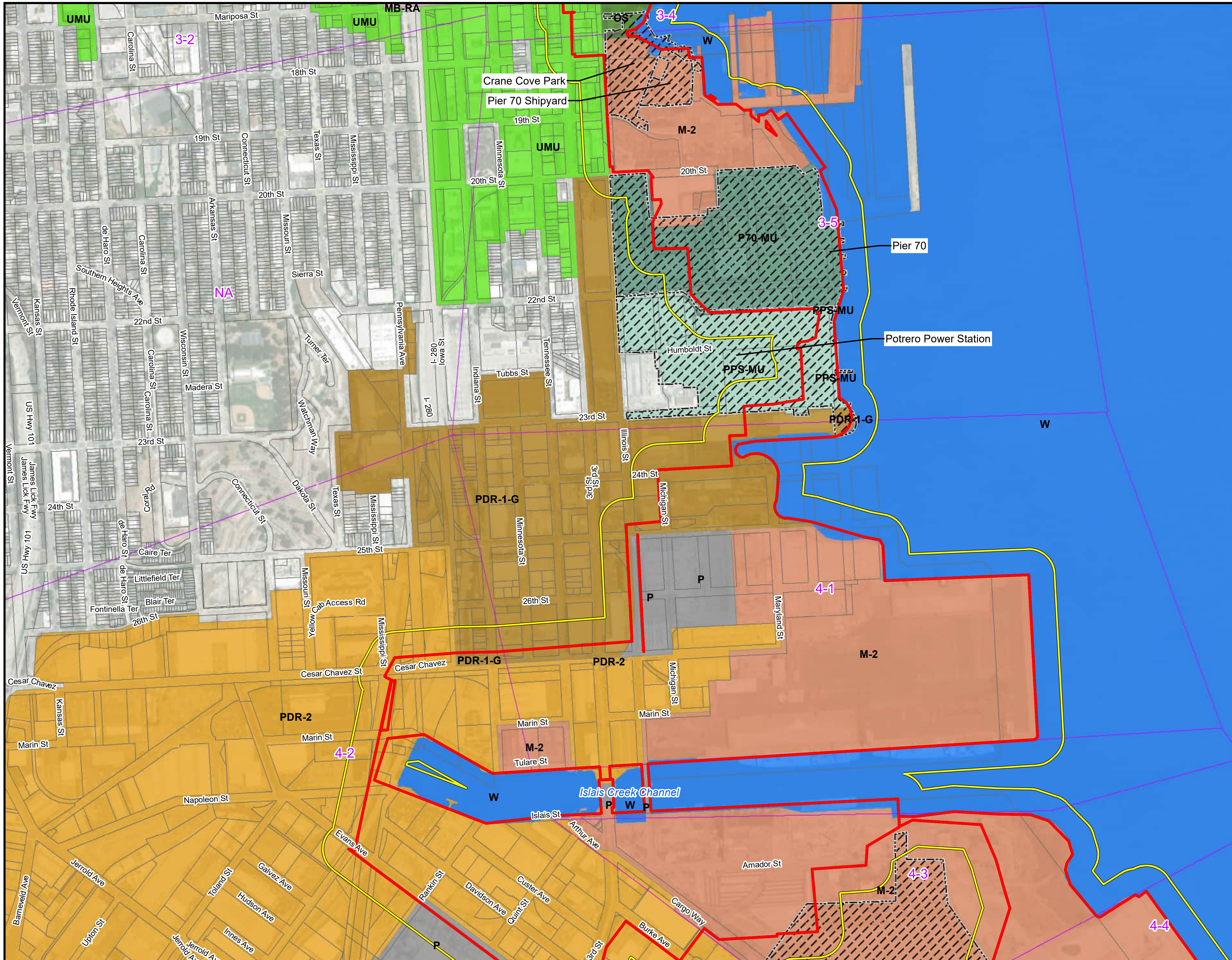
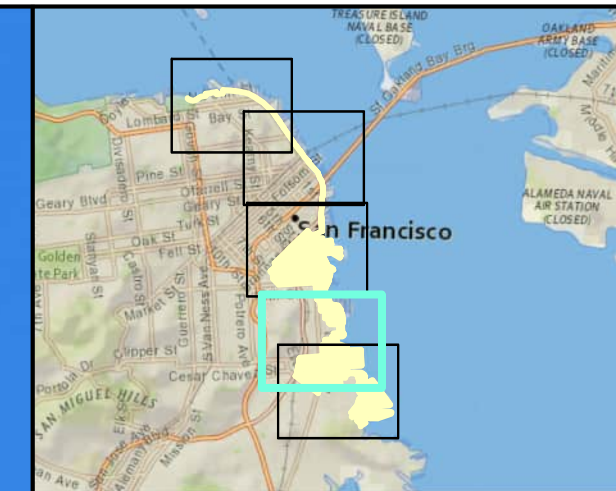




LEGEND

Alternative G 2090
- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Planned Development
- Parcels

Commercial Land
- Production Distribution and Repair, PDR-2
- Production Distribution and Repair - General, PDR-1-G

Industrial Land
- Heavy Industrial, M-2

Mixed Use Land
- Mission Bay Redevelopment, MB-RA
- Urban Mixed Use, UMU
- Potrero Power Station Mixed Use, PPS-MU
- Pier70 Mixed Use, P70-MU

Open Space
- Open Space, OS

Public Land
- Public, P

Water
- Water, W

0 750 1,500
Feet
N

FIGURE LU-9D LANDUSE

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT of SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOFUSACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_G_2090.MXD 10/25/2023 9:49:56 AM

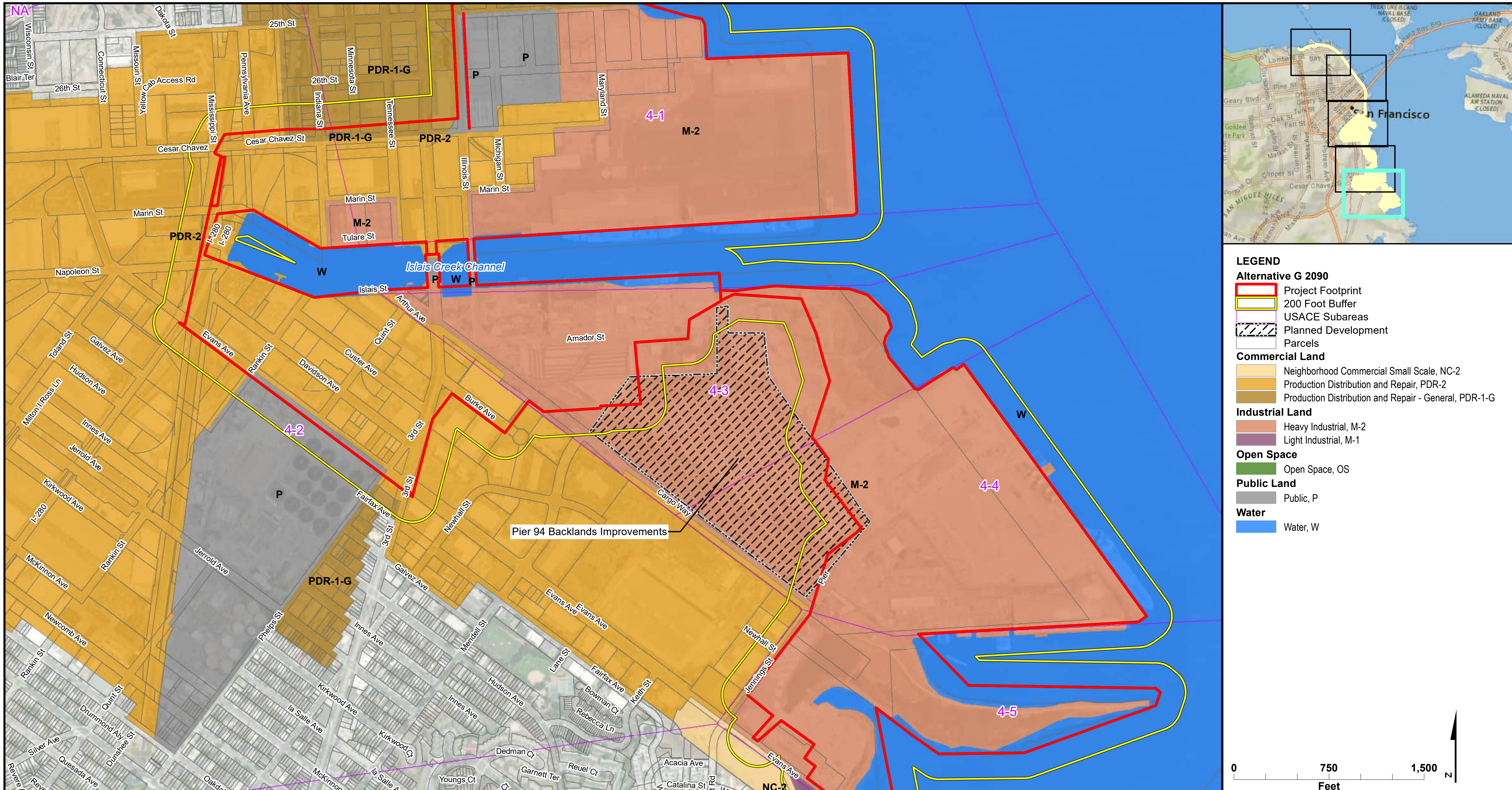


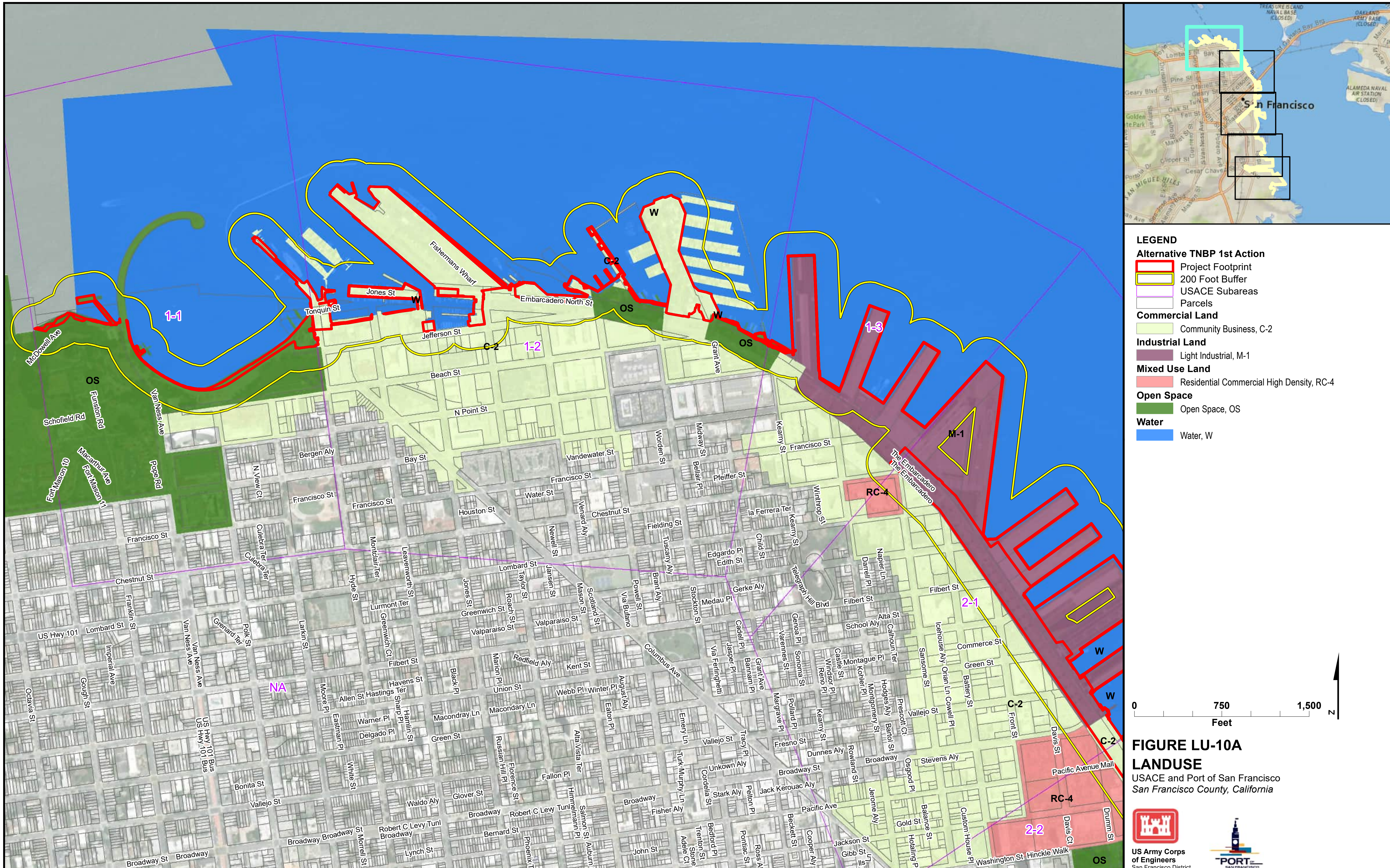
FIGURE LU-9E
LANDUSE

USACE and Port of San Francisco

San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_G_2090.MXD 10/25/2023 9:49:56 AM

TNBP 1st Action



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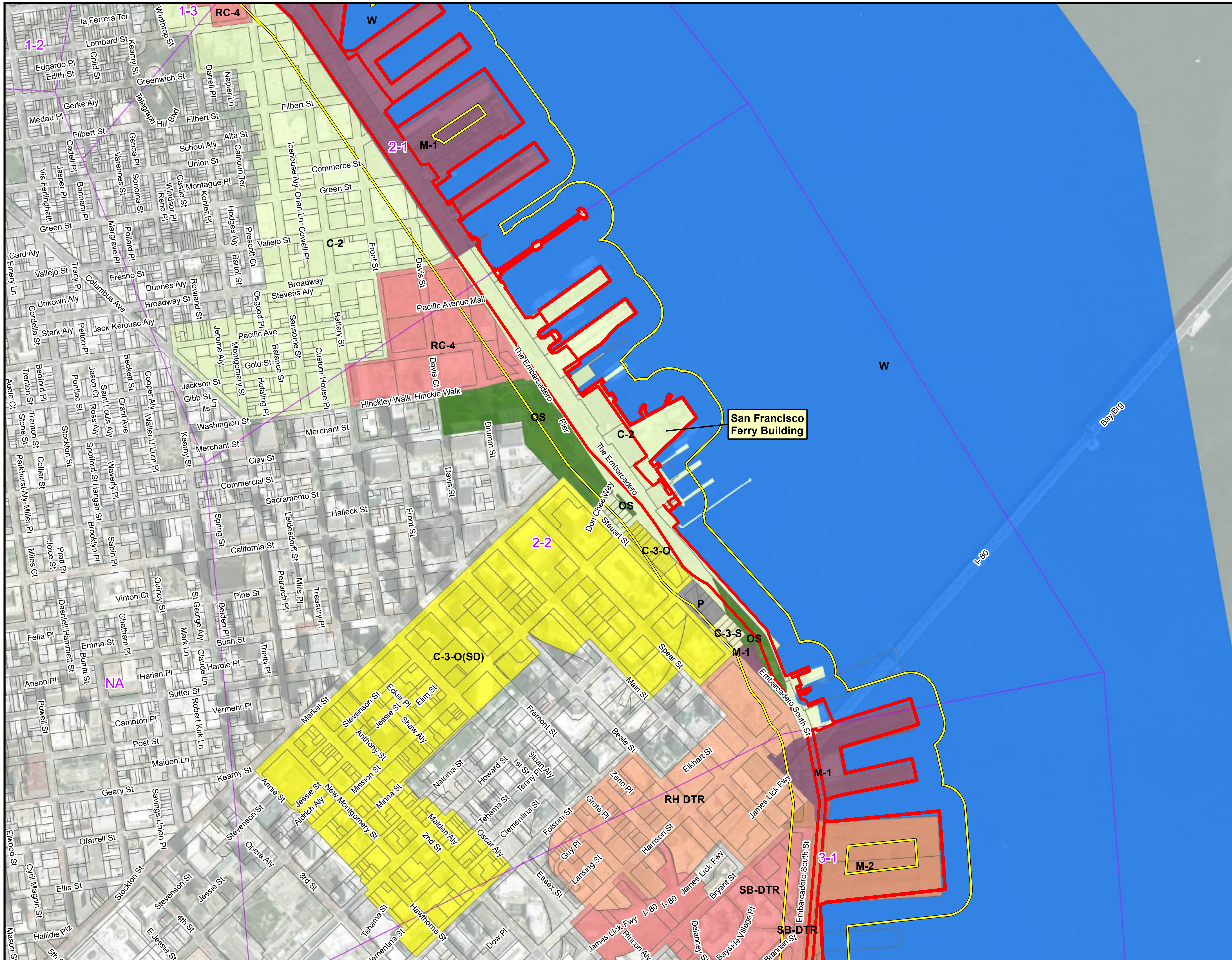
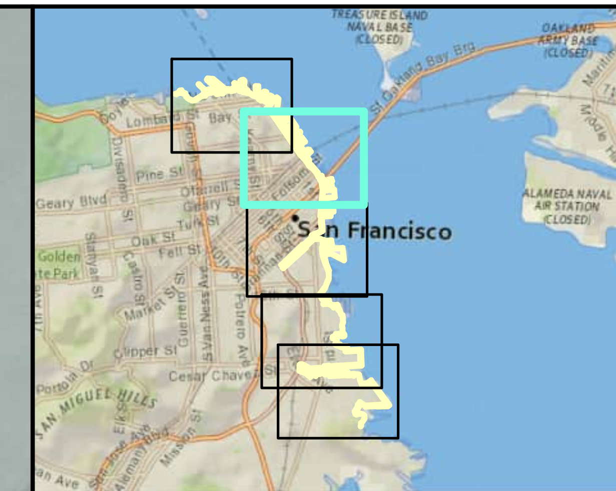




LEGEND

Alternative TNBP 1st Action

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Parcels

Commercial Land

- Community Business, C-2
- Downtown Support, C-3-S
- Downtown Office (Specail Development), C-3-O(SD)
- Downtown Office, C-3-O

Industrial Land

- Heavy Industrial, M-2
- Light Industrial, M-1

Mixed Use Land

- Residential Commercial High Density, RC-4

Open Space

- Open Space, OS

Public Land

- Public, P

Residential Land

- Rincon Hill Downtown Residential, RH DTR
- South Beach Downtown Residential, SB-DTR

Water

- Water, W

0 750 1,500
Feet

N

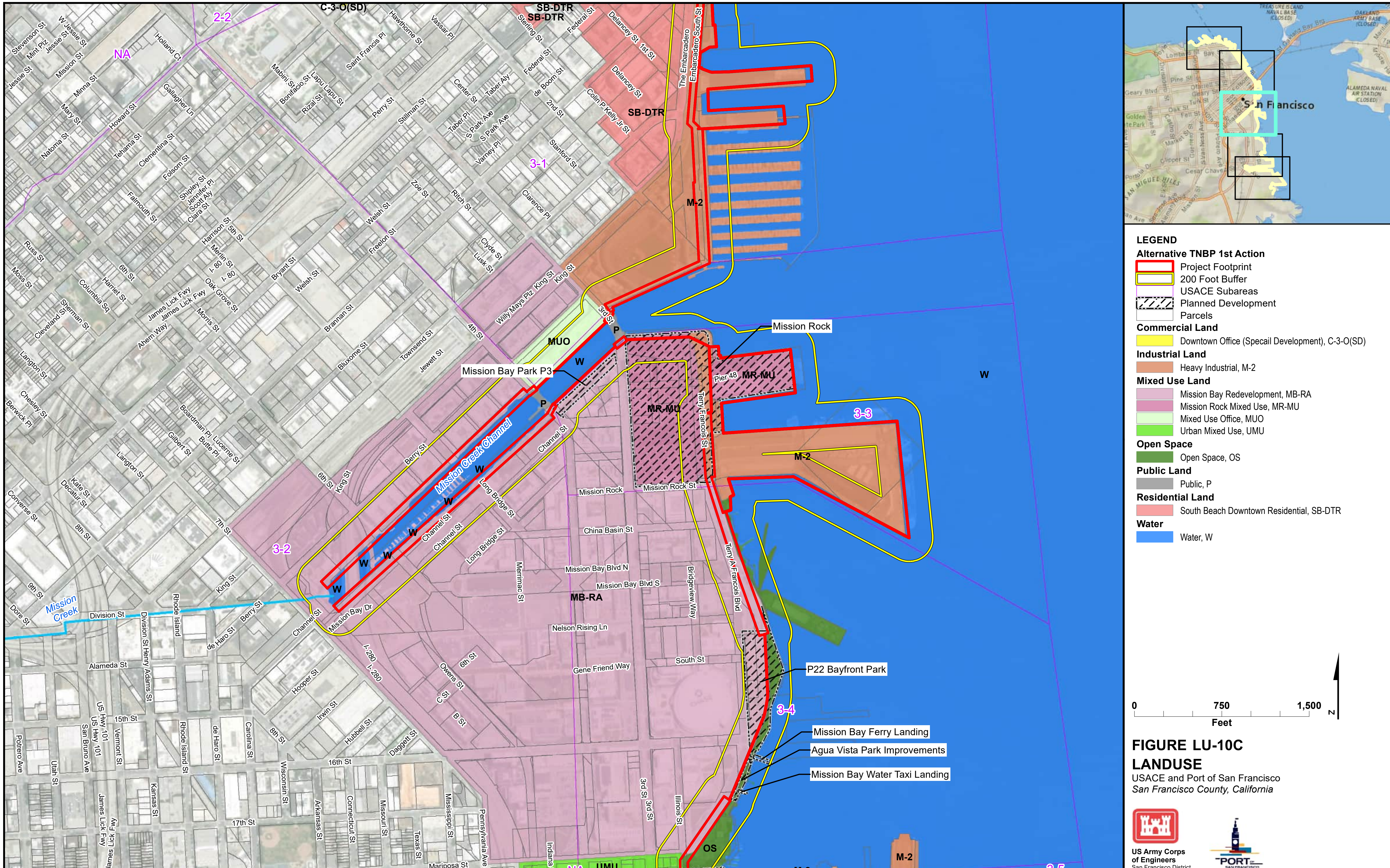
FIGURE LU-10B
LANDUSE

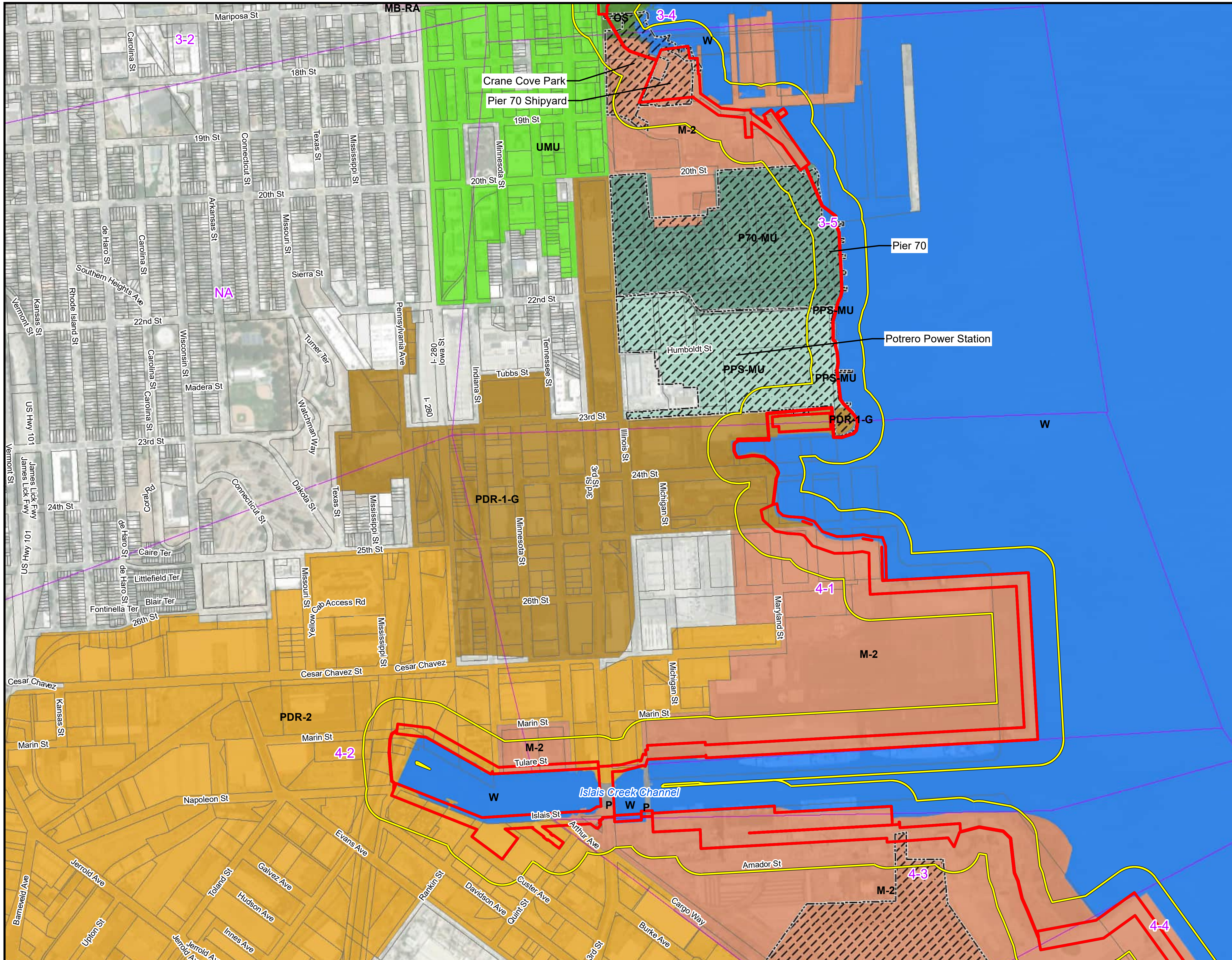
USACE and Port of San Francisco
San Francisco County, California

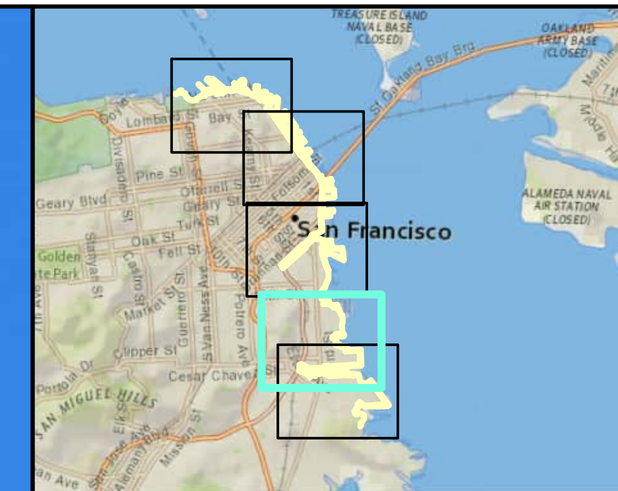
US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_CBP_PHASE1.MXD 10/25/2023 9:24:47 AM


LEGEND
Alternative TNBP 1st Action
Project Footprint
200 Foot Buffer
USACE Subareas
Planned Development
Parcels
Commercial Land
Downtown Office (Specail Development), C-3-O(SD)
Industrial Land
Heavy Industrial, M-2
Mixed Use Land
Mission Bay Redevelopment, MB-RA
Mission Rock Mixed Use, MR-MU
Mixed Use Office, MUO
Urban Mixed Use, UMU
Open Space
Open Space, OS
Public Land
Public, P
Residential Land
South Beach Downtown Residential, SB-DTR
Water
Water, W
0
750
1,500
Feet
N
FIGURE LU-10C
LANDUSE
USACE and Port of San Francisco
San Francisco County, California
US Army Corps of Engineers
San Francisco District
PORT
San Francisco
Mission Rock
Mission Bay Park P3
P22 Bayfront Park
Mission Bay Ferry Landing
Agua Vista Park Improvements
Mission Bay Water Taxi Landing
Mission Creek Channel
Mission Creek
Pier 48
C-3-O(SD)
SB-DTR
M-2
MUO
MR-MU
MB-RA
UMU
OS
W
P
NA
2-2
3-1
3-2
3-3
3-4
3-5





LEGEND

Alternative TNBP 1st Action
- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Planned Development
- Parcels

Commercial Land
- Production Distribution and Repair, PDR-2
- Production Distribution and Repair - General, PDR-1-G

Industrial Land
- Heavy Industrial, M-2

Mixed Use Land
- Mission Bay Redevelopment, MB-RA
- Urban Mixed Use, UMU
- Potrero Power Station Mixed Use, PPS-MU
- Pier70 Mixed Use, P70-MU

Open Space
- Open Space, OS

Public Land
- Public, P

Water
- Water, W

0 750 1,500
Feet
N

FIGURE LU-10D
LANDUSE

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOFUSACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_CBP_PHASE1.MXD 10/25/2023 9:24:47 AM

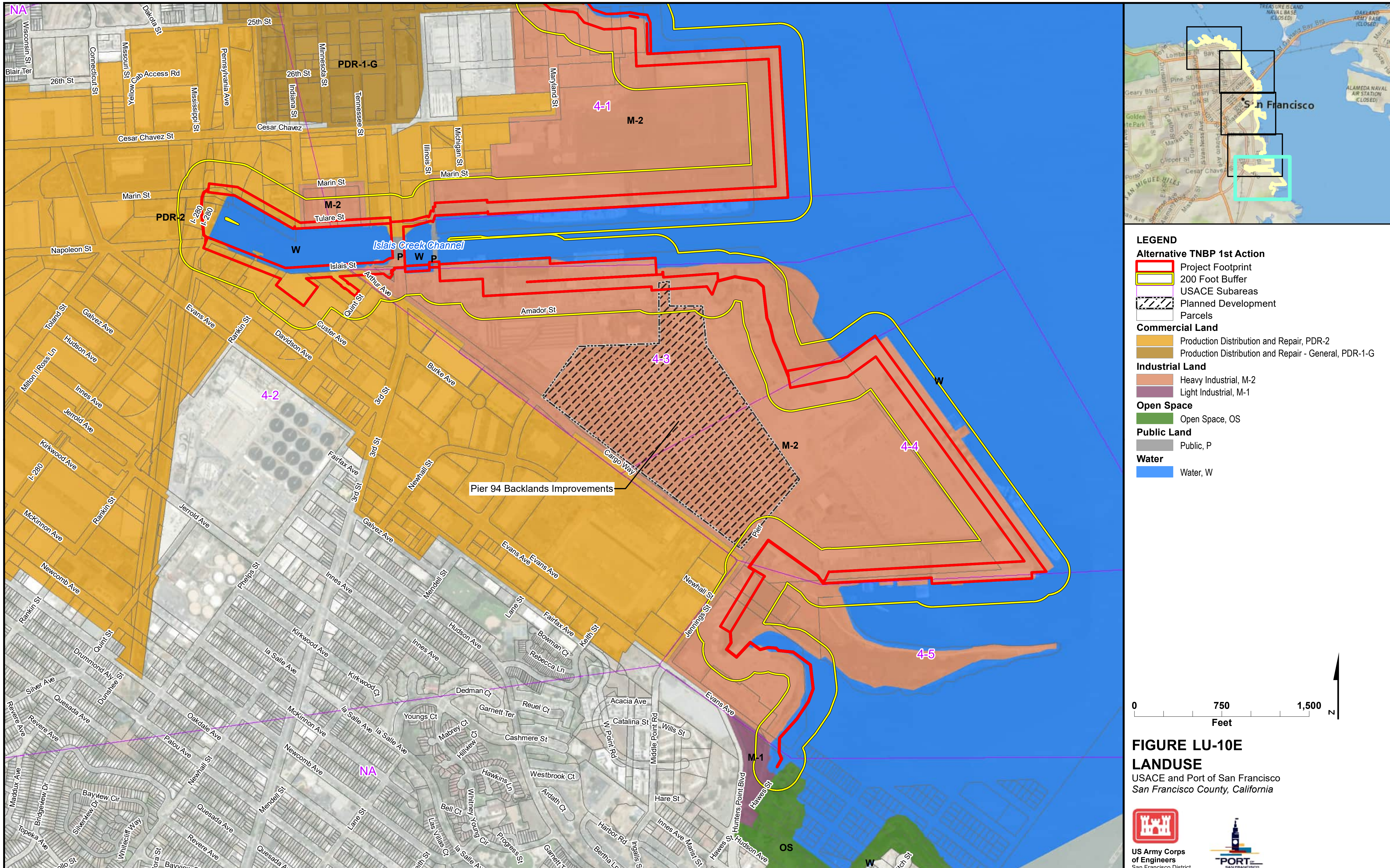
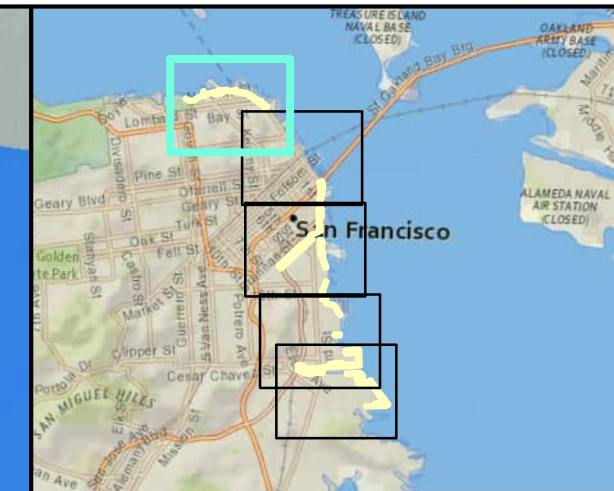


FIGURE LU-10E
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_CBP_PHASE1.MXD 10/25/2023 9:24:47 AM

TNBP 2nd Action



LEGEND

Alternative TNBP 2nd Action
- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Parcels

Commercial Land
- Community Business, C-2

Industrial Land
- Light Industrial, M-1

Mixed Use Land
- Residential Commercial High Density, RC-4

Open Space
- Open Space, OS

Public Land
- Public, P

Water
- Water, W

0 750 1,500
Feet

N

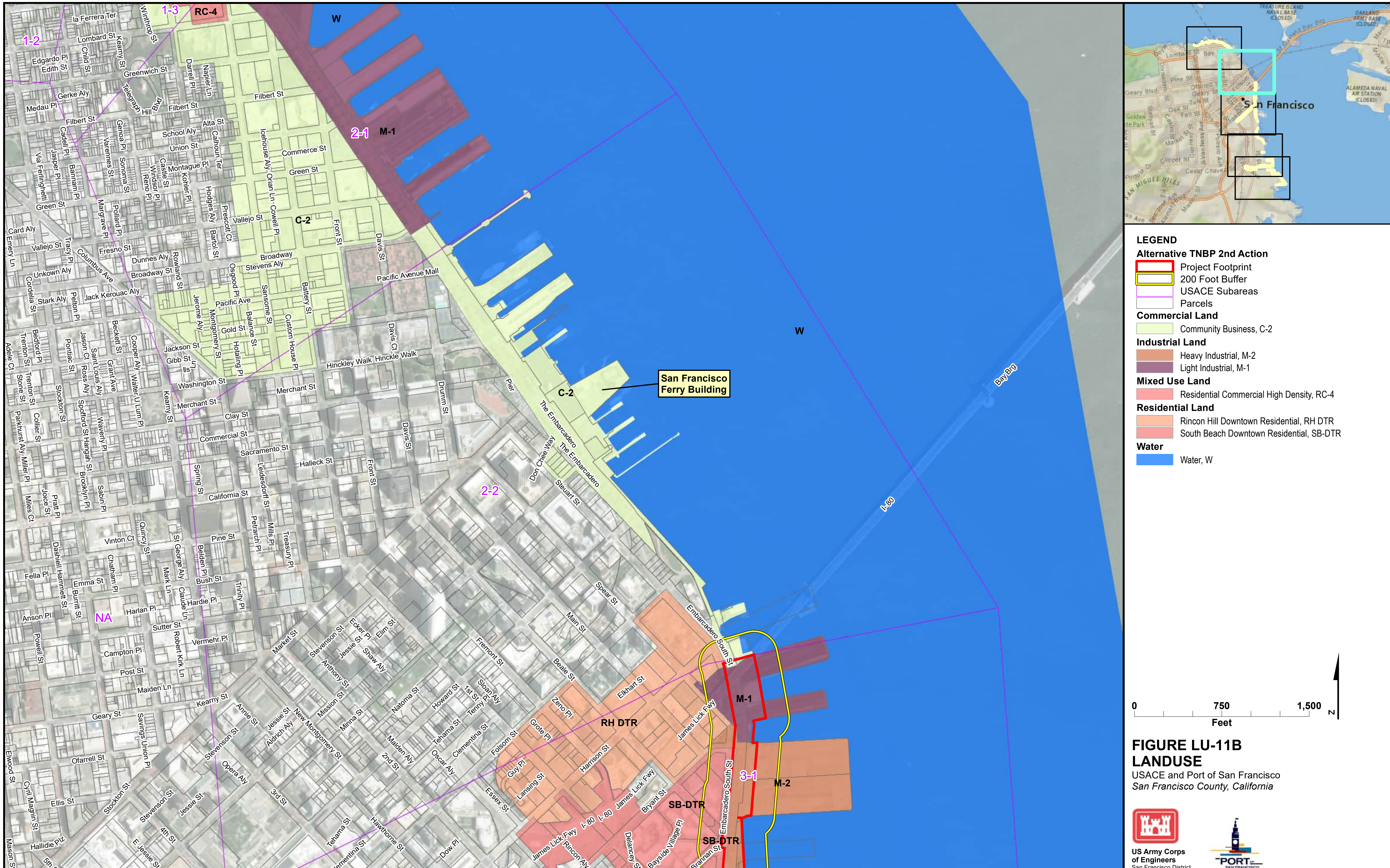
FIGURE LU-11A LANDUSE

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_CBP_PHASE2.MXD 10/25/2023 9:28:54 AM



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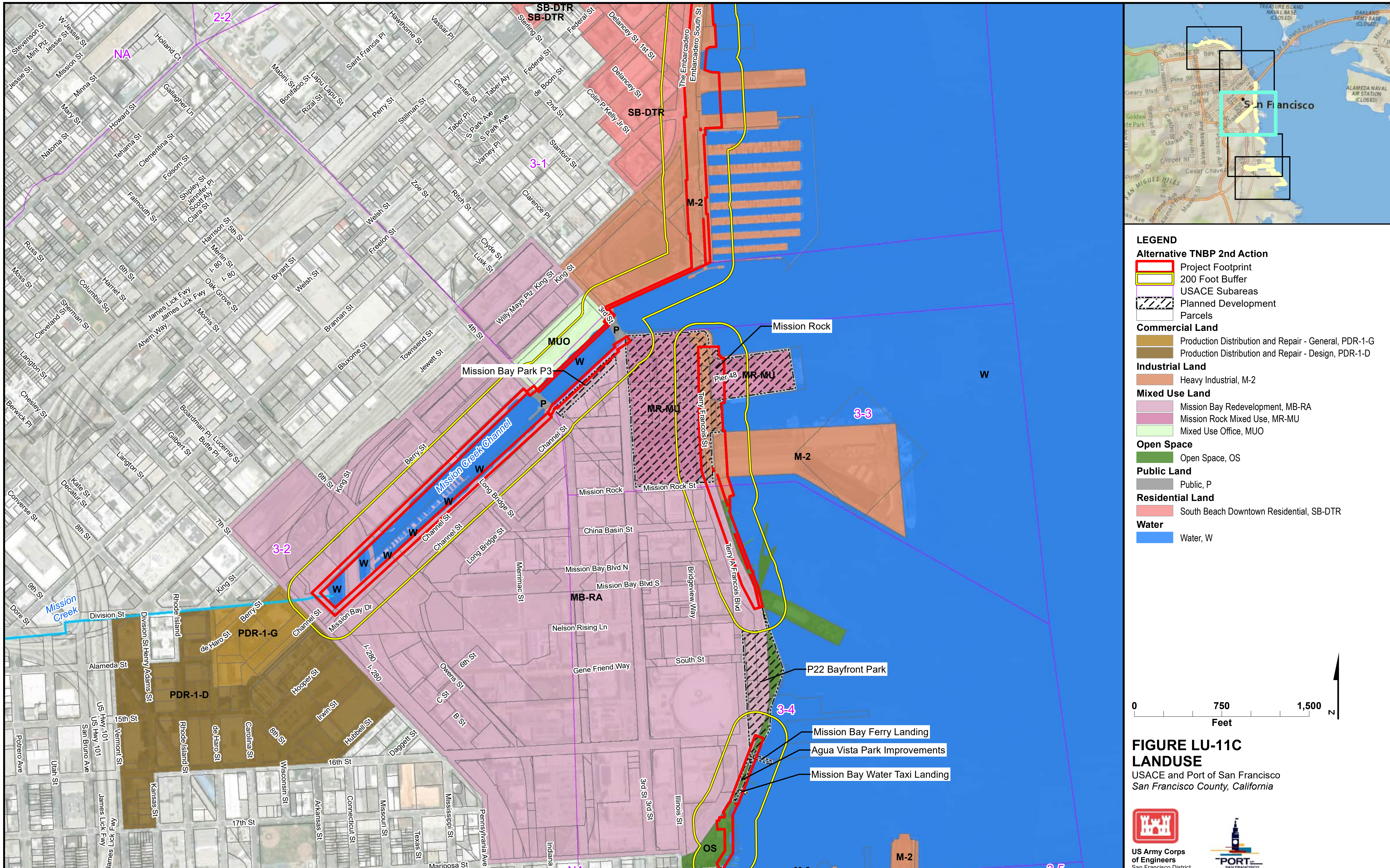


FIGURE LU-11C
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_CBP_PHASE2.MXD 10/25/2023 9:28:54 AM

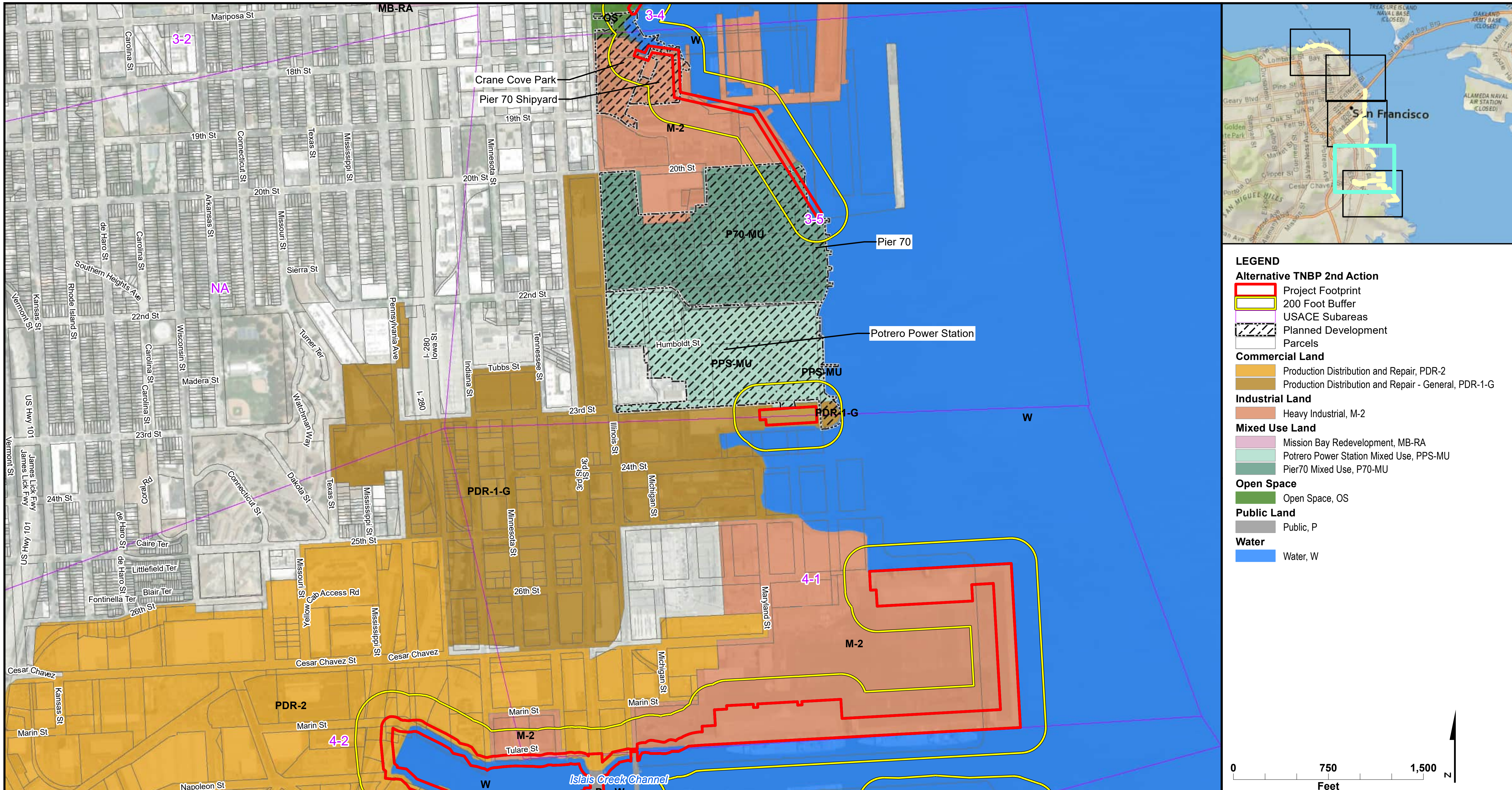
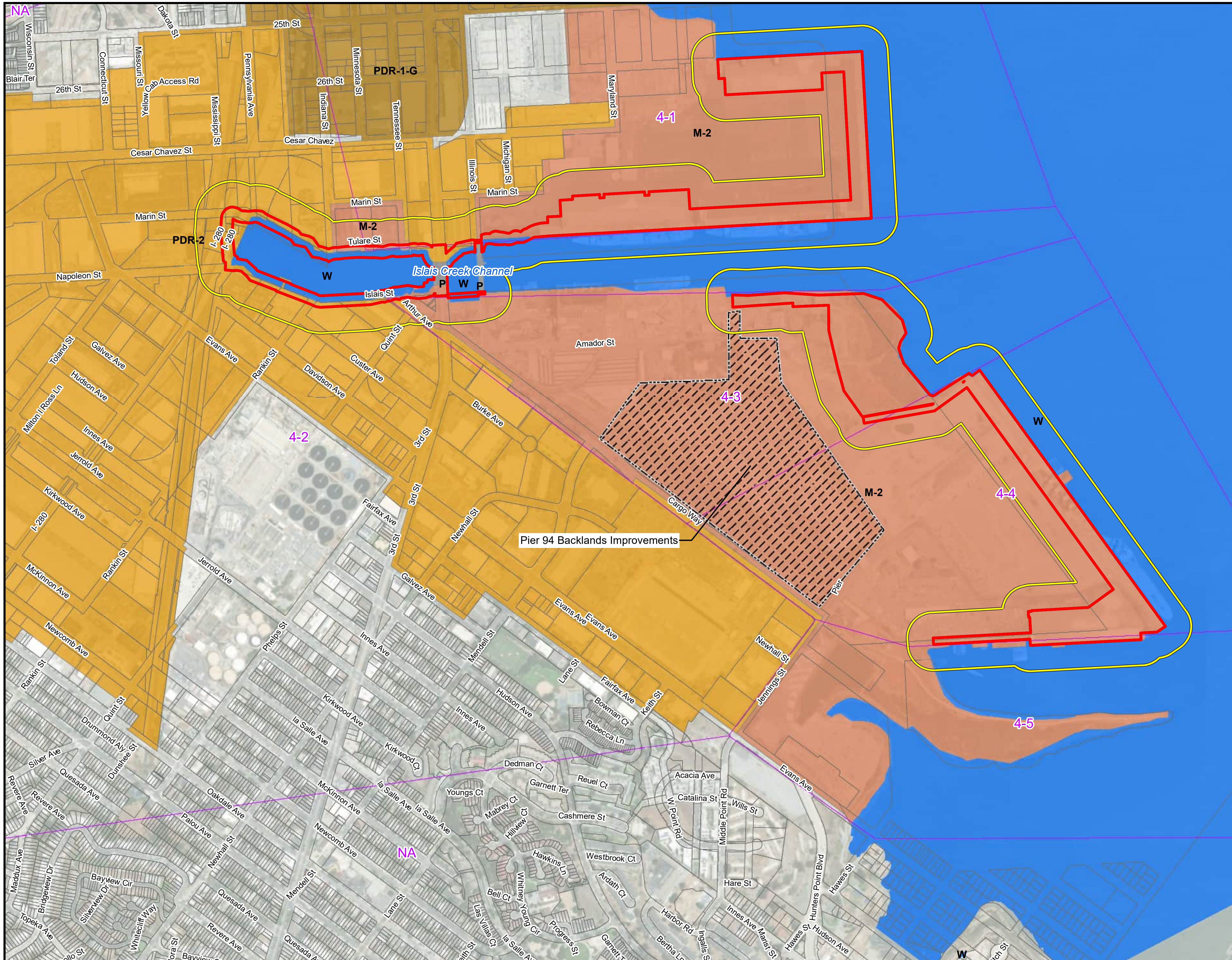
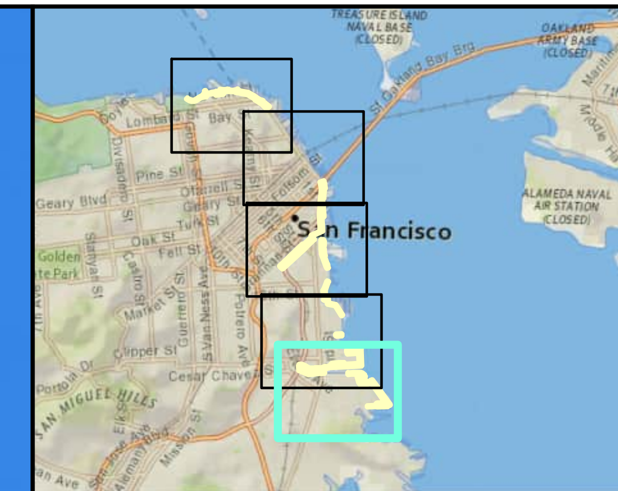


FIGURE LU-11D
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_ALT_CBP_PHASE2.MXD 10/25/2023 9:28:54 AM





LEGEND

Alternative TNBP 2nd Action
- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Planned Development
- Parcels

Commercial Land
- Production Distribution and Repair, PDR-2
- Production Distribution and Repair - General, PDR-1-G

Industrial Land
- Heavy Industrial, M-2

Public Land
- Public, P

Water
- Water, W

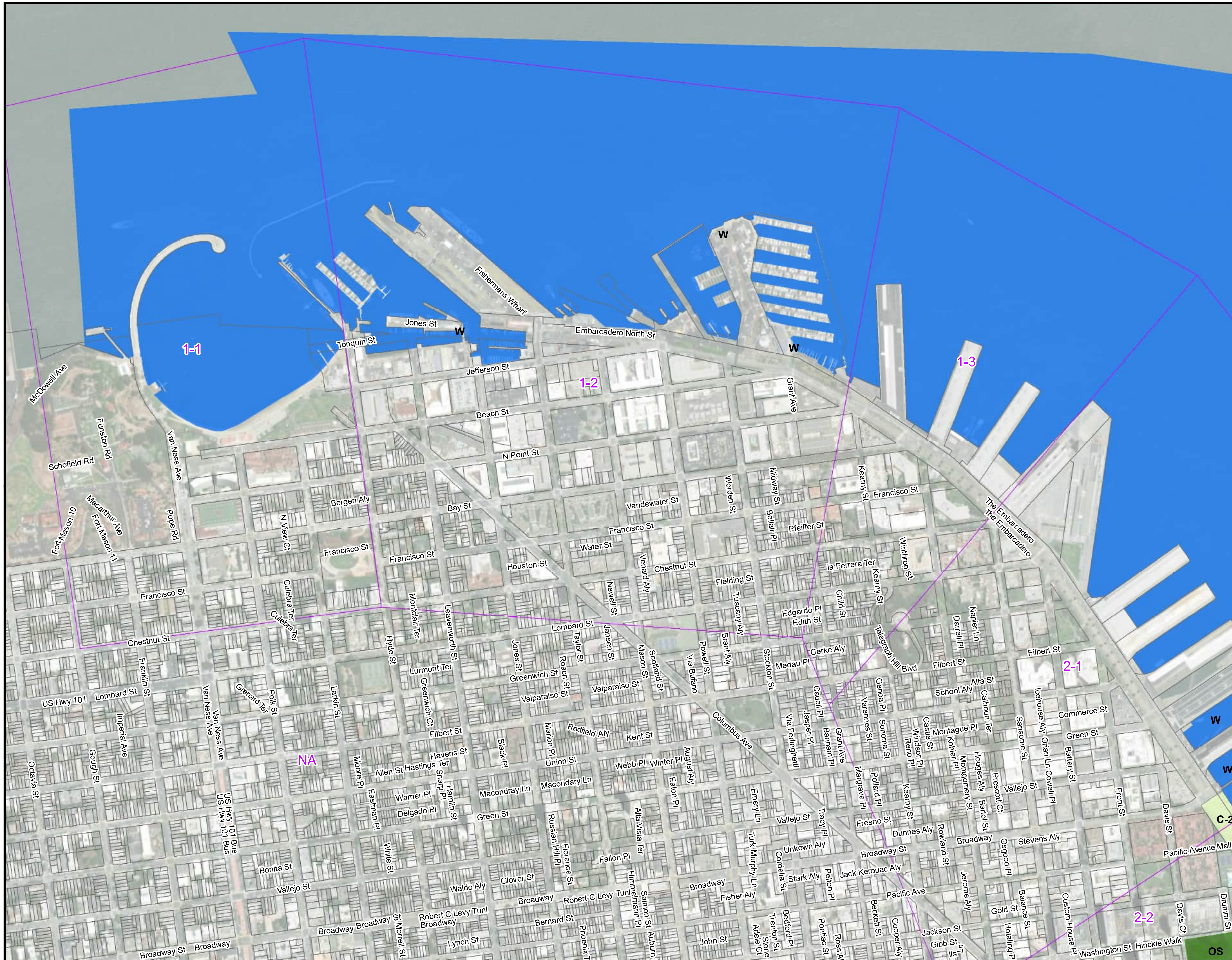
0 750 1,500
Feet
N

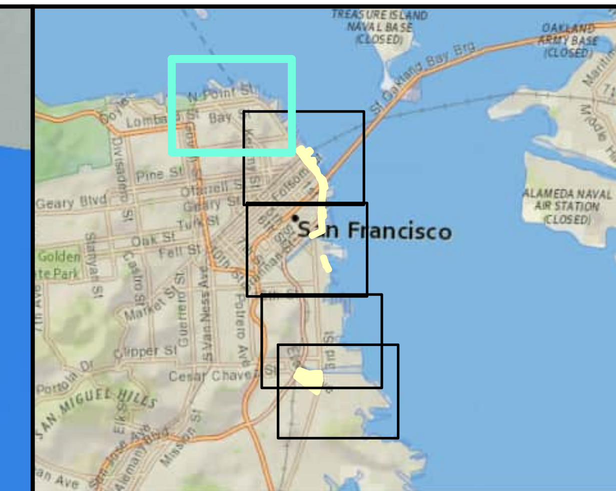
FIGURE LU-11E
LANDUSE

USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

Independent Measures





LEGEND

- USACE Subareas
- Parcels

Commercial Land

- Community Business, C-2

Open Space

- Open Space, OS

Water

- Water, W

0 750 1,500
Feet

N

FIGURE LU-12A
LANDUSE

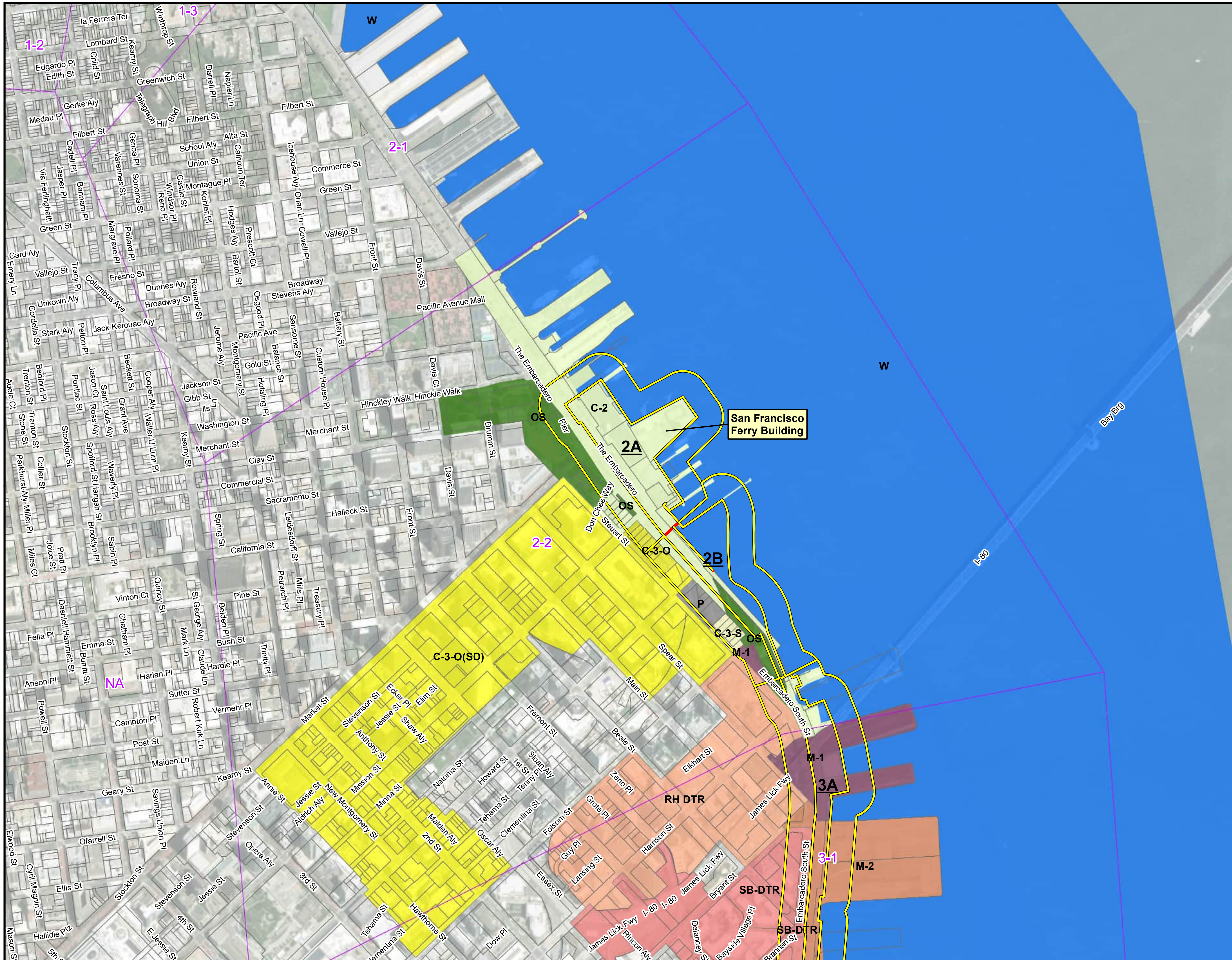
USACE and Port of San Francisco

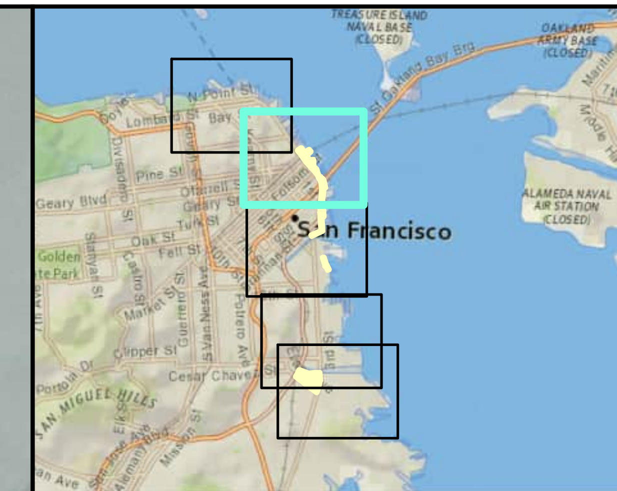
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_INDEPENDENT_MEASURES.MXD 10/25/2023 10:00:18 AM





LEGEND

Independent Measures
- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Parcels

Commercial Land
- Community Business, C-2
- Downtown Support, C-3-S
- Downtown Office (Specail Development), C-3-O(SD)
- Downtown Office, C-3-O

Industrial Land
- Heavy Industrial, M-2
- Light Industrial, M-1

Open Space
- Open Space, OS

Public Land
- Public, P

Residential Land
- Rincon Hill Downtown Residential, RH DTR
- South Beach Downtown Residential, SB-DTR

Water
- Water, W

0 750 1,500
Feet

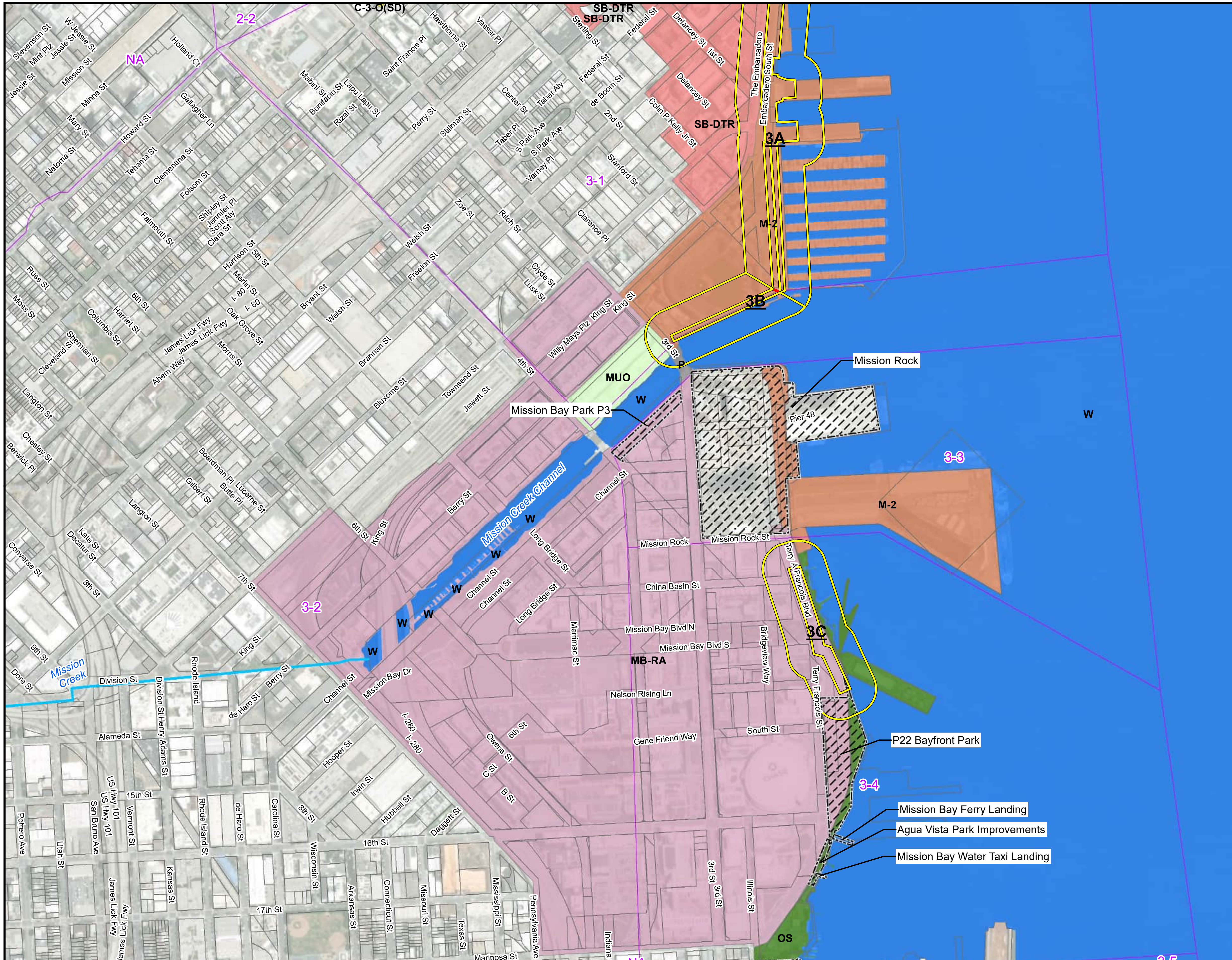
N

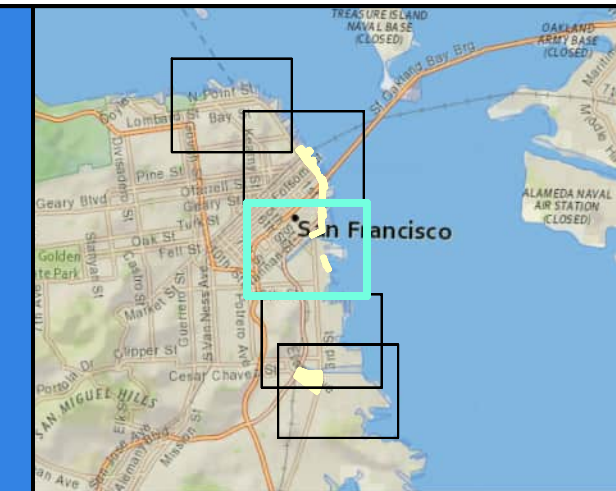
FIGURE LU-12B
LANDUSE
USACE and Port of San Francisco
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_INDEPENDENT_MEASURES.MXD 10/25/2023 10:00:18 AM





LEGEND

Independent Measures
- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Planned Development
- Parcels

Commercial Land
- Downtown Office (Specail Development), C-3-O(SD)

Industrial Land
- Heavy Industrial, M-2

Mixed Use Land
- Mission Bay Redevelopment, MB-RA
- Mixed Use Office, MUO

Open Space
- Open Space, OS

Public Land
- Public, P

Residential Land
- South Beach Downtown Residential, SB-DTR

Water
- Water, W

0 750 1,500
Feet

N

FIGURE LU-12C
LANDUSE

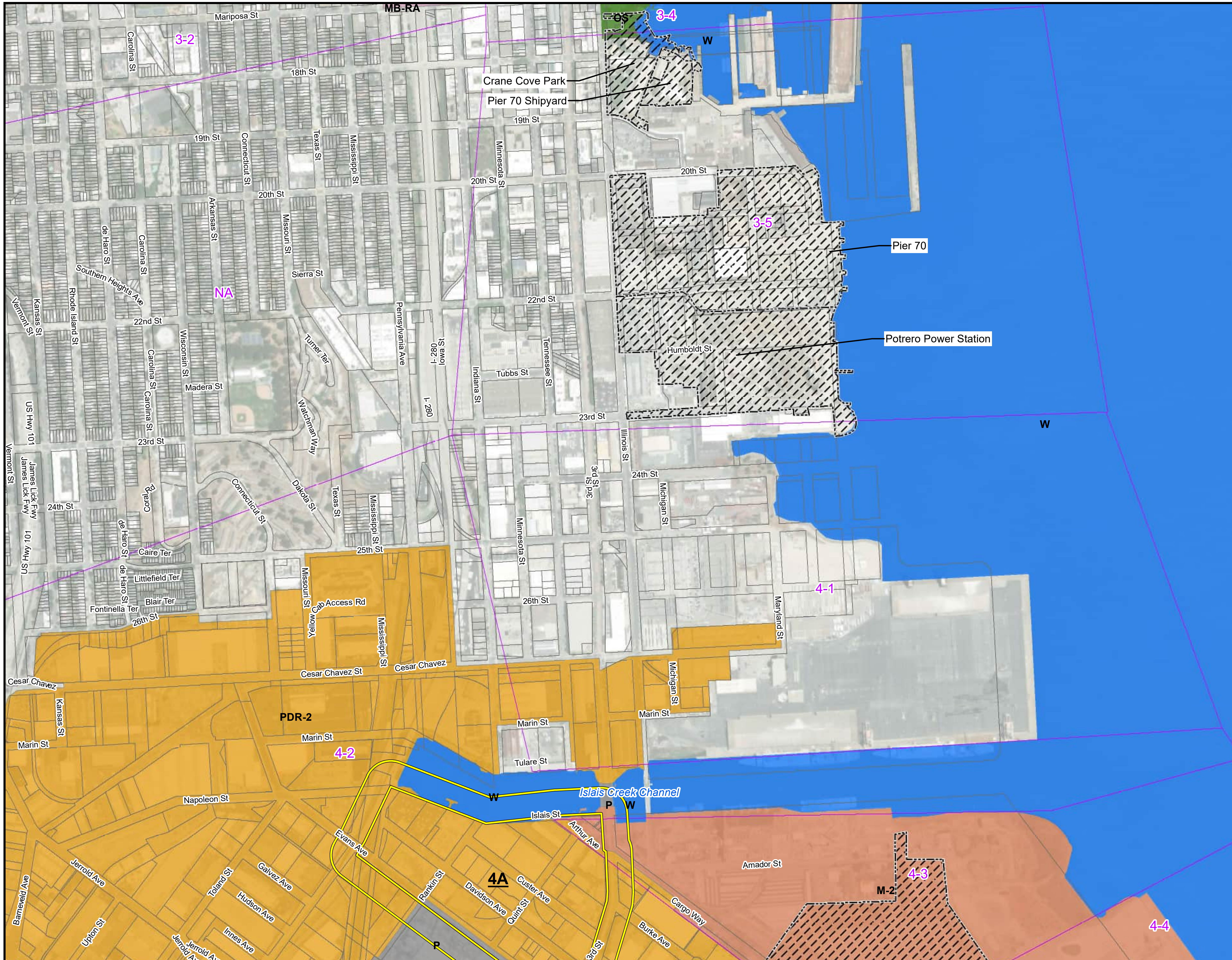
USACE and Port of San Francisco

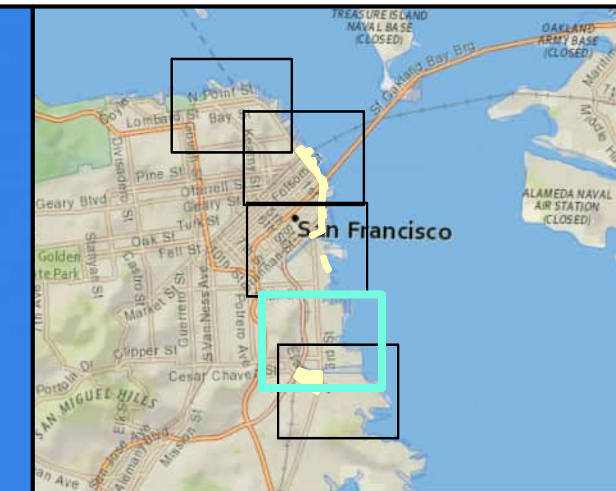
San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOF\USACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_INDEPENDENT_MEASURES.MXD 10/25/2023 10:00:18 AM





LEGEND

Independent Measures

- Project Footprint
- 200 Foot Buffer
- USACE Subareas
- Planned Development
- Parcels

Commercial Land

- Production Distribution and Repair, PDR-2

Industrial Land

- Heavy Industrial, M-2

Mixed Use Land

- Mission Bay Redevelopment, MB-RA

Open Space

- Open Space, OS

Public Land

- Public, P

Water

- Water, W

0 750 1,500
Feet

N

FIGURE LU-12D LANDUSE

USACE and Port of San Francisco

San Francisco County, California

US Army Corps of Engineers
San Francisco District

PORT SAN FRANCISCO

\\DC1VS01\GISPROJ\S\SANFRANCISCOPORTOFUSACE\MAPFILES\REPORT\2023\WRP_PROGRAMMATIC_EIS\10_OCT\LANDUSE\ZONING_MAP_INDEPENDENT_MEASURES.MXD 10/25/2023 10:00:18 AM

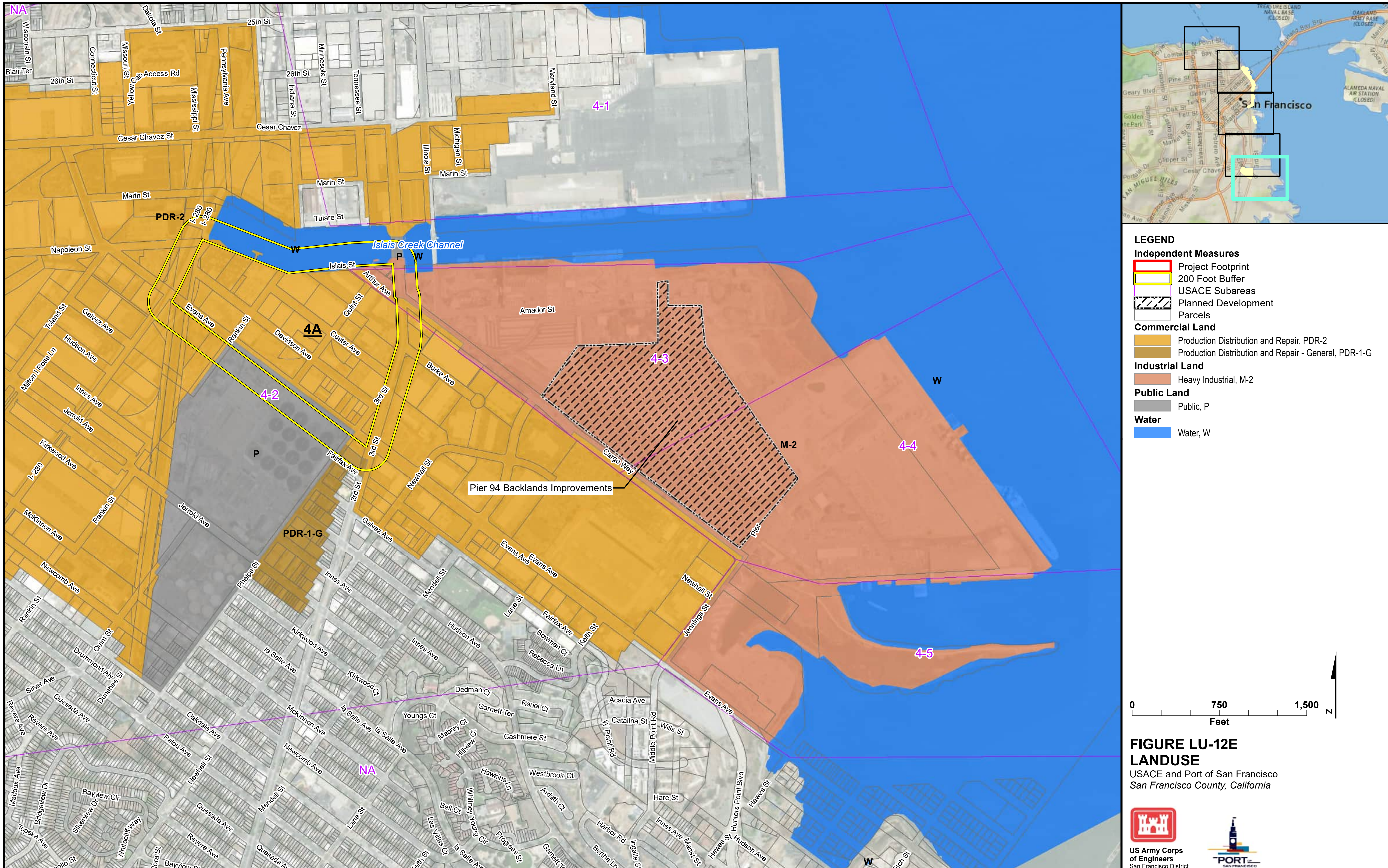


FIGURE LU-12E
LANDUSE
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SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY, CA

DRAFT APPENDIX D-1-8 REGULATORY FRAMEWORK

JANUARY 2024

USACE TULSA DISTRICT | THE PORT OF SAN FRANCISCO

US Army Corps of Engineers

PORT OF SAN FRANCISCO

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1.0 Federal Regulations

1.1 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 U.S.C. 668) enacted in 1940, prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald or golden eagles, including their parts (including feathers), nests, or eggs. The Act provides criminal penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle [or any golden eagle], alive or dead, or any part (including feathers), nest, or egg thereof."

The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb." Regulations further define "disturb" as “to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior" (50 CFR 22.6).

In addition to immediate impacts, this definition also covers effects that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habits, and causes injury, death, or nest abandonment.

1.2 Clean Air Act of 1970

The Clean Air Act (CAA) is the comprehensive Federal law that regulates air emissions form area, stationary, and mobile sources. To protect public health and welfare nationwide, the CAA requires the Environmental Protection Agency (EPA) to establish national ambient air quality standards for certain common and widespread pollutants based on the latest science. EPA has set air quality standards for six common criteria pollutants: particulate matter (also known as particle pollution), ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, and lead.

States are required to adopt enforceable plans to achieve and maintain air quality meeting the air quality standards. State plans also must control emissions that drift across state lines and harm air quality in downwind states. Other key provisions are designed to minimize pollution increases from growing numbers of motor vehicles, and from new or expanded industrial plants. The law calls for new stationary sources (e.g., power plants and factories) to use the best available technology and allows less stringent standards for existing sources. Congress drafted the Act with general authorities that can be used to address pollution problems that emerge over time, such as greenhouse gases that cause climate change.

Once EPA sets new air quality standards for the common criteria pollutants, EPA, considering state recommendations, determines whether areas do or do not meet the air quality standards. Areas the air quality does not meet national standards are designated as "non-attainment areas". Areas that meet air quality standards are called "attainment areas." Areas for which data is lacking are designated "unclassifiable" and generally have the same obligations as attainment areas. An area can be in attainment for one pollutant and out of attainment for another.

States are required to devise and carry out state implementation plans (SIPs) to clean up polluted air and protect clean air from degradation. The Act sets minimum requirements for measures that must be included in these plans. SIPs contain emission limits and compliance schedules for stationary pollution sources and may also include state measures to reduce emissions from existing vehicles.

Section 176 of the CAA prohibits federal agencies from taking actions that initiate or cause emissions of criteria or precursor pollutants to originate within nonattainment and maintenance areas unless the emissions from the actions conform to the applicable implementation plan for the nonattainment or maintenance areas. "Conform" means the activities will not cause or contribute to new air quality violations, worsen existing violations, or delay attainment of air quality standards. *De minimis* emission levels are minimum thresholds for which a conformity determination must be performed. The EPA has promulgated *de minimis* emission threshold rates for each of the criteria pollutants and their precursor pollutants (40 CFR 93.153). If the direct and indirect emissions from the action are below the *de minimis* threshold rates, the emissions are exempt from the provisions of the General Conformity regulations.

1.3 Clean Water Act

The Federal Water Pollution Control Act of 1972, as amended in 1977 via the Clean Water Act (CWA), which establishes the basic structure for regulating discharges of pollutants into the waters of the U.S. and regulating quality standards for surface waters. Under the CWA, the EPA has the authority to implement pollution control programs such as setting wastewater standards for industry. EPA also develops national water quality criteria recommendations for pollutants in surface waters.

EPA works with its federal, state, and tribal regulatory partners to monitor and ensure compliance with clean water laws and regulations to protect human health and the environment. The CWA is the primary federal law governing water pollution.

Section 401 of CWA provides states and authorized tribes with an important tool to help protect the water quality of federally regulated waters within their borders, in collaboration with federal agencies. EPA's regulations (40 CFR 121) address Section 401 certification generally. Under Section 401 of CWA, a federal agency may not issue a permit or license to conduct any activity that may result in any discharge into waters of the United States unless a Section 401 water quality certification is issued, or certification is waived. States and authorized tribes where the discharge would originate are generally responsible for issuing water quality certifications. In cases where a state or tribe does not have authority, EPA is responsible for issuing certification (33 U.S.C. 1341).

Section 404 of the CWA regulates the placement of dredged or fill material into wetlands, lakes, streams rivers, estuaries, and certain other types of waters. The goal of Section 404 is to avoid and minimize losses to wetlands and other waters and to compensate for unavoidable loss through mitigation and restoration. Section 404 is jointly implemented by EPA and U.S. Army Corps of Engineers (USACE). The USACE issues Section 404 permits and monitors compliance with the issued permits. Both the USACE and EPA are responsible for on-site investigations and enforcement of unpermitted discharges under CWA Section 404.

1.4 Coastal Zone Management Act of 1972

The Coastal Zone Management Act (CZMA) is a federal law passed in 1972 to encourage coastal states to develop and implement plans to manage and balance competing uses of the coastal zone. The CZMA establishes a voluntary national program within the Department of Commerce, administered by the National Oceanic and Atmospheric Administration (NOAA), that provides for the protection, preservation, development, and restoration of the nation’s coastal resources, including the Great Lakes. The goal is to “preserve, protect, develop, and where possible, to restore or enhance the resources of the nation’s coastal zone.”

Section 307 of the CZMA (16 U.S.C. § 1456) directs each Federal agency activity occurring within or outside the coastal zone that affects any land or water use or natural resources of the coastal zone shall coordinate with the state agency responsible for the Coastal Zone Management Program. Federal agencies will carry out activities in a manner which is consistent to the maximum extent practicable with the enforceable policies of approve State management programs. The CZMA directs federal agencies to submit a consistency determination to the state for review of enforceable policies and approval by the state agency.

1.5 Endangered Species Act

The Endangered Species Act (ESA), as amended, establishes a national policy designed to protect and conserve threatened and endangered species and the ecosystems upon which they depend (16 U.S.C. 1531-1543). The ESA is administered by the Department of Interior, through the U.S. Fish and Wildlife Service (USFWS), which oversees protection of non-marine species or marine species when not in the marine environment, and by the Department of Commerce, through the National Marine Fisheries Service (NMFS), which oversees marine species in the marine environment.

The ESA ensures that federal agencies and departments use their authorities to protect and conserve threatened and endangered species. Section 7 of ESA requires federal agencies prevent or modify any projects authorized, funded, or carried out by the agencies that are "likely to jeopardize the continued existence of any threatened or endangered species, or result in the destruction or adverse modification of critical habitat of such species." The procedures for Section 7 Consultation are defined in regulations issued by USFWS and NMFS (50 CFR Part 402).

1.6 Estuary Protection Act of 1968

The Estuary Restoration Act (ERA) was created to address accelerating wetland losses and ongoing damage from development, silting, and contamination. The ERA declared estuaries a national priority and promotes restoration and monitoring of estuary habitat around the country. The ERA promotes a coordinated approach to habitat restoration, forging effective partnerships with public and private agencies to promote and support these valuable waterways. The purpose of the ERA is to:

- Promote a coordinated federal approach to estuary habitat restoration.
- Forge effective partnerships among public agencies and between the public and private sectors.
- Provide financial and technical assistance for estuary habitat restoration projects.
- Develop and enhance monitoring and research capabilities.
- Authorize funding and implementation of estuary restoration projects by EPA, NOAA, USACE, U.S. Department of Agriculture (USDA), and USFWS.

The ERA established an interagency Estuary Habitat Restoration Council dedicated to directing policy relating to the directives of the ERA. The Council is responsible for the development and implementation of the Estuary Habitat Restoration Program, including a national Estuary Habitat Restoration strategy, monitoring standards for estuary habitat restoration projects, and recommending estuary restoration projects to the Secretary of the Army for funding. The ERA appoints NOAA to lead the development of monitoring standards for restoration projects implemented under the Estuary Habitat Restoration Program.

1.7 Executive Order 11988, Flood Plain Management

Executive Order (E.O.) 11988 requires Federal agencies avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities."

The Water Resources Council Floodplain Management Guidelines for implementation of E.O. 11988, as referenced in USACE Engineering Regulations (E.R.) 1165-2-26, requires an eight-step process that agencies should carry out as part of their decision making on projects that have potential impacts to, or are within, the floodplain. The eight steps include:

- Determine if a proposed action is in the base floodplain (area which has a one percent or greater change of flooding in any given year).
- If the action is in the base flood plain, identify and evaluate practicable alternatives to the action or to location of the action in the base flood plain.
- If the action must be in the flood plain, advise the general public in the affected areas and obtain their views and comments.
- Identify beneficial and adverse impacts due to the action and any expected losses of natural and beneficial flood plain values. Where actions proposed to be located outside the base flood plain will affect the base flood plain, impacts resulting from these actions should also be identified.
- If the action is likely to induce development in the base flood plain, determine if a practicable non-flood plain alternative for the development exists.
- As part of the planning process under the Principles and Guidelines, determine viable methods to minimize any adverse impacts of the action including any likely induced development for which there is no practicable alternative and methods to restore and preserve the natural and beneficial flood plain values. This should include re-evaluation of the "no action" alternative.
- If the final determination is made that no practicable alternative exists to locating the action in the flood plain, advise the public in the affected area of the findings.
- Recommend the plan most responsive to the planning objectives established by the study and consistent with the requirements of the E.O.

1.8 Executive Order 11990, Protection of Wetlands

The purpose of E.O. 11990 is to "minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands." To meet these objectives, this E.O. requires Federal agencies, in planning their actions, to consider alternatives to wetland sites and limit potential damage if any activity affecting a wetland cannot be avoided. The E.O. applies to:

- Acquisition, management, and disposition of Federal lands and facilities construction and improvement projects which are undertaken, financed, or assisted by Federal agencies; and
- Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing activities.

1.9 Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations

Environmental justice requires agencies to incorporate into NEPA documents an analysis of the environmental effects of their proposed programs on minorities and low-income populations and communities. Environmental justice is defined by the EPA as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, local, and tribal programs and policies."

E.O. 12898 directs federal agencies to:

- identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law;
- develop a strategy for implementing environmental justice; and
- promote nondiscrimination in federal programs that affect human health and the environment, as well as provide minority and low-income communities access to public information and public participation.

1.10 Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks

E.O. 13045 directs Federal agencies to ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks. Examples of risks to children include increased traffic volumes and industrial or production-oriented activities that would generate substances or pollutants that children may come into contact with or ingest.

1.11 Executive Order 13112 on Invasive Species

E.O. 13112 addresses the prevention of the introduction of invasive species and provides for their control and minimization of the economic, ecological, and human health impacts the invasive species causes. It establishes the Invasive Species Council, which is responsible for the preparation and issuance of the National Invasive Species Management Plan, which details and recommends performance-oriented goals and objectives and specific measures of success for Federal agencies.

1.12 Executive Order 13985, Advancing Racial Equity and Support for Underserved Communities through the Federal Government

E.O. 13985 calls on agencies to advance equity through identifying and addressing barriers to equal opportunity that underserved communities may face due to government policies and programs. E.O. 13985 directs federal agencies to support ongoing implementation of a comprehensive equity strategy that uses the agency's policy, budgetary, programmatic, service-delivery, procurement, data-collection processes, grantmaking, public engagement, research and evaluation, and regulatory functions to enable the agency's mission and service delivery to yield equitable outcomes for all Americans, including underserved communities.

1.13 Executive Order 14096, Revitalizing Our Nation's Commitment to Environmental Justice for All

E.O. 14096 directs the Federal Government to build upon and strengthen its commitment to deliver environmental justice to all communities across America through an approach that is informed by scientific research, high-quality data, and meaningful Federal engagement with communities with environmental justice concerns.

1.14 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) was enacted in 1934 to protect fish and wildlife when federal actions result in the control or modification of a natural stream or body of water. The Act provides the basic authority for the involvement of the USFWS in evaluating impacts to fish and wildlife from proposed water resource development projects. The FWCA provides for consultation with the USFWS whenever the waters or channel of a body of water are modified by a department or agency of the United States. The intent of consultation is to help prevent the loss of and damage to wildlife resources from water development projects.

1.15 Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fishery Conservation and Management Act (MSFMA; Public Law [PL] 94-265), as amended, provides for the conservation and management of the Nation's fishery resources through the preparation and implementation of Fishery

Management Plans (FMPs; 16 U.S.C 1801 et seq.) The MSFMA calls for NOAA fisheries to work with regional Fishery Management Councils to develop FMPs for each fishery under their jurisdiction.

One of the required provisions of FMPs specifies that essential fish habitat (EFH) be identified and described for the fishery, adverse fishing impacts on EFH be minimized to the extent practicable, and other actions to conserve and enhance EFH be identified. The MSFMA mandates that NMFS coordinate with and provide information to Federal agencies to further the conservation and enhancement of EFH. Federal agencies must consult with NMFS on any action that may adversely affect EFH. When NMFS finds that a Federal or State action would adversely affect EFH, it is required to provide conservation recommendations.

1.16 Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. 1361 et seq.) established a national policy to prevent marine mammal species and population stocks from declining beyond the point where they ceased to be significant functioning elements of the ecosystems of which they are a part of. The MMPA prohibits, with certain exceptions, the “take” of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S. In the MMPA, “take” is defined “as harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect”. The Department of Commerce, through NMFS, is charged with protecting species that are known to occur in a region. However, manatees are protected by the Department of the Interior through USFWS. The Animal and Plant Health Inspection Service, part of the USDA, is responsible for regulations managing marine mammals in captivity.

Federal agencies conducting activities that may result in “take” of marine mammals must request a letter of authorization from NMFS (50 CFR §§ 216.101- 216.106) pursuant to any regulations in § 216.105.

1.17 Migratory Bird Treaty Act, Migratory Bird Conservation Act, and Executive Order 13186, Responsibility of Federal Agencies to Protect Migratory Birds

The Migratory Bird Treaty Act (MBTA) of 1918 (16 U.S.C. §§ 703-712), as amended, extends Federal protection to migratory bird species. Among other activities, the MBTA makes it unlawful to pursue, hunt, take, capture, kill, or sell migratory birds (including, but not limited to, cranes, ducks, geese, shorebirds, hawks, and songbirds). The statute does not discriminate between live or dead birds and also grants full protection to any bird parts including feathers, eggs, and nests. The USFWS issues permits for otherwise prohibited activities under the act, including permits for taxidermy, falconry, propagation, scientific and educational use, and depredation, an example of the last being the killing of geese near an airport, where they pose a danger to aircraft.

E.O. 13186 requires Federal activities to assess and consider potential effects of their actions on migratory birds.

1.18 National Environmental Policy Act

The National Environmental Policy Act (NEPA) requires that all Federal agencies use a systematic, interdisciplinary approach to protect the human environment. This approach promotes the integrated use of natural and social sciences in planning and decision-making that could have an impact on the environment.

NEPA requires the preparation of an EIS for any major Federal action that could have a significant impact on the environment (42 United States Code [USC] 4321-4347). The EIS must address any adverse environmental effects that cannot be avoided or mitigated, alternatives to the proposed action, the relationship between short-term resources and long-term productivity, and irreversible and irretrievable commitments of resources. According to 40 CFR 1502.9, a supplement to either a DEIS or FEIS must be prepared if an agency makes substantial changes in the proposed action that are relevant to environmental concerns, or there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts.

The NEPA regulations provide for the use of the NEPA process to identify and assess reasonable alternatives to proposed action s that avoid or minimize adverse effects of these actions upon the quality of the human environment. “Scoping” is used to identify the range and significance of environmental issues associated with a proposed Federal action through coordination with Federal, State, and local agencies; the general public; and any interested individuals and organizations prior to the development of an EIS. The process also identifies and eliminates, from further detailed study, issues that are not significant or have been addressed by prior environmental review.

The Council on Environmental Quality (CEQ) issued guidance and interpreting regulations that implement NEPA’s procedural requirements. The CEQ completed a comprehensive update to its NEPA implementing regulations at 40 CFR 1500-1508 to modernize provisions, streamline infrastructure project development, and promote better decision making by the Federal government. The implementing regulations were published in the Federal Register on July 16, 2020 and became effective on September 14, 2020, superseding the original 1978 regulations and the 1986 and 2005 amendments.

1.19 National Historic Preservation Act

Compliance with the National Historic Preservation Act of 1966, as amended (54 U.S.C. § 306108), requires the consideration of effects of the undertaking on all historic properties in the project area and development of mitigation measures for those adversely affected properties in coordination with the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation. It has been determined that there is a potential for new construction, improvements to existing facilities, and maintenance of existing facilities to cause effects to historic properties. Additionally, the size of the project area and the number of alternatives being studied for proposed improvements make it necessary to defer the final identification and evaluation of historic properties until authorization of the proposed improvements is obtained. Therefore, in accordance with 36 CFR 800.14, the USACE will execute a Programmatic Agreement among the USACE, the California SHPO, and the Port of San Francisco to address the identification and discovery of cultural resources that may occur during the construction and maintenance of proposed or existing facilities. The USACE will also invite the ACHP, Native American tribes, and interested consulting parties to participate as signatories to the Programmatic Agreement.

1.19.1 National Register of Historic Places

The NRHP (36 CFR Part 60) was authorized by the NHPA in 1966 as “an authoritative guide to be used by federal, state, and local governments; private groups; and citizens to identify the nation’s cultural resources and to indicate what properties should be considered for protection from destruction or impairment.” The NRHP recognizes properties that are significant at national, state, and local levels. According to NRHP guidelines, the quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet any of the following criteria (36 CFR 60.4):

- **Criterion A.** A property is associated with events that have made a significant contribution to the broad patterns of our history.
- **Criterion B.** A property is associated with the lives of persons significant in our past.
- **Criterion C.** A property embodies the distinctive characteristics of a type, period, or method of construction; represents the work of a master; possesses high artistic values; or represents a significant and distinguishable entity whose components may lack individual distinction.
- **Criterion D.** A property yields, or may be likely to yield, information important in prehistory or history.

The NRHP requires that a resource not only meet one of these criteria but must also possess integrity. Integrity is the ability of a property to convey historical significance. The evaluation of a resource’s integrity must be grounded in an understanding of that resource’s physical characteristics and how those characteristics convey its significance. The NRHP recognizes seven aspects or qualities that, in various combinations, define the integrity of a property: location, design, setting, materials, workmanship, feeling, and association.

The process of identifying and evaluating properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization (i.e., Traditional Cultural Properties [TCPs]), is described in National Register Bulletin (NRB) 38, Guidelines for Evaluating and Documenting Traditional Cultural Properties (National Park Service 1992). NRB 38 is designed to supplement NRB 15 and aid in determining whether properties thought to have traditional cultural or religious significance meet one or more of the NRHP significance criteria and therefore are eligible for inclusion in the NRHP.

1.20 Rivers and Harbors Act of 1899

The Rivers and Harbors Act of 1899 (33 USC § 401 et seq.) is the initial authority for the USACE regulatory permit program to protect navigable waters in the development of harbors and other construction and excavation.

Section 10 of the Rivers and Harbors Act prohibits the unauthorized obstruction or alteration of any navigable water of the U.S. The construction of any structure in or over any navigable water of the U.S., or the accomplishment of any other work affecting the course, location, condition, or physical capacity of such waters is unlawful unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army. The Secretary's approval authority has since been delegated to the Chief of Engineers. Activities requiring section 10 permits include structures (e.g., piers, wharfs, breakwaters, bulkheads, jetties, weirs, transmission lines) and work such as dredging or disposal of dredged material, or excavation, filling, or other modifications to the navigable waters of the U.S.

2.0 State Regulations

2.1 California Building Code

The California Building Standards Code is the building code for California, maintained by the California Building Standards Commission which is granted the authority to oversee processes related to the California Building codes by California Building Standards law. The California building codes under Title 24 are established based on several criteria: standards adopted by states based on national model codes, national model codes adapted to meet California conditions, and standards passed by the California legislature that address concerns specific to California.

2.2 California Endangered Species Act

The California Endangered Species Act (CESA) is a California environmental law that conserves and protects plant and animal species at risk of extinction. Plant and animal species may be designated threatened or endangered under CESA after a formal listing process by the California Fish and Game Commission. Approximately 250 species are currently listed under CESA. A CESA-listed species, or any part or product of the plant or animal, may not be imported into the state, exported out of the state, “taken” (i.e., killed), possessed, purchased, or sold without proper authorization. Implementation of CESA has reduced and avoided impacts to California’s most imperiled plants and animals, has protected hundreds of thousands of acres of vital habitat, and has led to a greater scientific understanding of California’s incredible biodiversity.

The California Department of Fish and Wildlife (CDFW) works with agencies, organizations, and other interested persons to study, protect, and preserve CESA-listed species and their habitats. CDFW also conducts scientific reviews of species petitioned for listing under CESA, administers regulatory permitting programs to authorize take of listed species, maintains an extensive database of listed species occurrences, and conducts periodic reviews of listed species to determine if the conditions that led to original listing are still present.

2.3 California Environmental Quality Act

The California Environmental Quality Act (CEQA) is a statewide policy of environmental protection that was passed in 1970. CEQA requires state and local government agencies to inform decision makers and the public about the potential environmental impacts of proposed projects, and to reduce those environmental impacts to the extent feasible. CEQA also requires agencies to consider alternatives and mitigation measures that will substantially reduce or eliminate significant impacts to the environment.

2.4 California Fish and Game Code

The California Fish and Game Code is a collection of laws that govern the management and conservation of fish, wildlife, and other natural resources in California. The code is divided into three parts: fish and game, public resources, and water. The Fish and Game code regulates hunting, fishing, and other recreational activities related to wildlife. The Public Resources Code covers forestry, parks, and recreation. The water code regulates water rights, water quality, and flood control.

2.5 California Green Building Code

The California Green Building Standards Code is a mandatory green building standards code that was developed by the California Building Standards Commission. It is the first-in-the-nation green building standards code and is part of the Title 24 of the California Code of Regulations. The code includes regulations for energy efficiency, water efficiency and conservation, material conservation and resource efficiency, environmental quality, etc. The building code applies to all new residential and nonresidential buildings, as well as additions and alterations to existing buildings where no other state agency has the authority to adopt green building standards applicable to those occupancies. The purpose is to improve public health, safety, and general welfare through enhanced design and construction of buildings using concepts which reduce negative impacts and promote those principles which have a positive environmental impact and encourage sustainable construction practices.

2.6 California Health and Safety Code

The California Health and Safety Code is the codification of general statutory law covering the subject areas of health and safety in the state of California.

2.7 California Native Plant Protection Act

The California Native Plant Protection Act (NPPA) was enacted in 1977 and allows the California Fish and Game Commission to designate plants as rare or endangered. There are 64 species, subspecies, and varieties of plants that are protected as rare under the NPPA. The NPPA prohibits take of endangered or rare native plants, but includes some exceptions for agricultural and nursery operations; emergencies; and after properly notifying CDFW for vegetation removal from canals, roads, and other sites, changes in land use, and in certain other situations. Take is defined as the harvest, transport, sale, or possession of native plants under any circumstance unless a person has a valid permit or wood receipt, and the required tags and seals or the exceptions have been meet. The appropriate permits, tags and seals must be obtained from the sheriff or commissioner of the county where collecting will occur, and the county will charge a fee.

2.8 California State Implementation Plan

The CAA requires areas that exceed the health-based national ambient air quality standards to develop State Implementation Plans (SIP) that demonstrate how they will attain the standards by specified dates.

2.9 California State Water Resource Control Board

The State Water Resources Control Board and the nine Regional Water Quality Control Boards, collectively known as the California Water Boards, are dedicated to a single vision: abundant clean water for human uses and environmental protection to sustain California's future. Under the CWA and the state's pioneering Porter-Cologne Water Quality Control Act, the State and Regional Water Boards have regulatory responsibility for protecting the water quality of nearly 1.6 million acres of lakes, 1.3 million acres of bays and estuaries, 211,000 miles of rivers and streams, and about 1,100 miles of California coastline. The State and Regional Water Boards protect water quality and allocate surface water rights.

2.10 Marine Life Management Act

The Marine Life Management Act (MLMA), which became law on January 1, 1999, opened a new era in the management and conservation of California's marine living resources. In fashioning the MLMA, the Legislature drew upon years of experience in California and elsewhere in the United States and the world.

The Act includes a number of innovative features.

- The MLMA applies not only to fish and shellfish taken by commercial and recreational fishermen, but to all marine wildlife.
- Rather than assuming that exploitation should continue until damage has become clear, the MLMA shifts the burden of proof toward demonstrating that fisheries and other activities are sustainable.
- Through the MLMA, the Legislature delegates greater management authority to the Fish and Game Commission and the California Department of Fish and Wildlife.
- Rather than focusing on single fisheries management, the MLMA requires an ecosystem perspective including the whole environment.
- The MLMA strongly emphasizes science-based management developed with the help of all those interested in California's marine resources.

The fishery management system established by the MLMA applies to four groups of fisheries.

- The nearshore finfish fishery and the white seabass fishery.
- Emerging fisheries - new and growing fisheries that are not currently subject to specific regulation.
- Those fisheries for which the Fish and Game Commission held some management authority before January 1, 1999. Future regulations affecting these fisheries will need to conform to the MLMA.
- Those commercial fisheries for which there is no statutory delegation of authority to the Commission and Department. (In the case of these fisheries, CDFW may prepare, and the Commission may adopt, a fishery management plan, but that plan cannot be implemented without a further delegation of authority through the legislative process.)

The MLMA sets out several underlying goals.

- Conserves Entire Systems: It is not simply exploited populations of marine life that are to be conserved, but the species and habitats that make up the ecosystem of which they are a part.

- Non-Consumptive Values: Marine life need not be consumed to provide important benefits to people, including aesthetic and recreational enjoyment as well as scientific study and education.
- Sustainability: Fisheries and other uses of marine living resources are to be sustainable so that long-term health is not sacrificed for short-term benefits.
- Habitat Conservation: The habitat of marine wildlife is to be maintained, restored or enhanced, and any damage from fishing practices is to be minimized.
- Restoration: Depressed fisheries are to be rebuilt within a specified time.
- Bycatch: The bycatch of marine living resources in fisheries is to be limited to acceptable types and amounts.
- Fishing Communities: Fisheries management should recognize the long-term interests of people dependent on fishing, and adverse impacts of management measures on fishing communities are to be minimized.

2.11 McAteer-Petris Act

The McAteer-Petris Act established the San Francisco Bay Conservation and Development Commission (BCDC). BCDC grants San Francisco Bay Permits for projects that are necessary to the safety, welfare, or health of the public in the entire bay area or are consistent with the provisions of the implementing regulations and the Bay Plan. BCDC has jurisdiction over the bay waters and shoreline areas on or around several parts of the project area and a permit from BCDC will be required.

2.12 Ocean Protection Council Sea Level Rise Guidance

The Ocean Protection Council is a Cabinet-level state body that works jointly with state and federal agencies, NGOs, tribes and the public to ensure that California maintains healthy, resilient, and productive ocean and coastal ecosystems. The Council was created pursuant to the California Ocean Protection Act (COPA) which was signed into law in 2004. The Ocean Protection Council is guided by principles included in COPA:

- Recognizing the interconnectedness of the land and the sea, supporting sustainable uses of the coast, and ensuring the health of ecosystems
- Improving the protection, conservation, restoration, and management of coastal and ocean ecosystems through enhanced scientific understanding, including monitoring and data gathering
- Recognizing the “precautionary principle”: where the possibility of serious harm exists, lack of scientific certainty should not preclude action to prevent the harm
- Identifying the most effective and efficient use of public funds by identifying funding gaps and creating new and innovative processes for achieving success

- Making aesthetic, educational, and recreational uses of the coast and ocean a priority
- Involving the public in all aspects of Ocean Protection Council process through public meetings, workshops, public conferences, and other symposia

The council is tasked with the following responsibilities:

- Coordinate activities of ocean-related state agencies to improve the effectiveness of state efforts to protect ocean resources within existing fiscal limitations
- Establish policies to coordinate the collection and sharing of scientific data related to coast and ocean resources between agencies
- Identify and recommend to the Legislature changes in law
- Identify and recommend changes in federal law and policy to the Governor and Legislature

2.13 Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Action provides for protection of the quality of waters of the State of California for use and enjoyment by the people of California. The act also establishes provisions for a statewide program for the control of water quality, recognizing that waters of the state are increasingly influenced by interbasin water development projects and other statewide considerations, and that factors such as precipitation, topography, population, recreation, agriculture, industry, and economic development vary regionally within the state. The statewide program for water quality control is therefore administered most effectively on a local level with statewide oversight. Within this framework, the act establishes the authority of the state board and the nine regional boards. The state board administers water rights, sets state policy for water pollution control, and implements various water quality functions throughout the state, while the regional boards conduct planning, permitting, and most enforcement activities.

2.14 Seismic Hazards Mapping Act of 1990

The Seismic Hazards Mapping Act of 1990 was enacted by the California legislature following the Loma Prieta earthquake of 1989. The Act requires the California State Geologist to create maps delineating zones where data suggest amplified ground shaking, liquefaction, or earthquake-induced landsliding may occur. The purpose of the Act is to protect public safety from the effects of strong ground shaking, liquefaction, landslides, and other hazards caused by earthquakes. The Alquist-Priolo Earthquake Fault Zoning Act (1972) and the Seismic Hazards Mapping Act (1990) direct the State Geologist to delineate regulatory "Zones of Required Investigation" to reduce the threat to public health and safety and to minimize the loss of life and property posed by earthquake-triggered ground failures and other hazards.

2.15 The Public Trust

The public trust is a common law doctrine historically designed to protect the use of trust lands for commerce, navigation, and fisheries, but it has evolved over time to embrace a wider range of public purposes, including open space, recreation, and environmental preservation. Public trust lands are generally owned by the state and managed by the California State Lands Commission. The state has considerable discretion over how trust lands will be used, but it holds those lands in trust for the people, and it must exercise that discretion in a manner consistent with the purposes of the trust.

3.0 Local Regulations

3.1 Better Streets Plan

The San Francisco Better Streets Plan (Better Streets Plan) focuses on creating a positive pedestrian environment through measures such as careful streetscape design and traffic-calming measures to increase pedestrian safety. The Better Streets Plan includes guidelines for the pedestrian environment, which it defines as the areas of the street where people walk, sit, shop, play, or interact.

3.2 City and County of San Francisco General Plan

The Transportation Element of the General Plan is composed of objectives and policies that relate to the eight aspects of the citywide transportation system: General Regional Transportation, Congestion Management, Vehicle Circulation, Transit, Pedestrians, Bicycles, Citywide Parking, and Goods Management. The Transportation Element references San Francisco's Transit-First Policy in its introduction. It contains objectives and policies, including objectives related to locating development near transit investments, encouraging transit use, and regulating traffic signal timing to emphasize transit, pedestrian, and bicycle traffic as part of a balanced multimodal transportation system.

3.3 Construction Regulations Blue Book

The San Francisco MTA published the Regulations for Working in San Francisco Street, also named the "Blue Book". This provides direction for agencies working in the City, utility crews, private contractors and other organizations that work on city streets. These regulations set the requirements for working with pedestrian, bicycle, transit, and other traffic to cost the least interference (SFMTA 2023).

3.4 Plan Bay Area 2050

The Plan Bay Area 2050 connects the elements of housing, the economy, transportation, and the environment through 35 strategies that will make the Bay Area more equitable for all residents and more resilient in the face of unexpected challenges. Plan Bay Area 2050 is a 30-year plan that charts a course for a Bay Area that is affordable, connected, diverse, healthy, and vibrant for all residents through 2050 and beyond. Thirty-five strategies comprise the heart of the plan to improve housing, the economy, transportation and the environment across the Bay Area's nine counties — Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano and Sonoma. This long-range plan, developed by the Bay Area's two regional planning agencies, the Metropolitan Transportation Commission and the Association of Bay Area Governments, lays out a $1.4 trillion vision for a more equitable and resilient future for Bay Area residents.

3.5 Port of San Francisco Waterfront Plan

The Waterfront Plan describes the Port's of San Francisco's long-term goals and policies to guide the use and improvement of Port piers and properties along its 7½ mile waterfront, from Fisherman's Wharf to India Basin/Bayview. The Waterfront Plan was originally adopted in 1997. In 2019, the Waterfront Plan Working Group of citizen and waterfront stakeholders produced comprehensive recommendations to update the Plan approved in 2023. The Waterfront Plan has nine goals and supporting policies, including new direction to promote racial and social equity, and climate change resilience and sustainability which support the detailed work of the Port's Waterfront Resilience Program.

3.6 San Francisco Bay Plan

The Bay Plan was prepared during three years of study and public deliberation by the members of the San Francisco Bay Conservation and Development Commission. The Bay Plan covers the following matters as specified by law:

- The results of the Commission's detailed study of the Bay;
- The comprehensive plan adopted by the Commission for the conservation of the water of San Francisco Bay and the development of its shoreline;
- The Commission's recommendation of the appropriate agency to maintain and carry out the Bay Plan;
- The Commission's estimate of the approximate amount of money that would be required to maintain and carry out the provisions of the Plan for the Bay;
- Other information and recommendations the Commission deemed desirable.

Major plans proposed in the Bay Plan included developing maritime ports, deepening shipping channels, developing and preserving land for water related industries, expanding airport facilities on land, maintaining wildlife refuges in diked historic Baylands, and encouraging private shoreline development with private investments.

The Commission is authorized to control both: (1) Bay filling and dredging, and (2) Bay related shoreline development. Under the CZMA, federal agencies are generally required to carry out their activities and programs in a manner "consistent" with the Commission's coastal management program. To implement this provision, federal agencies make "consistency determinations" on their proposed activities, and applicants for federal permits, licenses, other authorization, or federal financial assistance make "consistency certifications." The Commission then has the opportunity to review the consistency determinations and certifications and to either concur with them or object to them. The Commission's decisions on federal consistency matters are governed by the provisions of the Coastal Zone Management Act and the Department of Commerce regulations.

3.7 San Francisco Bay Trail Plan

The Association of Bay Area Governments administers the San Francisco Bay Trail Plan. The San Francisco Bay Trail is a multi-purpose recreational trail that, when complete, will encircle San Francisco Bay and San Pablo Bay with a continuous 500-mile network of bicycling and hiking trails; to date, 338 miles of the alignment have been completed (Association of Bay Area Governments 2020).

3.8 San Francisco Bay Water Quality Control Plan (Basin Plan)

The Porter-Cologne Water Quality Control Act requires the state board and/or the regional boards to adopt statewide and/or regional water quality control plans, the purpose of which is to establish water quality objectives for specific water bodies. The regional board prepared the Water Quality Control Plan for the San Francisco Bay Basin (the Basin Plan) that identifies existing and potential beneficial uses for surface and ground waters and provides numerical and narrative water quality objectives designed to protect those uses.

3.9 San Francisco Bicycle Plan

The San Francisco Bicycle Plan describes a city program to provide the safe and attractive environment needed to promote bicycling as a transportation mode. The Bicycle Plan identifies the citywide bicycle route network and establishes the level of treatment (i.e., Class I, Class II, or Class III facility) on each route. The Bicycle Plan also identifies near-term improvements, long-term improvements, and minor improvements that would be implemented to facilitate bicycling in San Francisco.

3.10 San Francisco General Plan

The San Francisco General Plan serves to guide the City's evolution and growth, by providing a set of objectives and policies that influence how residents live, work, and move, as well as the quality and character of San Francisco. The Planning Commission periodically updates the General Plan to reflect four key themes including climate change, economics, healthy communities, and equitable opportunities. State law and San Francisco's Charter require a comprehensive, long-term general plan for the physical development of the city. The San Francisco General Plan ensures that there is adequate infrastructure to support residential, commercial, recreational, and institutional land uses and facilities, and that neighborhoods are walkable and connected by a robust transportation system geared toward public transit, walking, and biking. Economic growth should position San Francisco for a resilient future sustainably linked to and coordinated with regional development.

The General Plan attempts to navigate complex imperatives between preserving cherished qualities and assets, tackling needed changes, and preparing for both known and unpredictable challenges and crises.

3.11 San Francisco Noise Ordinance

In San Francisco, it is illegal to create or cause any noise greater than 5 decibels (dBA) above the ambient level in residential areas, and greater than 8 dBA above the ambient level in commercial or industrial areas. The policy of San Francisco is to maintain noise levels in areas with existing healthful and acceptable levels of noise and to reduce noise levels in those areas where noise levels are above acceptable levels.

3.12 San Francisco Planning Code

The San Francisco Planning Code is a legislative policy document that specifies land uses and development standards, along with zoning regulations. The Code determines if a use is permitted, conditional, or not permitted, and also includes other physical controls for land development such as height, setbacks, parking, etc. The Code affects the types of permits required to operate businesses or to perform construction activity in San Francisco.

3.13 San Francisco Planning Code Section 139

This Section establishes standards for bird-safe buildings to help reduce injury and mortality in birds caused by certain types of new construction, replacement facades, and building features.

3.14 San Francisco Public Utilities Commission

The San Francisco Public Utilities Commission (SFPUC) is a public agency of the City and County of San Francisco that provides water, wastewater, and electric power services to the city and an additional 1.9 million customers within three San Francisco Bay Area counties.

3.15 San Francisco Waterfront Special Area Plan

The San Francisco Waterfront Special Area Plan articulates a practicable attainable vision of the future San Francisco Waterfront. The Special Area Plan applies the requirements of the McAteer-Petris Act and the provisions of the San Francisco Bay Plan to the San Francisco waterfront in greater detail. The Special Area Plan facilitates non-maritime, maritime, commercial, and recreational shoreline development along the San Francisco waterfront. The goals will benefit the citizenry of the entire Bay Area, while promoting the viability and success of public trust uses along the waterfront. The area covered by the plan are the land and water area located along the existing shoreline of the City and County of San Francisco from Hyde Street Pier through the India Basin, including all areas in the jurisdiction of the Port of San Francisco. The policies apply only to areas within the jurisdiction of BCDC for permit purposes.

3.16 Sea-Level Rise Action Plan

The San Francisco Sea-Level Rise Action Plan aims to establish overarching goals and set of guiding principles for short- and long-term sea-level rise planning that will drive citywide adaptation planning to protect and enhance the City’s public and private assets, natural resources, and quality of life for all its residents. The plan discusses the impact of shoreline erosion on recreational opportunities and access, and emphasizes the need for innovative, inter-disciplinary design approaches that increase resilience to sea-level rise while enhancing the city’s shoreline qualities, including recreational access.

3.17 Transit-First Policy

In 1998, San Francisco voters amended the City Charter (Charter Article 8A, Section 8A.115) to include a Transit-First Policy, which was first articulated as a City and County of San Francisco priority policy by the Board of Supervisors in 1973. The Transit-First Policy is a set of principles that underscore the City’s commitment that travel by transit, bicycle, and foot be given priority over the private automobile. These principles are embodied in the policies and objectives of the Transportation Element of the City.

3.18 Water Emergency Transportation Authority's Water Transportation System Management Plan

The Water Emergency Transportation Authority (WETA) is a regional agency authorized by the State to operate a comprehensive San Francisco Bay Area public water transit system. In 2009, the WETA adopted the Water Transportation System Management Plan, which complements and reinforces other transportation emergency plans that will enable the Bay Area to restore mobility after a regional disaster.

General Plan.

4.0 References

SFMTA (San Francisco Metropolitan Transit Agency). 2023. Regulations for Working in San Francisco Streets. Available: https://www.sfmta.com/sites/default/files/reports-and-documents/2023/02/blue_book_rev_2023-0221_0.pdf. Accessed March 21, 2023.

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SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY, CA

DRAFT APPENDIX D-2 CLEAN AIR ACT COMPLIANCE

JANUARY 2024

USACE TULSA DISTRICT | THE PORT OF SAN FRANCISCO

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Appendix

Attachment A: Air Quality Model Outputs and Calculations

1.0 Introduction

The U.S. Army Corps of Engineers (USACE) is conducting a San Francisco Waterfront Coastal Flood Risk Study (San Francisco Coastal Study) to assess the feasibility of enhancing, restoring, and sustaining the environment, economy, and culture along San Francisco's coast.

The San Francisco Waterfront Coastal Flood Risk Study Draft Environmental Impact Statement analyzes several alternatives, including the Total Benefits Plan (TNBP), which is the recommended plan. The purpose of this document is to provide a preliminary assessment of the TNBP to inform future analysis conducted in accordance with the Clean Air Act (CAA) 40 Code of Federal Regulations (CFR) Part 93 Subpart B, which prohibits federal actions that do not meet the requirements of the CAA and applicable state implementation plans (SIPs). This analysis provides a rough order of magnitude to the potential emissions that may result from construction of the TNBP and the need to prepare a future general conformity determination (GCD) for the proposed action. This document is not a GCD for the TNBP, and it does not alleviate USACE's responsibility to conduct a thorough conformity analysis of the TNBP once sufficient project-level details are available.

The TNBP will be implemented through a phased approach with separate groups of actions for 2040 and 2090. The first actions (2040) are analyzed quantitatively using conceptual engineering data from USACE. The subsequent actions (2090) are analyzed qualitatively, as USACE has determined any assumptions or analysis of actions beginning in 2090 would be too speculative to be reasonable. The TNBP would install berms, seawalls, sheet pile walls, and related infrastructure, thus operational emissions would be negligible. Consequently, operational emissions are not analyzed further as there would be no trigger for a GCD or inconsistency with the CAA.

2.0 Project Description

The TNBP is a cost-effective, hybridized strategy that combines retreat and defend measures, tailored to address varying levels of sea-level rise. The first actions, with construction beginning in 2030, involve the initial measures to combat sea-level rise in San Francisco's waterfront areas. These include raising shorelines, floodproofing buildings, and constructing protective barriers and walls in The Embarcadero, Mission Creek/Mission Bay, and Islais Creek/Bayview. Construction of the first actions would occur over a 10-year period. The subsequent actions, beginning in 2090, build on the first actions and are intended to address more advanced stages of sea-level rise. They include further elevating shorelines, enhancing flood defenses with additional barriers, and making necessary infrastructure modifications. These subsequent actions would also occur over a 10-year period.

3.0 Regulatory Background

3.1 Federal Clean Air Act and General Conformity

The federal CAA of 1970 authorized the establishment of national health-based air quality standards, and also set deadlines for their attainment. The Federal CAA Amendments of 1990 (1990 CAAA) made major changes in deadlines for attaining National Ambient Air Quality Standards (NAAQS) and in the actions required of areas of the nation that exceeded these standards. Under the CAA, state and local agencies in areas that exceed the NAAQS are required to develop SIPs to show how they will achieve the NAAQS for nonattainment criteria air pollutants by specific dates. SIPs are not single documents; rather, they are a compilation of new and previously submitted plans, programs (such as monitoring, modeling, permitting, etc.), district rules, state regulations and federal controls. The United States Environmental Protection Agency (USEPA) is responsible for enforcing the NAAQS primarily through reviewing SIPs that are prepared by each state.

Pursuant to CAA Section 176(c) requirements, USEPA promulgated the General Conformity Rule (GCR), which applies to most federal actions, including the TNBP. The GCR is used to determine if federal actions meet the requirements of the CAA and the applicable SIP by ensuring that pollutant emissions related to the action do not cause or contribute to new violations of a NAAQS, increase the frequency or severity of any existing violation of a NAAQS, or delay timely attainment of a NAAQS or interim emissions reduction.

Federal projects must undertake an applicability analysis to determine whether all project emissions sources are subject to the GCR. The applicability analysis includes a stepwise process in which the federal agency determines the following.

1. **Is the emissions source located in a federal attainment area?** If yes, the emissions source is not subject to general conformity and no additional analysis is required. If no, document whether the emissions source is in a nonattainment or maintenance area and proceed to step 2.
2. **Does one or more of the specific exemptions apply to the project?**[1] If yes, the project is exempt from general conformity and no further analysis is required. If no, proceed to step 3.
3. **Has the federal agency included the action on its list of presumed-to-conform actions (40 CFR Section 93.153(f))?** If yes, the action is presumed to conform to the applicable SIP and the requirements of general conformity are satisfied. If no, proceed to step 4.

[1] Exemptions include those that meet the narrow exemption for federal actions in response to an emergency or disaster (40 CFR Section 93.153(e)) or one of the topical exemptions identified in 40 CFR Section 93.153(c) or 40 CFR Section 93.153(d).

Are the total direct and indirect emissions below the de minimis thresholds? The *de minimis* levels established in the GCR are shown in Table 1 and Table 2. If the levels are not exceeded, the action would not cause or contribute to new violations of air quality standards; the requirements of general conformity would be satisfied.

Table 1: De Minimis Levels for Nonattainment Areas

Pollutant and Status	Tons per Year
Ozone (VOC's or NOx)	
Serious nonattainment	50
Severe nonattainment	25
Extreme nonattainment	10
Other ozone nonattainment area outside an ozone transport region	100
Other ozone nonattainment area inside an ozone transport region	
VOC	50
NOx	100
SO_2 or NO_2 (all nonattainment areas)	100
PM10	
Moderate nonattainment	100
Serious nonattainment	70
PM2.5 (direct emissions, SO_2, NOx, VOC, and ammonia):	
Moderate nonattainment	100
Serious nonattainment	70
Pb (all nonattainment areas)	25
Source: CAA 40 CFR Part 93 Subpart B Section 93.153 (a)(1)	

Table 2: *de minimis* Levels for Maintenance Areas

Pollutant and Status	Tons per Year
Ozone (NOx), SO_2 or NO_2 (all maintenance areas)	100
Ozone (VOC)	
Maintenance areas inside an ozone transport region	50
Maintenance areas outside an ozone transport region	100
Carbon monoxide (all maintenance areas)	100
PM_{10} (all maintenance areas)	100
$PM_{2.5}$ (SO_2, NO_X, VOC, and ammonia) (all maintenance areas)	100
Pb (all maintenance areas)	25
Source: CAA 40 CFR Part 93 Subpart B Section 93.153 (a)(1)	

VOC = volatile organic carbon; NOx = nitrogen oxides; SO_2 = sulfur dioxide; NO_2 = nitrogen dioxide; PM2.5 = particulate matter 2.5 microns in diameter or less; PM10 = particulate matter 10 microns in diameter or less; and Pb = lead.

If, through the applicability analysis process, the federal agency determines that requirements of general conformity are satisfied, no further analysis or documentation is required. If, however, conformity requirements are not satisfied, the federal agency must conduct a conformity evaluation in accordance with the criteria and procedures in the implementing regulations, publish a draft GCD for public review, and publish the final GCD. A general GCD is made by satisfying any of the following requirements (USEPA 2023a).

- Showing that the emissions increases caused by the federal action are included in the SIP. This typically means that the SIP accounts for and accommodates the emissions from the proposed action.
- Obtaining a written statement from the entity responsible for the SIP that the total indirect and direct emissions from the action, along with other emissions in the area, will not exceed the total SIP emissions budget.
- Fully offsetting the total direct and indirect emissions by reducing emissions of the same pollutant in the same nonattainment or maintenance area, or a nearby area as allowed under the CAA. This maintains the overall emissions balance within SIP limits.
- Conducing air quality modeling to demonstrate that the proposed action would not result in air quality standards violations or a worsening of existing

violations. This modeling considers various factors like emissions rates, meteorological conditions, and pollutant dispersion.

- Using a combination of the above strategies.

By adhering to these methods, agencies and organizations can establish that a proposed action conforms to the requirements of the SIP, ensuring that air quality standards are upheld and that the project complies with the CAA.

3.2 Action Area Attainment Status and GCR Applicability

The TNBP falls within San Francisco County, which has been designated as a nonattainment area for three NAAQS: 8-hour ozone (2008 standard), 8-hour ozone (2015 standard), and 24-hour fine particulate matter (PM2.5) (2006 standard). These designations vary in severity, with the classifications being "marginal" nonattainment for the 2008 and 2015 8-hour ozone standards, and moderate nonattainment for the 24-hour PM2.5 standard (USEPA 2023b). Because the action is in a nonattainment area, general conformity applies to the project (applicability step 1).

None of the GCR exemptions apply to the proposed action, and they are not included in USACE's presumed-to-conform list (applicability steps 2 and 3). As such, the need for a conformity determination must be assessed through a comparison of project emissions to the applicable *de minimis* levels (applicability step 4). The *de minimis* levels apply to direct and indirect emissions generated by the proposed action, including precursor emissions. Based on the current action area nonattainment designations, the following *de minimis* levels from Table D-2-1-1 would apply.

- Volatile organic compounds (VOC) (ozone precursor) - 100 tons per year
- Nitrogen oxides (NOx) (ozone precursor) - 100 tons per year
- PM2.5 - 100 tons per year
- Sulfur dioxide (SO_2) (PM2.5 precursor[2]) - 100 tons per year

4.0 Methods for Estimating Construction Emissions

4.1 First Actions (2040)

Ozone precursor (VOC and NOx), PM2.5, and SO_2 (PM2.5 precursor) emissions generated by construction of the first actions were quantified using the California Emissions Estimator Model (CalEEMod), version 2022.1, the California Air Resources Board's Off-Road Web Tool, and preliminary engineering assumptions provided by USACE.

[2] Ammonia is also a precursor to PM2.5. However, construction of the TNBP would not result in material emissions of ammonia.

For the purposes of this high-level assessment, construction activities for the first actions are grouped into 10 general phases: (1) demolition C&A, (2) demolition of structures, (3) bedding and riprap, (4) ground improvements, (5) earth fill, (6) raise, (7) sheet pile driving, (8) H-pile driving, (9) steel pile driving, and (10) concrete. Specific start dates for these individual phases (e.g., earth fill) are not currently known. It was, therefore, conservatively assumed that construction of all phases would start in 2030, which is the first year in which construction of the first actions could begin.

The conceptual engineering data provided by USACE for the 10 phases cover a 2.5-year period. Engineering assumptions beyond these initial 2.5 years of construction are not available. For the purposes of this analysis, the activity estimates provided by USACE for the first 2.5-year period were assumed to repeat every 2.5 years thereafter over the extent of the 10-year construction period for the first actions.

The following emissions sources were included in the modeling. Refer to Appendix A for model outputs and calculations.

- **Off-road construction equipment**. USACE estimated the number of pieces of equipment and total operating hours. These assumptions were input into CalEEMod. Model defaults were used to define the equipment horsepower and load factors. All equipment was conservatively assumed to be diesel-fueled. State regulatory mandates for zero-emissions vehicles (ZEVs) and additional electrification of the off-road equipment sector are likely to increase the future use of electric and alternatively fueled equipment and vehicles during construction.
- **Marine vessels**: Specific marine vessel information was not provided by USACE other than the known use of vessels during bay fill operations. For the purposes of this analysis, bay fill activities were assumed to occur during the earth fill and bedding and riprap phases. Two tugboats and two workboats were assumed to operate, requiring 16 operating hours per day of each vessel type. This analysis also accounts for the potential use of barges for piledriving. Two barges and two tugboats were assumed to operate during the sheet pile, H-pile, and steel pile phases. Emissions factors for marine vessel operation were obtained from California Air Resource Board (CARB)'s Off-Road Web Tool.
- **Construction workers' vehicle trips**. The number of construction employees was estimated from the number of onsite off-road equipment using an industry-standard 1.25 workers per equipment. This analysis assumes two vehicle trips per employee. The resulting vehicle trips were input into CalEEMod. Model defaults were used to define the trip length (11.7 miles one way) and vehicle fleet mix.
- **Construction haul truck trips.** USACE estimated the total number of haul trucks needed for the raise, bedding and riprap, sheet pile, H-pile, steel pile, and concrete truck phases. CalEEMod defaults were used to define hauling

trips for the demo C&A, demo structures, ground improvement, and earth fill phases. Defaults were also used for the trip lengths and fleet mix.

- **Earthmoving**. USACE estimated expected earthmoving activities, which includes grading 56 acres during the earth fill phase. Additionally, 10,545,000 cubic yards and 171,658 cubic yards of soil would be exported and imported during the ground improvement and earth fill phases, respectively. These assumptions were input into CalEEMod.
- **Demolition**. USACE estimated expected demolition activities, which includes demolition of 35,981 square feet during the demo C&A phase and 2,735 square feet during the demo structures phase. These assumptions were input into CalEEMod.

The activity assumptions described above are based on a preliminary and conceptual level of design detail for the first actions. While general activities expected for construction can be defined based on common techniques and known quantities, specific details will be informed by conditions at the time of construction. The activity assumptions are considered reasonably representative of the first actions based on currently available information, but this analysis recognizes that industry-standard construction practices, as well as available equipment and control technologies, will change throughout the 10-year construction period and over the next 15 years. Accordingly, this analysis incorporates a 100 percent contingency on the activity assumptions provided by USACE to account for the project's distant timeline, inherent uncertainties, and preliminary estimations which results in an estimate that is double the calculated emissions using the assumptions noted above.

4.2 Subsequent Actions (2090)

The subsequent actions are evaluated through a qualitative analysis due to USACE's determination that making engineering assumptions for activities that would begin in 2090 would be too speculative. Additionally, current air quality models do not include emissions projections beyond 2050.

5.0 Preliminary Results

5.1 First Actions (2040)

Estimated construction emissions for the first actions are summarized in Table D-2-1-3. As stated previously, the results provide a rough order of magnitude to the potential emissions that may result from construction of the first actions. They are considered preliminary and should not be used in any regulatory compliance document. The results are provided to support ongoing project planning and provide information on the potential conformity outcome for the TNBP.

Table D-2-1-3: Preliminary Emissions Estimate for the TNBP First Actions (tons per year) [a,b]

Construction Year	VOC	NO_X	SO_2	PM2.5
2030	2	76	<1	5
2031	1	56	<1	3
2032	<1	27	<1	6
2033	2	76	<1	5
2034	1	56	<1	3
2035	<1	27	<1	6
2036	2	76	<1	5
2037	1	56	<1	3
2038	<1	27	<1	6
2039	2	76	<1	5
Current *de minimis* level	100	100	100	100
Exceeds *de minimis* level?	No	No	No	No

Note: The results presented provide a rough order of magnitude to the potential emissions that may result from construction of the first actions. They are considered preliminary and should not be used in any regulatory compliance document.
[a] Emissions are rounded to the nearest whole number.
[b] The modeling output files are included in Appendix A of this report.

Preliminary analysis of the first actions indicates that emissions may not exceed the *de minimis* levels that are currently applicable to the action area. As noted previously, this result does not mean that conformity requirements have been satisfied and that compliance with the CAA has been achieved. CAA compliance is formally assessed when more realistic emissions estimates are available. This is necessary due to the potential for both over- or underestimating emissions given the analysis uncertainties and limitations, as discussed in Section D-2-1-5.1.1, *Analysis Uncertainty and Limitations*.

5.1.1 Analysis Uncertainty and Limitations

The preliminary emissions analysis of the first actions includes substantial uncertainty and thus, any material conclusions drawn from the results are limited. This is because the information and models used to estimate emissions lack the necessary precision and reliability required to make a conclusive assessment of air quality impacts occurring between 2030 and 2040. Specific limitations include the following.

- **Construction Details**: The analysis relies on assumptions about specific equipment and methods that would be used over a 10-year period and up to 15 years in the future (2030-2039). These details are not known with certainty and may vary depending on evolving construction technologies and methods, such as fuel and equipment types.

- **Construction durations.** The duration of construction activities was provided; however, data only for the initial 2.5 years of the 10-year construction period were available. This partial information indicates a potential gap in the understanding of the long-term construction timeline.
- **Construction costs.** Construction costs, like fuel price, are estimated based on certain assumptions, and cost overruns or other changes could affect final construction activities.
- **State and local regulations.** The effectiveness of state and local regulations in mitigating emissions is assumed but not guaranteed. Changes in regulations or their enforcement may affect actual emissions.
- **Future technological advancements.** The first actions analysis does not consider the potential for future technological advancements that could reduce emissions or improve construction efficiency, like advancements in zero-emissions construction equipment and vehicles.
- **Mitigation measures.** Emissions modeling does not account for implementation of avoidance and minimization measures or mitigation measures described in Appendix D-1-1, *Air Quality and Greenhouse Gases* (AMM-AQ-1, AMM-AQ-2, AMM-AQ-3, MM-AQ-1, MM-AQ-2). These measures may affect the project in the future differently than they would today, indicating the extent to which they can reduce impacts is speculative.
- **Future air quality conditions.** Nonattainment and maintenance designations for the action area are likely to change in the next 10 to 15 years, influencing the determination of applicable *de minimis* levels for CAA compliance.

5.2 Subsequent Actions (2090)

Construction of the subsequent actions would not begin until 2090. It is impossible to predict industry, economic, and technological conditions that will influence project actions occurring 50 years in the future. Thus, even a preliminary estimate of emissions for the subsequent actions cannot be reasonably generated. It would also be inappropriate to presume the current *de minimis* levels would apply to the action area in 2090 (or even in 2050 when a more reasonable estimate of emissions could be generated). As noted previously, *de minimis* levels are informed by the area attainment designations for the NAAQS. SIPs for the San Francisco Bay Area describe how the region will attain the current (2008 and 2015) ozone standards and PM2.5 (2006) standard in the coming decades. If the action area reaches attainment for the ozone and PM2.5 NAAQS, general conformity requirements would not apply to future federal actions. However, while the current NAAQS may be achieved in the near future, USEPA regularly reviews and adopts new (lower) NAAQS in accordance with evolving scientific and health information. Thus, it is likely the nonattainment and maintenance designations for the action area in 2090 will differ from what they are today, influencing the determination of applicable *de minimis* levels for CAA compliance.

An emissions analysis for the subsequent actions cannot be performed; however, it is known that the emissions intensity of future construction equipment and vehicles will decline over time. This is due, in part, to the state's regulatory framework for achieving carbon neutrality by 2045. For example, the Advanced Clean Cars II regulations identify ZEV sales requirements starting with the 2026 model year through 2035, after which all new passenger cars, trucks, and utility vehicles sold in California will be zero emissions. CARB is also developing ZEV requirements for medium- and heavy-duty drayage, high-priority, and government fleets through the Advanced Clean Fleets regulation, which is still in draft form. While regulatory mandates for zero-emissions construction equipment have not yet been proposed, Executive Order N-79-20 establishes a goal for full electrification by 2035. These regulatory mandates and other technological advancements will minimize equipment and vehicle combustion emissions, although dust emissions from earthmoving and demolition would still occur. However, based on the results for the first actions (Table D-2-1-3), it is anticipated that dust (PM2.5) emissions would be minimal.

6.0 Next Steps for Project-Level Analysis

Once more realistic project assumptions are known, a general conformity applicability analysis would need to be completed to assess CAA compliance and the need for a GCD. The preliminary analysis conducted for the first actions indicates that a GCD may not be required (Table D-2-1-3). However, as discussed previously, the reliability of this conclusion is limited given the analysis uncertainties. If the revised project analysis indicates that emissions from first actions or subsequent actions exceed the *de minimis* levels, a GCD would be required. Section D-2-1-3.2, *Action Area Attainment Status and GCR Applicability*, summarizes the primary methods for satisfying general conformity requirements through a GCD. Once a draft GCD is made it must be circulated for a minimum 30-day public review period in accordance with 40 CFR Sections 93.155 and 93.156. Following public review, USACE would issue a Final GCD and publish notice in the *Federal Register*.

7.0 Conclusion

The quantitative and qualitative analyses presented for the first and subsequent actions of the TNBP indicate that construction emissions may not exceed the *de minimis* levels that currently apply to the action area. However, given that construction would not begin until 2030 for the first actions and 2090 for the subsequent actions, the information currently available to support the emissions analysis lacks the necessary precision to make a reliable and defensible conclusion with respect to CAA consistency. A comprehensive emissions analysis will be conducted when more accurate information and data are available to define expected construction activities and project conditions. Based on the results of that analysis, a GCD may be required to satisfy general conformity.

8.0 References

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Attachment A: Air Quality Model Outputs and Calculations

Total Emissions - CalEEMod Outputs with 100% Contingency + Marine Vessels

	VOC	NO_X	CO	SO2	PM_{10}	$PM_{2.5}$
2030	2	76	69	0	18	5
2031	1	56	57	0	11	3
2032	0	27	29	0	0	6
2033	2	76	69	0	18	5
2033	1	56	57	0	11	3
2035	0	27	29	0	0	6
2036	2	76	69	0	18	5
2037	1	56	57	0	11	3
2038	0	27	29	0	0	6
2039	2	76	69	0	18	5

2.2. CalEEMod Outputs - Construction Emissions by Year, Unmitigated (Does not include 100% contingency)

Year	TOG	ROG	NOx	CO	SO_2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T
Annual											
2030	4.48	0.78	31.86	33.13	0.13	0.32	8.78	9.10	0.31	1.88	2.19
2031	3.64	0.38	27.06	28.35	0.12	0.24	5.28	5.52	0.24	1.47	1.71
2032	1.80	0.19	13.43	14.43	0.06	0.12	2.81	2.94	0.12	0.78	0.91

Marine Vessels

CalEEMod Schedule				Tons (2030)						Tons (2031)					
				ROG	NOx	CO	PM10	PM2.5	SO2	ROG	NOx	CO	PM10	PM2.5	SO2
Phase	Start	End	Days												
Demo C&A	1/3/2030	9/10/2030	179												
Demo Structures	1/3/2030	1/4/2030	2												
Raise	1/3/2030	10/15/2030	204												
Ground Improvement	1/3/2030	7/13/2032	659												
Earthfill	1/3/2030	11/12/2030	224	0.1	2.1	0.6	0.0	0.0	0.0						
Bedding & Riprap	1/3/2030	6/3/2030	108	0.1	1.0	0.3	0.0	0.0	0.0						
Sheetpile Driving	1/3/2030	9/10/2030	179	0.2	3.4	0.9	0.1	0.1	0.0						
H-Pile	1/3/2030	3/1/2030	42	0.1	0.8	0.2	0.0	0.0	0.0						
Steel Pile	1/3/2030	6/4/2031	370	0.3	5.0	1.3	0.1	0.1	0.0	0.1	2.1	0.5	0.0	0.0	0.0
Concrete Truck	1/3/2030	10/24/2030	211												
			TOTAL	0.8	12.4	3.2	0.2	0.2	0.0	0.1	2.1	0.5	0.0	0.0	0.0

Seawall CBP 2030 Custom Report

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1. Basic Project Information

1.1. Basic Project Information

Data Field	Value
Project Name	Seawall CBP 2030
Construction Start Date	1/1/2030
Lead Agency	—
Land Use Scale	Project/site
Analysis Level for Defaults	County
Windspeed (m/s)	3.90
Precipitation (days)	2.60
Location	37.795670987249224, -122.3925256780877
County	San Francisco
City	San Francisco
Air District	Bay Area AQMD
Air Basin	San Francisco Bay Area
TAZ	1072
EDFZ	1
Electric Utility	Pacific Gas & Electric Company
Gas Utility	—
App Version	2022.1.1.21

1.2. Land Use Types

Land Use Subtype	Size	Unit	Lot Acreage	Building Area (sq ft)	Landscape Area (sq ft)	Special Landscape Area (sq ft)	Population	Description
User Defined Industrial	609,840	User Defined Unit	14.0	0.00	0.00	0.00	—	—

2. Emissions Summary

2.2. Construction Emissions by Year, Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Year	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Daily - Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	35.9	6.75	246	266	1.01	2.66	72.7	75.4	2.60	15.1	17.7	—	161,684	161,684	28.8	25.2	219	170,137
2031	28.3	3.30	202	221	0.89	1.92	40.7	42.6	1.90	11.3	13.2	—	140,602	140,602	24.0	22.6	182	148,133
2032	25.8	2.77	185	207	0.88	1.78	40.4	42.2	1.78	11.3	13.1	—	133,962	133,962	22.1	21.7	162	141,155
Daily - Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	36.8	7.30	265	276	1.03	2.85	74.6	77.4	2.77	15.5	18.2	—	164,624	164,624	29.1	25.4	5.75	172,933
2031	28.2	3.21	213	221	0.89	1.92	40.7	42.6	1.90	11.3	13.2	—	140,582	140,582	24.0	22.6	4.75	147,935
2032	25.8	2.68	196	208	0.88	1.78	40.4	42.2	1.78	11.3	13.1	—	133,958	133,958	22.1	21.7	4.20	140,994
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	24.5	4.25	175	182	0.69	1.74	48.1	49.9	1.71	10.3	12.0	—	111,826	111,826	20.1	17.6	66.1	117,636
2031	19.9	2.11	148	155	0.63	1.31	28.9	30.2	1.31	8.07	9.37	—	99,801	99,801	17.1	16.2	56.3	105,103
2032	9.84	1.04	73.6	79.1	0.34	0.68	15.4	16.1	0.68	4.30	4.98	—	51,119	51,119	8.43	8.30	26.7	53,829
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2030	4.48	0.78	31.9	33.1	0.13	0.32	8.78	9.10	0.31	1.88	2.19	—	18,514	18,514	3.32	2.91	10.9	19,476
2031	3.64	0.38	27.1	28.4	0.12	0.24	5.28	5.52	0.24	1.47	1.71	—	16,523	16,523	2.84	2.68	9.33	17,401
2032	1.80	0.19	13.4	14.4	0.06	0.12	2.81	2.94	0.12	0.78	0.91	—	8,463	8,463	1.40	1.37	4.42	8,912

3. Construction Emissions Details

3.1. Demo C&A (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.22	0.18	1.84	3.84	0.01	0.04	—	0.04	0.04	—	0.04	—	580	580	0.02	< 0.005	—	582
Demolition	—	—	—	—	—	—	0.21	0.21	—	0.03	0.03	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.22	0.18	1.84	3.84	0.01	0.04	—	0.04	0.04	—	0.04	—	580	580	0.02	< 0.005	—	582
Demolition	—	—	—	—	—	—	0.21	0.21	—	0.03	0.03	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.11	0.09	0.90	1.88	< 0.005	0.02	—	0.02	0.02	—	0.02	—	285	285	0.01	< 0.005	—	286
Demolition	—	—	—	—	—	—	0.10	0.10	—	0.02	0.02	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	0.02	0.02	0.16	0.34	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	47.1	47.1	< 0.005	< 0.005	—	47.3
Demolition	—	—	—	—	—	—	0.02	0.02	—	< 0.005	< 0.005	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.01	0.28	0.00	0.00	0.08	0.08	0.00	0.02	0.02	—	82.8	82.8	< 0.005	< 0.005	0.20	83.2
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.04	< 0.005	0.24	0.26	< 0.005	< 0.005	0.04	0.05	< 0.005	0.01	0.01	—	167	167	0.03	0.03	0.23	176
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.02	0.26	0.00	0.00	0.08	0.08	0.00	0.02	0.02	—	78.3	78.3	< 0.005	< 0.005	0.01	78.6
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.03	< 0.005	0.26	0.26	< 0.005	< 0.005	0.04	0.05	< 0.005	0.01	0.01	—	167	167	0.03	0.03	0.01	176
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.01	0.12	0.00	0.00	0.04	0.04	0.00	0.01	0.01	—	38.5	38.5	< 0.005	< 0.005	0.04	38.6
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.02	< 0.005	0.12	0.13	< 0.005	< 0.005	0.02	0.02	< 0.005	0.01	0.01	—	81.8	81.8	0.02	0.01	0.05	86.1
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.02	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	6.37	6.37	< 0.005	< 0.005	0.01	6.40
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	0.02	0.02	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	13.5	13.5	< 0.005	< 0.005	0.01	14.3

3.3. Demo Structures (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.22	0.18	1.84	3.84	0.01	0.04	—	0.04	0.04	—	0.04	—	580	580	0.02	< 0.005	—	582
Demolition	—	—	—	—	—	—	1.42	1.42	—	0.22	0.22	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	< 0.005	0.01	0.02	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	3.18	3.18	< 0.005	< 0.005	—	3.19
Demolition	—	—	—	—	—	—	0.01	0.01	—	< 0.005	< 0.005	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	0.53	0.53	< 0.005	< 0.005	—	0.53
Demolition	—	—	—	—	—	—	< 0.005	< 0.005	—	< 0.005	< 0.005	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.01	0.13	0.00	0.00	0.04	0.04	0.00	0.01	0.01	—	39.2	39.2	< 0.005	< 0.005	< 0.005	39.3
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.24	0.03	1.77	1.78	0.01	0.01	0.31	0.32	0.01	0.09	0.10	—	1,153	1,153	0.21	0.19	0.04	1,215
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.21	0.21	< 0.005	< 0.005	< 0.005	0.22
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	6.32	6.32	< 0.005	< 0.005	< 0.005	6.66
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.04	0.04	< 0.005	< 0.005	< 0.005	0.04
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	1.05	1.05	< 0.005	< 0.005	< 0.005	1.10

3.5. Bedding & Riprap (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.47	0.40	3.49	3.61	0.01	0.14	—	0.14	0.13	—	0.13	—	659	659	0.03	0.01	—	661
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	0.47	0.40	3.49	3.61	0.01	0.14	—	0.14	0.13	—	0.13	—	659	659	0.03	0.01	—	661
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.14	0.12	1.03	1.07	< 0.005	0.04	—	0.04	0.04	—	0.04	—	195	195	0.01	< 0.005	—	196
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.03	0.02	0.19	0.19	< 0.005	0.01	—	0.01	0.01	—	0.01	—	32.3	32.3	< 0.005	< 0.005	—	32.4
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.01	0.14	0.00	0.00	0.04	0.04	0.00	0.01	0.01	—	41.4	41.4	< 0.005	< 0.005	0.10	41.6
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.61	0.07	4.20	4.43	0.02	0.04	0.78	0.81	0.04	0.22	0.26	—	2,883	2,883	0.53	0.47	4.06	3,041
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.01	0.13	0.00	0.00	0.04	0.04	0.00	0.01	0.01	—	39.2	39.2	< 0.005	< 0.005	< 0.005	39.3
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.60	0.07	4.43	4.44	0.02	0.04	0.78	0.81	0.04	0.22	0.26	—	2,883	2,883	0.53	0.47	0.11	3,036
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.04	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	11.6	11.6	< 0.005	< 0.005	0.01	11.7
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Hauling	0.18	0.02	1.29	1.31	0.01	0.01	0.23	0.24	0.01	0.07	0.08	—	853	853	0.16	0.14	0.52	899
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.01	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	1.92	1.92	< 0.005	< 0.005	< 0.005	1.93
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.03	< 0.005	0.24	0.24	< 0.005	< 0.005	0.04	0.04	< 0.005	0.01	0.01	—	141	141	0.03	0.02	0.09	149

3.7. Ground Improvement (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.07	0.05	0.41	0.32	< 0.005	0.02	—	0.02	0.01	—	0.01	—	56.3	56.3	< 0.005	< 0.005	—	56.5
Dust From Material Movement	—	—	—	—	—	—	1.50	1.50	—	0.23	0.23	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.07	0.05	0.41	0.32	< 0.005	0.02	—	0.02	0.01	—	0.01	—	56.3	56.3	< 0.005	< 0.005	—	56.5
Dust From Material Movement	—	—	—	—	—	—	1.50	1.50	—	0.23	0.23	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05	0.04	0.29	0.23	< 0.005	0.01	—	0.01	0.01	—	0.01	—	40.0	40.0	< 0.005	< 0.005	—	40.1
Dust From Material Movement	—	—	—	—	—	—	1.07	1.07	—	0.16	0.16	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.01	0.05	0.04	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	6.62	6.62	< 0.005	< 0.005	—	6.65
Dust From Material Movement	—	—	—	—	—	—	0.19	0.19	—	0.03	0.03	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.01	0.28	0.00	0.00	0.08	0.08	0.00	0.02	0.02	—	82.8	82.8	< 0.005	< 0.005	0.20	83.2
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	30.3	3.57	210	221	0.88	1.76	38.8	40.6	1.76	11.0	12.8	—	144,167	144,167	26.7	23.5	203	152,041
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.02	0.26	0.00	0.00	0.08	0.08	0.00	0.02	0.02	—	78.3	78.3	< 0.005	< 0.005	0.01	78.6
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	30.3	3.48	221	222	0.88	1.76	38.8	40.6	1.76	11.0	12.8	—	144,157	144,157	26.6	23.5	5.27	151,832

Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.01	0.18	0.00	0.00	0.06	0.06	0.00	0.01	0.01	—	55.7	55.7	< 0.005	< 0.005	0.06	56.0
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	21.5	2.51	155	157	0.63	1.25	27.6	28.8	1.25	7.83	9.08	—	102,409	102,409	18.9	16.7	62.4	107,920
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.03	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	9.23	9.23	< 0.005	< 0.005	0.01	9.26
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	3.93	0.46	28.3	28.7	0.11	0.23	5.03	5.26	0.23	1.43	1.66	—	16,955	16,955	3.13	2.76	10.3	17,867

3.9. Ground Improvement (2031) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.07	0.05	0.41	0.32	< 0.005	0.02	—	0.02	0.01	—	0.01	—	56.3	56.3	< 0.005	< 0.005	—	56.5
Dust From Material Movement	—	—	—	—	—	—	1.50	1.50	—	0.23	0.23	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.07	0.05	0.41	0.32	< 0.005	0.02	—	0.02	0.01	—	0.01	—	56.3	56.3	< 0.005	< 0.005	—	56.5

Dust From Material Movement	—	—	—	—	—	—	1.50	1.50	—	0.23	0.23	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.05	0.04	0.30	0.23	< 0.005	0.01	—	0.01	0.01	—	0.01	—	40.2	40.2	< 0.005	< 0.005	—	40.4
Dust From Material Movement	—	—	—	—	—	—	1.07	1.07	—	0.16	0.16	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.01	0.05	0.04	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	6.66	6.66	< 0.005	< 0.005	—	6.68
Dust From Material Movement	—	—	—	—	—	—	0.20	0.20	—	0.03	0.03	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.01	0.27	0.00	0.00	0.08	0.08	0.00	0.02	0.02	—	82.0	82.0	< 0.005	< 0.005	0.17	82.4
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	27.6	2.69	197	214	0.88	1.76	38.8	40.6	1.76	11.0	12.8	—	138,952	138,952	23.9	22.6	182	146,474
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Worker	0.02	0.02	0.02	0.25	0.00	0.00	0.08	0.08	0.00	0.02	0.02	—	77.5	77.5	< 0.005	< 0.005	< 0.005	77.8
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	27.5	2.60	208	215	0.88	1.76	38.8	40.6	1.76	11.0	12.8	—	138,948	138,948	23.9	22.6	4.73	146,292
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.01	0.17	0.00	0.00	0.06	0.06	0.00	0.01	0.01	—	55.5	55.5	< 0.005	< 0.005	0.05	55.7
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	19.7	1.89	147	153	0.63	1.26	27.7	29.0	1.26	7.87	9.13	—	99,250	99,250	17.1	16.2	56.2	104,549
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.03	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	9.19	9.19	< 0.005	< 0.005	0.01	9.22
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	3.59	0.34	26.8	28.0	0.11	0.23	5.06	5.29	0.23	1.44	1.67	—	16,432	16,432	2.83	2.68	9.31	17,309

3.11. Ground Improvement (2032) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.07	0.05	0.41	0.32	< 0.005	0.02	—	0.02	0.01	—	0.01	—	56.3	56.3	< 0.005	< 0.005	—	56.5
Dust From Material Movement	—	—	—	—	—	—	1.50	1.50	—	0.23	0.23	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Off-Road Equipment	0.07	0.05	0.41	0.32	< 0.005	0.02	—	0.02	0.01	—	0.01	—	56.3	56.3	< 0.005	< 0.005	—	56.5
Dust From Material Movement	—	—	—	—	—	—	1.50	1.50	—	0.23	0.23	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.03	0.02	0.16	0.12	< 0.005	0.01	—	0.01	0.01	—	0.01	—	21.5	21.5	< 0.005	< 0.005	—	21.6
Dust From Material Movement	—	—	—	—	—	—	0.57	0.57	—	0.09	0.09	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	< 0.005	< 0.005	0.03	0.02	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	3.56	3.56	< 0.005	< 0.005	—	3.57
Dust From Material Movement	—	—	—	—	—	—	0.10	0.10	—	0.02	0.02	—	—	—	—	—	—	—
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.01	0.26	0.00	0.00	0.08	0.08	0.00	0.02	0.02	—	80.8	80.8	< 0.005	< 0.005	0.15	81.2
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	25.8	2.69	185	206	0.88	1.76	38.8	40.6	1.76	11.0	12.8	—	133,825	133,825	22.1	21.7	161	141,017

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.02	0.24	0.00	0.00	0.08	0.08	0.00	0.02	0.02	—	76.5	76.5	< 0.005	< 0.005	< 0.005	76.7
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	25.7	2.60	195	207	0.88	1.76	38.8	40.6	1.76	11.0	12.8	—	133,825	133,825	22.1	21.7	4.20	140,860
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.01	0.09	0.00	0.00	0.03	0.03	0.00	0.01	0.01	—	29.2	29.2	< 0.005	< 0.005	0.03	29.3
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	9.81	1.01	73.4	78.9	0.34	0.67	14.8	15.5	0.67	4.21	4.88	—	51,068	51,068	8.43	8.30	26.7	53,778
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.02	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	4.84	4.84	< 0.005	< 0.005	< 0.005	4.86
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	1.79	0.18	13.4	14.4	0.06	0.12	2.70	2.82	0.12	0.77	0.89	—	8,455	8,455	1.40	1.37	4.41	8,904

3.13. Earthfill (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.30	0.25	1.78	2.81	< 0.005	0.08	—	0.08	0.07	—	0.07	—	426	426	0.02	< 0.005	—	427
Dust From Material Movement	—	—	—	—	—	—	0.34	0.34	—	0.04	0.04	—	—	—	—	—	—	—
Onsite truck	0.01	< 0.005	0.10	0.11	< 0.005	< 0.005	28.3	28.3	< 0.005	2.82	2.82	—	69.3	69.3	0.01	0.01	0.10	73.0

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.30	0.25	1.78	2.81	< 0.005	0.08	—	0.08	0.07	—	0.07	—	426	426	0.02	< 0.005	—	427
Dust From Material Movement	—	—	—	—	—	—	0.34	0.34	—	0.04	0.04	—	—	—	—	—	—	—
Onsite truck	0.01	< 0.005	0.11	0.11	< 0.005	< 0.005	28.3	28.3	< 0.005	2.82	2.82	—	69.3	69.3	0.01	0.01	< 0.005	72.9
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.18	0.15	1.09	1.72	< 0.005	0.05	—	0.05	0.05	—	0.05	—	261	261	0.01	< 0.005	—	262
Dust From Material Movement	—	—	—	—	—	—	0.21	0.21	—	0.02	0.02	—	—	—	—	—	—	—
Onsite truck	0.01	< 0.005	0.06	0.07	< 0.005	< 0.005	17.2	17.2	< 0.005	1.72	1.72	—	42.5	42.5	0.01	0.01	0.03	44.8
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.03	0.03	0.20	0.31	< 0.005	0.01	—	0.01	0.01	—	0.01	—	43.3	43.3	< 0.005	< 0.005	—	43.4
Dust From Material Movement	—	—	—	—	—	—	0.04	0.04	—	< 0.005	< 0.005	—	—	—	—	—	—	—
Onsite truck	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	3.14	3.14	< 0.005	0.31	0.31	—	7.04	7.04	< 0.005	< 0.005	< 0.005	7.42
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.07	0.07	0.04	0.85	0.00	0.00	0.25	0.25	0.00	0.06	0.06	—	248	248	< 0.005	< 0.005	0.59	250

Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	1.45	0.17	10.1	10.6	0.04	0.08	1.86	1.94	0.08	0.53	0.61	—	6,905	6,905	1.28	1.13	9.72	7,282
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.07	0.07	0.06	0.77	0.00	0.00	0.25	0.25	0.00	0.06	0.06	—	235	235	< 0.005	< 0.005	0.02	236
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	1.45	0.17	10.6	10.6	0.04	0.08	1.86	1.94	0.08	0.53	0.61	—	6,904	6,904	1.28	1.13	0.25	7,272
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.04	0.04	0.03	0.46	0.00	0.00	0.15	0.15	0.00	0.04	0.04	—	144	144	< 0.005	< 0.005	0.16	145
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.89	0.10	6.42	6.51	0.03	0.05	1.14	1.19	0.05	0.32	0.38	—	4,237	4,237	0.78	0.69	2.58	4,465
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.01	0.08	0.00	0.00	0.03	0.03	0.00	0.01	0.01	—	23.9	23.9	< 0.005	< 0.005	0.03	24.0
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.16	0.02	1.17	1.19	< 0.005	0.01	0.21	0.22	0.01	0.06	0.07	—	702	702	0.13	0.11	0.43	739

3.15. Raise (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.40	0.33	2.69	3.01	0.01	0.11	—	0.11	0.10	—	0.10	—	990	990	0.04	0.01	—	994
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.40	0.33	2.69	3.01	0.01	0.11	—	0.11	0.10	—	0.10	—	990	990	0.04	0.01	—	994
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.22	0.19	1.50	1.68	0.01	0.06	—	0.06	0.06	—	0.06	—	554	554	0.02	< 0.005	—	555
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.04	0.03	0.27	0.31	< 0.005	0.01	—	0.01	0.01	—	0.01	—	91.6	91.6	< 0.005	< 0.005	—	92.0
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	< 0.005	0.09	0.00	0.00	0.02	0.02	0.00	0.01	0.01	—	24.8	24.8	< 0.005	< 0.005	0.06	25.0
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.01	0.08	0.00	0.00	0.02	0.02	0.00	0.01	0.01	—	23.5	23.5	< 0.005	< 0.005	< 0.005	23.6
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Worker	< 0.005	< 0.005	< 0.005	0.04	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	13.2	13.2	< 0.005	< 0.005	0.01	13.2
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.01	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	2.18	2.18	< 0.005	< 0.005	< 0.005	2.19
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.17. Sheetpile Driving (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.00	0.84	5.36	6.86	0.02	0.20	—	0.20	0.18	—	0.18	—	2,448	2,448	0.10	0.02	—	2,456
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	1.00	0.84	5.36	6.86	0.02	0.20	—	0.20	0.18	—	0.18	—	2,448	2,448	0.10	0.02	—	2,456
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.49	0.41	2.63	3.36	0.01	0.10	—	0.10	0.09	—	0.09	—	1,201	1,201	0.05	0.01	—	1,205

Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.09	0.07	0.48	0.61	< 0.005	0.02	—	0.02	0.02	—	0.02	—	199	199	0.01	< 0.005	—	199
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.01	0.23	0.00	0.00	0.07	0.07	0.00	0.02	0.02	—	66.2	66.2	< 0.005	< 0.005	0.16	66.6
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.01	0.21	0.00	0.00	0.07	0.07	0.00	0.02	0.02	—	62.6	62.6	< 0.005	< 0.005	< 0.005	62.8
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.01	0.01	0.01	0.10	0.00	0.00	0.03	0.03	0.00	0.01	0.01	—	30.8	30.8	< 0.005	< 0.005	0.03	30.9
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.02	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	5.10	5.10	< 0.005	< 0.005	0.01	5.12
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

3.19. H-pile (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.49	0.41	3.39	3.96	0.01	0.13	—	0.13	0.12	—	0.12	—	1,114	1,114	0.05	0.01	—	1,118
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.06	0.05	0.39	0.46	< 0.005	0.01	—	0.01	0.01	—	0.01	—	128	128	0.01	< 0.005	—	129
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.01	0.01	0.07	0.08	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	21.2	21.2	< 0.005	< 0.005	—	21.3
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Worker	0.01	0.01	0.01	0.13	0.00	0.00	0.04	0.04	0.00	0.01	0.01	—	39.2	39.2	< 0.005	< 0.005	< 0.005	39.3
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.02	< 0.005	0.11	0.11	< 0.005	< 0.005	0.02	0.02	< 0.005	0.01	0.01	—	72.1	72.1	0.01	0.01	< 0.005	75.9
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.01	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	4.51	4.51	< 0.005	< 0.005	< 0.005	4.53
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	8.29	8.29	< 0.005	< 0.005	0.01	8.74
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	< 0.005	0.00	0.00	< 0.005	< 0.005	0.00	< 0.005	< 0.005	—	0.75	0.75	< 0.005	< 0.005	< 0.005	0.75
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	1.37	1.37	< 0.005	< 0.005	< 0.005	1.45

3.21. Steel Pile (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.58	0.49	4.10	4.91	0.01	0.14	—	0.14	0.13	—	0.13	—	1,237	1,237	0.05	0.01	—	1,241
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.58	0.49	4.10	4.91	0.01	0.14	—	0.14	0.13	—	0.13	—	1,237	1,237	0.05	0.01	—	1,241

Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.42	0.35	2.92	3.49	0.01	0.10	—	0.10	0.09	—	0.09	—	879	879	0.04	0.01	—	882
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.08	0.06	0.53	0.64	< 0.005	0.02	—	0.02	0.02	—	0.02	—	145	145	0.01	< 0.005	—	146
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06	0.06	0.04	0.71	0.00	0.00	0.21	0.21	0.00	0.05	0.05	—	207	207	< 0.005	< 0.005	0.49	208
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.02	< 0.005	0.11	0.11	< 0.005	< 0.005	0.02	0.02	< 0.005	0.01	0.01	—	72.1	72.1	0.01	0.01	0.10	76.0
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06	0.06	0.05	0.64	0.00	0.00	0.21	0.21	0.00	0.05	0.05	—	196	196	< 0.005	< 0.005	0.01	196
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.02	< 0.005	0.11	0.11	< 0.005	< 0.005	0.02	0.02	< 0.005	0.01	0.01	—	72.1	72.1	0.01	0.01	< 0.005	75.9
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.04	0.04	0.03	0.44	0.00	0.00	0.15	0.15	0.00	0.03	0.03	—	139	139	< 0.005	< 0.005	0.15	140
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.01	< 0.005	0.08	0.08	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	—	51.2	51.2	0.01	0.01	0.03	54.0
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Worker	0.01	0.01	0.01	0.08	0.00	0.00	0.03	0.03	0.00	0.01	0.01	—	23.1	23.1	< 0.005	< 0.005	0.03	23.2
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	8.48	8.48	< 0.005	< 0.005	0.01	8.93

3.23. Steel Pile (2031) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.57	0.48	3.94	4.87	0.01	0.13	—	0.13	0.12	—	0.12	—	1,237	1,237	0.05	0.01	—	1,241
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.57	0.48	3.94	4.87	0.01	0.13	—	0.13	0.12	—	0.12	—	1,237	1,237	0.05	0.01	—	1,241
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.17	0.15	1.20	1.48	< 0.005	0.04	—	0.04	0.04	—	0.04	—	375	375	0.02	< 0.005	—	377
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.03	0.03	0.22	0.27	< 0.005	0.01	—	0.01	0.01	—	0.01	—	62.1	62.1	< 0.005	< 0.005	—	62.3

Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.06	0.05	0.03	0.68	0.00	0.00	0.21	0.21	0.00	0.05	0.05	—	205	205	< 0.005	< 0.005	0.43	206
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.01	< 0.005	0.10	0.11	< 0.005	< 0.005	0.02	0.02	< 0.005	0.01	0.01	—	69.5	69.5	0.01	0.01	0.09	73.2
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.05	0.05	0.04	0.62	0.00	0.00	0.21	0.21	0.00	0.05	0.05	—	194	194	< 0.005	< 0.005	0.01	194
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.01	< 0.005	0.10	0.11	< 0.005	< 0.005	0.02	0.02	< 0.005	0.01	0.01	—	69.5	69.5	0.01	0.01	< 0.005	73.1
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.01	0.18	0.00	0.00	0.06	0.06	0.00	0.01	0.01	—	58.9	58.9	< 0.005	< 0.005	0.06	59.1
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	0.03	0.03	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	—	21.1	21.1	< 0.005	< 0.005	0.01	22.2
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.03	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	9.75	9.75	< 0.005	< 0.005	0.01	9.79
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	< 0.005	< 0.005	0.01	0.01	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	—	3.49	3.49	< 0.005	< 0.005	< 0.005	3.67

3.25. Concrete Truck (2030) - Unmitigated

Criteria Pollutants (lb/day for daily, ton/yr for annual) and GHGs (lb/day for daily, MT/yr for annual)

Location	TOG	ROG	NOx	CO	SO2	PM10E	PM10D	PM10T	PM2.5E	PM2.5D	PM2.5T	BCO2	NBCO2	CO2T	CH4	N2O	R	CO2e
Onsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.17	0.14	1.09	0.84	< 0.005	0.04	—	0.04	0.04	—	0.04	—	148	148	0.01	< 0.005	—	148
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.17	0.14	1.09	0.84	< 0.005	0.04	—	0.04	0.04	—	0.04	—	148	148	0.01	< 0.005	—	148
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.10	0.08	0.63	0.49	< 0.005	0.02	—	0.02	0.02	—	0.02	—	85.5	85.5	< 0.005	< 0.005	—	85.7
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Off-Road Equipment	0.02	0.02	0.11	0.09	< 0.005	< 0.005	—	< 0.005	< 0.005	—	< 0.005	—	14.1	14.1	< 0.005	< 0.005	—	14.2
Onsite truck	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Offsite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Daily, Summer (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03	0.03	0.02	0.43	0.00	0.00	0.12	0.12	0.00	0.03	0.03	—	124	124	< 0.005	< 0.005	0.30	125
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

Daily, Winter (Max)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.03	0.03	0.03	0.39	0.00	0.00	0.12	0.12	0.00	0.03	0.03	—	117	117	< 0.005	< 0.005	0.01	118
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Average Daily	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	0.02	0.02	0.01	0.22	0.00	0.00	0.07	0.07	0.00	0.02	0.02	—	68.0	68.0	< 0.005	< 0.005	0.07	68.3
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Annual	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Worker	< 0.005	< 0.005	< 0.005	0.04	0.00	0.00	0.01	0.01	0.00	< 0.005	< 0.005	—	11.3	11.3	< 0.005	< 0.005	0.01	11.3
Vendor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00
Hauling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	—	0.00	0.00	0.00	0.00	0.00	0.00

5. Activity Data

5.1. Construction Schedule

Phase Name	Phase Type	Start Date	End Date	Days Per Week	Work Days per Phase	Phase Description
Demo C&A	Demolition	1/3/2030	9/10/2030	5.00	179	—
Demo Structures	Demolition	1/3/2030	1/4/2030	5.00	2.00	—
Bedding & Riprap	Site Preparation	1/3/2030	6/3/2030	5.00	108	—
Ground Improvement	Grading	1/3/2030	7/13/2032	5.00	659	—
Earthfill	Grading	1/3/2030	11/12/2030	5.00	224	—
Raise	Building Construction	1/3/2030	10/15/2030	5.00	204	—
Sheetpile Driving	Building Construction	1/3/2030	9/10/2030	5.00	179	—
H-pile	Building Construction	1/3/2030	3/1/2030	5.00	42.0	—

Steel Pile	Building Construction	1/3/2030	6/4/2031	5.00	370	—
Concrete Truck	Building Construction	1/3/2030	10/24/2030	5.00	211	—

5.2. Off-Road Equipment

5.2.1. Unmitigated

Phase Name	Equipment Type	Fuel Type	Engine Tier	Number per Day	Hours Per Day	Horsepower	Load Factor
Demo C&A	Tractors/Loaders/Backhoes	Diesel	Average	1.00	8.00	84.0	0.37
Demo C&A	Tractors/Loaders/Backhoes	Diesel	Average	1.00	8.00	84.0	0.37
Demo Structures	Tractors/Loaders/Backhoes	Diesel	Average	1.00	8.00	84.0	0.37
Demo Structures	Tractors/Loaders/Backhoes	Diesel	Average	1.00	8.00	84.0	0.37
Bedding & Riprap	Rubber Tired Dozers	Diesel	Average	1.00	3.00	367	0.40
Bedding & Riprap	Excavators	Diesel	Average	1.00	8.00	36.0	0.38
Ground Improvement	Cement and Mortar Mixers	Diesel	Average	1.00	8.00	10.0	0.56
Earthfill	Graders	Diesel	Average	1.00	4.00	148	0.41
Earthfill	Rollers	Diesel	Average	1.00	8.00	36.0	0.38
Raise	Cranes	Diesel	Average	1.00	8.00	367	0.29
Sheetpile Driving	Other General Industrial Equipment	Diesel	Average	1.00	8.00	35.0	0.34
Sheetpile Driving	Cranes	Diesel	Average	1.00	8.00	367	0.29
Sheetpile Driving	Off-Highway Trucks	Diesel	Average	1.00	8.00	376	0.38
H-pile	Other General Industrial Equipment	Diesel	Average	1.00	8.00	35.0	0.34
H-pile	Cranes	Diesel	Average	1.00	8.00	367	0.29

Steel Pile	Other General Industrial Equipment	Diesel	Average	1.00	16.0	35.0	0.34
Steel Pile	Cranes	Diesel	Average	1.00	8.00	367	0.29
Concrete Truck	Cement and Mortar Mixers	Diesel	Average	1.00	21.0	10.0	0.56

5.3. Construction Vehicles

5.3.1. Unmitigated

Phase Name	Trip Type	One-Way Trips per Day	Miles per Trip	Vehicle Mix
Demo C&A	—	—	—	—
Demo C&A	Worker	10.0	11.7	LDA,LDT1,LDT2
Demo C&A	Vendor	0.00	8.40	HHDT,MHDT
Demo C&A	Hauling	2.31	20.0	HHDT
Demo C&A	Onsite truck	0.00	—	HHDT
Demo Structures	—	—	—	—
Demo Structures	Worker	5.00	11.7	LDA,LDT1,LDT2
Demo Structures	Vendor	0.00	8.40	HHDT,MHDT
Demo Structures	Hauling	16.0	20.0	HHDT
Demo Structures	Onsite truck	0.00	—	HHDT
Bedding & Riprap	—	—	—	—
Bedding & Riprap	Worker	5.00	11.7	LDA,LDT1,LDT2
Bedding & Riprap	Vendor	0.00	8.40	HHDT,MHDT
Bedding & Riprap	Hauling	40.0	20.0	HHDT
Bedding & Riprap	Onsite truck	0.00	—	HHDT
Ground Improvement	—	—	—	—
Ground Improvement	Worker	10.0	11.7	LDA,LDT1,LDT2
Ground Improvement	Vendor	0.00	8.40	HHDT,MHDT

Ground Improvement	Hauling	2,000	20.0	HHDT
Ground Improvement	Onsite truck	0.00	—	HHDT
Earthfill	—	—	—	—
Earthfill	Worker	30.0	11.7	LDA,LDT1,LDT2
Earthfill	Vendor	0.00	8.40	HHDT,MHDT
Earthfill	Hauling	95.8	20.0	HHDT
Earthfill	Onsite truck	1.00	19.2	HHDT
Raise	—	—	—	—
Raise	Worker	3.00	11.7	LDA,LDT1,LDT2
Raise	Vendor	0.00	8.40	HHDT,MHDT
Raise	Hauling	0.00	20.0	HHDT
Raise	Onsite truck	0.00	—	HHDT
Sheetpile Driving	—	—	—	—
Sheetpile Driving	Worker	8.00	11.7	LDA,LDT1,LDT2
Sheetpile Driving	Vendor	0.00	8.40	HHDT,MHDT
Sheetpile Driving	Hauling	0.00	20.0	HHDT
Sheetpile Driving	Onsite truck	0.00	—	HHDT
H-pile	—	—	—	—
H-pile	Worker	5.00	11.7	LDA,LDT1,LDT2
H-pile	Vendor	0.00	8.40	HHDT,MHDT
H-pile	Hauling	1.00	20.0	HHDT
H-pile	Onsite truck	0.00	—	HHDT
Steel Pile	—	—	—	—
Steel Pile	Worker	25.0	11.7	LDA,LDT1,LDT2
Steel Pile	Vendor	0.00	8.40	HHDT,MHDT
Steel Pile	Hauling	1.00	20.0	HHDT
Steel Pile	Onsite truck	0.00	—	HHDT

Concrete Truck	—	—	—	—
Concrete Truck	Worker	15.0	11.7	LDA,LDT1,LDT2
Concrete Truck	Vendor	0.00	8.40	HHDT,MHDT
Concrete Truck	Hauling	0.00	20.0	HHDT
Concrete Truck	Onsite truck	0.00	—	HHDT

5.5. Architectural Coatings

Phase Name	Residential Interior Area Coated (sq ft)	Residential Exterior Area Coated (sq ft)	Non-Residential Interior Area Coated (sq ft)	Non-Residential Exterior Area Coated (sq ft)	Parking Area Coated (sq ft)

5.6. Dust Mitigation

5.6.1. Construction Earthmoving Activities

Phase Name	Material Imported (Cubic Yards)	Material Exported (Cubic Yards)	Acres Graded (acres)	Material Demolished (Building Square Footage)	Acres Paved (acres)
Demo C&A	0.00	0.00	0.00	35,981	—
Demo Structures	0.00	0.00	0.00	2,735	—
Ground Improvement	5,272,500	5,272,500	0.00	0.00	—
Earthfill	85,829	85,829	56.0	0.00	—

5.6.2. Construction Earthmoving Control Strategies

Non-applicable. No control strategies activated by user.

5.7. Construction Paving

Land Use	Area Paved (acres)	% Asphalt
User Defined Industrial	0.00	0%

5.8. Construction Electricity Consumption and Emissions Factors

kWh per Year and Emission Factor (lb/MWh)

Year	kWh per Year	CO2	CH4	N2O
2030	0.00	204	0.03	< 0.005
2031	0.00	204	0.03	< 0.005
2032	0.00	204	0.03	< 0.005

8. User Changes to Default Data

Screen	Justification
Construction: Construction Phases	Applicant provided information.
Land Use	Size of Wharf Area.
Construction: Off-Road Equipment	Pile drivers and hammers are categorized as "other industrial equipment."
Construction: Dust From Material Movement	Applicant provided information.
Construction: Trips and VMT	Applicant provided information.

Model Output: OFFROAD2021 (v1.0.5) Emissions Inventory
Region Type: County
Region: San Francisco
Calendar Year: 2030
Scenario: All Adopted Rules - Exhaust
Vehicle Classification: OFFROAD2021 Equipment Types
Units: tons/day for Emissions, gallons/year for Fuel, hours/year for Activity, Horsepower-hours/year for Horsepower-hours

Region	Year	Vehicle Category	Model Year	Horsepower Bin	Fuel	HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2.5_tpd	SOx_tpd	NH3_tpd	Fuel	Activity_hpy	Population	Hhpy
San Francisco	2030	Commercial Harbor Craft - AE - Barge-Other	Aggregate	Aggregate	Diesel	0.00036	0.00044	0.00053	0.00223	0.00876	1.44121	0.00015	0.00014	0.00000	0.00000	48128.69	17558.41	41.80	874232.96
San Francisco	2030	Commercial Harbor Craft - AE - Tugboat-Push/Tow	Aggregate	Aggregate	Diesel	0.00202	0.00245	0.00291	0.00814	0.03921	4.50498	0.00060	0.00057	0.00000	0.00000	147699.92	82287.91	63.21	2567697.83
San Francisco	2030	Commercial Harbor Craft - AE - Work Boat	Aggregate	Aggregate	Diesel	0.00080	0.00097	0.00116	0.00380	0.01421	1.50429	0.00038	0.00036	0.00000	0.00000	55715.07	24160.46	33.75	1002884.24
San Francisco	2030	Commercial Harbor Craft - ME - Tugboat-Push/Tow	Aggregate	Aggregate	Diesel	0.00629	0.00761	0.00906	0.04163	0.13209	32.72001	0.00192	0.00184	0.00000	0.00000	1074232.57	76708.86	69.37	20390843.11
San Francisco	2030	Commercial Harbor Craft - ME - Work Boat	Aggregate	Aggregate	Diesel	0.00373	0.00451	0.00537	0.01421	0.06222	6.41588	0.00129	0.00124	0.00000	0.00000	238082.91	37246.55	58.29	4446184.92

		HC_tpd	ROG_tpd	TOG_tpd	CO_tpd	NOx_tpd	CO2_tpd	PM10_tpd	PM2.5_tpd	SOx_tpd	NH3_tpd
Commercial Harbor Craft - Tugboat-Push/Tow	Tons/year	0.43	0.52	0.61	2.20	8.38	1075.11	0.19	0.18	0.00	0.00
Commercial Harbor Craft - Work Boat	Tons/year	3.04	3.67	4.37	18.17	62.52	13587.12	0.92	0.88	0.00	0.00
Commercial Harbor Craft - Barge-Other	Tons/year	1.36	1.65	1.96	5.19	22.71	2341.80	0.47	0.45	0.00	0.00
Commercial Harbor Craft - Tugboat-Push/Tow	Tons/hour	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
Commercial Harbor Craft - Work Boat	Tons/hour	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00
Commercial Harbor Craft - Barge-Other	Tons/hour	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00

	hrs/day	
Commercial Harbor Craft - Tugboat-Push/Tow		16
Commercial Harbor Craft - Work Boat		16
Commercial Harbor Craft - Barge-Other		16

CalEEMod Schedule					Tons (2030)						Tons (2031)					
CalEEMod Schedule					ROG	NOx	CO	PM10	PM2.5	SO2	ROG	NOx	CO	PM10	PM2.5	SO2
Phase	Type	Start	End	Days												
Demo C&A	Demolition	1/3/2030	9/10/2030	179												
Demo Structures	Demolition	1/3/2030	1/4/2030	2												
Raise	Building Construction	1/3/2030	10/15/2030	204												
Ground Improvement	Grading	1/3/2030	7/13/2032	659												
Earthfill	Grading	1/3/2030	11/12/2030	224	0.13	2.13	0.60	0.04	0.04	0.00						
Bedding & Riprap	Site Preparation	1/3/2030	6/3/2030	108	0.06	1.03	0.29	0.02	0.02	0.00						
Sheetpile Driving	Building Construction	1/3/2030	9/10/2030	179	0.23	3.45	0.88	0.07	0.06	0.00						
H-Pile	Building Construction	1/3/2030	3/1/2030	42	0.05	0.81	0.21	0.02	0.01	0.00						
Steel Pile	Building Construction	1/3/2030	6/4/2031	370	0.33	4.99	1.27	0.10	0.09	0.00	0.14	2.14	0.54	0.04	0.04	0.00
Concrete Truck	Building Construction	1/3/2030	10/24/2030	211												

12/31/2030	259
6/4/2041	111

SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY, CA

DRAFT APPENDIX D-3 National Historic Preservation Act Compliance

JANUARY 2024

USACE TULSA DISTRICT | THE PORT OF SAN FRANCISCO

US Army Corps of Engineers

PORT OF SAN FRANCISCO

List of Sub-Appendices

D-3-1: Programmatic Agreement

D-3-2: Agency and Tribal Coordination (to be added in the final)

Appendix D-3-1 Programmatic Agreement

PROGRAMMATIC AGREEMENT
REGARDING COMPLIANCE WITH SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT FOR
THE SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY
IN
SAN FRANCISCO COUNTY, CALIFORNIA
AMONG
THE U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT,
THE CALIFORNIA STATE HISTORIC PRESERVATION OFFICER,
AND
THE PORT OF SAN FRANCISCO

WHEREAS, the U.S. Army Corps of Engineers, Tulsa District (USACE) has determined that new construction, improvements to existing facilities, and maintenance of existing facilities of the Port of San Francisco Waterfront (hereinafter, “undertaking”) has a potential to affect historic resources that are listed in or eligible for listing in the National Register of Historic Places (NRHP) (hereinafter, “historic properties”) pursuant to Section 106 of the National Historic Preservation Act (54 U.S.C. § 306108) (NHPA), as amended, and its implementing regulations (36 CFR 800); and

WHEREAS, the San Francisco Waterfront Study was authorized by the Section 110 of the Rivers and Harbors Act of 1950 and Section 705 of the Water Resources and Development Act of 1986, and Section 203 of the Water Resources Development Act of 2020; and

WHEREAS, the USACE will partner with the non-federal sponsor, the Port of San Francisco, (NFS) for the development and construction of this undertaking, and who will provide the necessary lands, easements, relocations, and rights-of-way; and

WHEREAS, the undertaking consists of an integrated and coordinated approach for reducing coastal flood risk through structural measures, including berms, floodwalls, tide gates, and elevating structures and buildings, and nonstructural measures, including floodproofing or relocating buildings and structures, and property acquisition.;
and

WHEREAS, the size of the project area and the number of alternatives being studied for proposed improvements make it necessary to defer final identification and evaluation of historic properties until authorization of proposed improvements is obtained; and

WHEREAS, the Area of Potential Effect (APE) shall be established by the USACE in consultation with the SHPO, Tribes, and consulting parties to include all areas that are directly or indirectly affected by the undertaking; and

WHEREAS, this Programmatic Agreement (PA) is being executed to describe the process the USACE and the NFS will utilize to inventory and evaluate historic properties, and assess and resolve adverse effects prior to construction and maintenance; and

WHEREAS, the USACE, and the California State Historic Preservation Officer (SHPO) have agreed that it is advisable to execute this PA for the purposes stated above in accordance with 36 CFR 800.6 and 36 CFR 800.14(b)(1)(ii); and

WHEREAS, the USACE will invite the NFS to participate as signatories to this agreement; and

WHEREAS, the USACE will invite the Advisory Council on Historic Preservation (Council) to participate; and

WHEREAS, although there are no federally recognized Tribes within San Francisco County, California, in accordance with 36 C.F.R. § 800.2 (a)(4), the USACE will invite the Tribal consulting parties, Amah Mutsun Tribal Band of Mission San Juan Bautista, Amah-Mutsun Tribal Band, Association of Ramaytush Ohlone, Costanoan-Rumsen Carmel Tribe, Indian Canyon Mutsun Band of Costanoan, Muwekma Ohlone Indian Tribe of the San Francisco Bay Area, The Ohlone Indian Tribe, Rumšen Am:a Tur:ataj Ohlone, Wuksache Indian Tribe/Eshom Valley Band (hereinafter, "Tribes", to participate in the development and execution of this PA; and

WHEREAS, in accordance with 36 C.F.R. § 800.2 (a)(4), the USACE will invite the consulting parties, the California Preservation Foundation, Dogpatch Neighborhood Association, National Park Service, National Trust for Historic Preservation, San Francisco Architectural Heritage, San Francisco Historic Preservation Commission, South Beach Rincon Mission Bay Neighborhood Association, Telegraph Hill Dwellers Neighborhood Association, to participate in the development and execution of this PA.; and

WHEREAS, the USACE will involve the public through public notices and meetings in accordance with 36 C.F.R. § 800.2(d)(3) and 40 C.F.R. § 1506.6.

NOW, THEREFORE, the USACE, SHPO, and NFS agree that the proposed undertaking shall be implemented and administered in accordance with the following stipulations in order to take into account the effects of the undertaking on historic properties and to satisfy the USACE's Section 106 responsibilities for all individual aspects of the undertaking.

STIPULATIONS

I. Scope of Undertaking

A. Scope of Undertaking. This PA shall be applicable to all new construction, improvements, and maintenance activities related to the proposed undertaking. The APE shall be established by the USACE in consultation with the SHPO, Tribes, and consulting parties and shall include all areas to be directly or indirectly affected by new construction, construction staging and access areas, new or extensions of existing storm or flood risk management features, ecological mitigation features, and project maintenance activities. A description and map of the proposed project footprint is provided in the attached Project Summary

B. Qualifications and Standards. The USACE shall ensure that all work conducted in conjunction with this PA is performed in a manner consistent with the Secretary of Interior's "Standards and Guidelines for Archeology and Historic Preservation" (48 FR 44716-44740; September 23, 1983), as amended, or the Secretary of the Interior's "Standards for the Treatment of Historic Properties" (36 CFR 68), as appropriate.

C. Definitions. The definitions set forth in 36 CFR 800.16 are incorporated herein by reference and apply throughout this PA.

II. Identification of Historic Properties

Prior to the initiation of construction, the USACE shall make a reasonable and good faith effort to identify historic properties located within the APE. These steps may include, but are not limited to, background research, consultation, oral history interviews, sample field investigations, field survey, and monitoring. The USACE will consult with the SHPO to identify individuals or organizations to invite as consulting parties. If additional consulting parties are identified, the USACE shall provide them copies of documentation specified in 36 CFR 800.11(e), subject to confidentiality provisions of 36 CFR 800.11(c). The level of effort for these activities shall be determined in consultation with the SHPO, Tribes that attach religious and cultural significance to the APE, and any consulting parties.

A. Programmatic Historic Properties Management Plan

1. After the initiation of the Preconstruction Engineering and Design Phase, and upon receipt of funding, the USACE, in consultation with SHPO, the Tribes, and all consulting parties, will prepare a Programmatic Historic Properties Management Plan (PHPMP) that will guide the overall technical work stipulated in this Agreement. This document will provide an overarching research framework for the Section 106 compliance and agreement implementation undertaken for the Project.

2. The USACE will provide a hard-copy draft PHPMP for review via mail, or an electronic copy via email, to all consulting parties to the PA. Unless otherwise stipulated, any written comments provided by the consulting parties to the PA within 30 calendar days from the date of receipt will be considered in the revision of the document.

3. The USACE will provide the final document to the SHPO, Tribes, and all consulting parties for review and concurrence. The SHPO, Tribes, and all consulting parties will have 30 days to respond. If the SHPO, Tribes, and all consulting parties determine that the final document does not meet 36 CFR 800.11(a) standards, the USACE will continue to consult with the SHPO, Tribes, and all consulting parties as applicable.

4. The PHPMP will include, but is not limited to:

   i. A research design for the identification and evaluation of known and potential historic properties in the APE.
   ii. The methods that will be used to establish the APE under consideration for each phase of work.
   iii. A description of the inventory and NRHP evaluation methods appropriate for each historic property type and each phase of work.
   iv. Methods used to assess the Project's effects on historic properties.
   v. A description of the general types of treatment, avoidance, minimization, or mitigation that will be considered to resolve adverse effects to historic properties.
   vi. Resource-specific treatment for resources with unique characteristics and where using a general property type approach is not appropriate.
   vii. An overall Project outreach and communication plan detailing how Native American Tribes and other Potential Interested Parties will be engaged during each phase of work.
   viii. Procedures for the curation of recovered materials.
   ix. Procedures to be followed in the event of unanticipated discoveries including the recovery and treatment of Native American and non-Native American human remains.
   x. Native American Graves Protection and Repatriation Act (NAGPRA) Plan of Action to address portions of the Project situated on federal property; and
   xi. Requirements for public interpretation and dissemination of results from cultural resource studies.

B. Reports of Investigations

The USACE shall provide the results of investigations in a draft report(s) to the SHPO, Tribes, and all consulting parties for review and comment. Comments received by the USACE from the SHPO, Tribes, or consulting parties shall be addressed in subsequent draft report(s), which shall be provided to all consulting parties for review. If comments on the draft report(s) by the SHPO, Tribes, and any consulting parties are not received by the USACE within thirty (30) days of receipt, the reports and their recommendations shall be considered adequate and the reports may be finalized. The USACE shall provide a final report(s) of all investigations to the SHPO, Tribes, and any consulting parties. If no historic properties are identified in the APE, the USACE shall document this finding pursuant to 36 CFR 800.11(d), provide this documentation to the SHPO, Tribes, and any consulting parties.

III. Evaluation of National Register of Historic Places.

If cultural resources are identified within the APE, the USACE shall determine their eligibility for inclusion in the NRHP in accordance with the process described in 36 CFR 800.4(c) and criteria established in 36 CFR 60. NRHP evaluations of cultural resources shall be conducted by individuals that meet or exceed the *Secretary of Interior's Standards and Guidelines for Archeology and Historic Preservation* (48 Fed. Reg. 44738-44739, September 29, 1983).

All draft reports of NRHP site testing or other NRHP investigations shall be submitted to the SHPO, Tribes, and any consulting parties for review and comment. Comments received by the USACE from the SHPO, Tribes, or any consulting parties shall be addressed in subsequent draft report(s), which shall be provided to all consulting parties for review. If comments on the draft report(s) by the SHPO, Tribes, and any consulting parties are not received by the USACE within thirty (30) days of receipt, the reports and their recommendations shall be considered adequate, and the reports may be finalized. Determinations of eligibility for inclusion in the NRHP shall be conducted in consultation with the SHPO, Tribes, and any consulting parties. Should the USACE, SHPO, and Tribes agree that a cultural resource is or is not eligible, then such consensus shall be deemed conclusive for the purpose of this PA. Should the USACE, SHPO, and Tribes not agree regarding the eligibility of a cultural resources, the USACE shall obtain a determination of eligibility from the Keeper of the National Register pursuant to 36 CFR 63. For cultural resources found not eligible for inclusion in the NRHP, no further protection or consideration of the site will be afforded for compliance purposes.

IV. Assessment of Effects.

A. No Historic Properties Affected
The USACE shall make a reasonable and good faith effort to evaluate the effect of the undertaking on historic properties in the APE. The USACE may conclude that no historic properties are affected by an undertaking if no historic properties are present in the APE, or the undertaking will have no effect as defined in 36 CFR 800.16(i). This finding shall be documented in compliance with 36 CFR 800.11(d) and the documentation shall be provided to the SHPO, Tribes, and any consulting parties for concurrence. The USACE shall provide information on the finding to the public upon request, consistent with the confidentiality requirements or 36 CFR 800.11(c).

B. Finding of No Adverse Effect. The USACE, in consultation with the SHPO, Tribes, and any consulting parties, shall apply the criteria of adverse effect to historic properties within the APE in accordance with 36 CFR 800.5. The USACE may propose a finding of no adverse effect if the undertaking's effects do not meet the criteria of 36 CFR 800.5(a)(1) or the undertaking is modified to avoid adverse effects in accordance with 36 CFR 68. The USACE shall provide to the SHPO, Tribes, and any consulting parties documentation of this finding meeting the requirements of 36 CFR 800.11(e). The SHPO, Tribes, and any consulting parties shall have 30 days in which to review the findings and provide a written response to the USACE. The USACE may proceed upon receipt of written concurrence from the SHPO, Tribes, and any consulting parties. Failure of the SHPO, Tribes, and any consulting parties to respond with 30 calendar days of receipt of the finding shall be considered agreement with the finding. The USACE shall maintain a record of the finding and provide information on the finding to the public upon request, consistent with the confidentiality requirements of 36 CFR 800.11(c).

C. Resolution of Adverse Effect. If the USACE determines that the undertaking will have an adverse effect on historic properties as measured by criteria in 36 CFR 800.5(a)(1), the USACE shall consult with the SHPO, Tribes, and any consulting parties to resolve adverse effects in accordance with 36 CFR 800.6.

   1. For historic properties that the SHPO, Tribes, and any consulting parties agree will be adversely affected, the USACE shall:

      i. Afford the public an opportunity to express their views on resolving adverse effects in a manner appropriate to the magnitude of the project and its likely effects on historic properties.
      ii. Consult with the SHPO, Tribes, and any consulting parties to seek ways to avoid, minimize or mitigate adverse effects.
      iii. Prepare a historic property treatment plan (Plan) which describes mitigation measures the USACE proposes to resolve the undertaking's adverse effects and provide this Plan for review and comment to all consulting parties. All parties have 30 days in which to provide a written response to the USACE.

   2. If the USACE, SHPO, Tribes, and any consulting parties fail to agree on how adverse effects will be resolved, the USACE shall request that the Council join the consultation and provide the Council and all consulting parties with documentation pursuant to 36 CFR 800.11(g).
   3. If the Council agrees to join the consultation, the USACE shall proceed in accordance with 36 CFR 800.9.

   4. If, after consulting to resolve adverse effects, the Council, the USACE, the SHPO, Tribes, and any consulting parties determines that further consultation will not be productive, then any party may terminate consultation in accordance with the notification requirements and processes prescribed in 36 CFR 800.7.

V. Curation and Disposition of Recovered Materials, Records, and Reports

A. Curation. The USACE shall ensure that all archeological materials and associated records owned by the U.S Government, the State of California, or any non-federal sponsor, which result from identification, evaluation, and treatment efforts conducted under this PA, are accessioned into a curation facility in accordance with the standards of 36 CFR 79, except as specified in Stipulation IV for human remains. The curation of items owned by the State of California, or any non-federal sponsor, shall be maintained in perpetuity by the non-federal sponsor. Archeological items and materials from privately owned lands shall be returned to their owners upon completion of analyses required for Section 106 compliance under this PA.

B. Reports. The USACE shall provide copies of final technical reports of investigations and mitigation to the SHPO, Tribes, and consulting parties, as well as additional copies for public distribution. All consulting parties shall withhold site location information or other data that may be of a confidential or sensitive nature pursuant to 36 CFR 800.11(c).

VI. Treatment of Native American Human Remains

A. Prior Consultation. If the USACE's investigations, conducted pursuant to Stipulation I of this PA, indicate a high likelihood that Native American Indian human remains may be encountered, the USACE shall develop a treatment plan for these remains in consultation with the SHPO and Tribes. The USACE shall ensure that Tribes indicating an interest in the undertaking are afforded a reasonable opportunity to identify concerns, provide advice on identification and evaluation, and participation in the resolution of adverse effects in compliance with the terms of this PA.

B. Inadvertent Discovery. Immediately upon the inadvertent discovery of human remains during historic properties investigations or construction activities conducted pursuant to this PA, the USACE shall ensure that all ground disturbing activities cease in the vicinity of the human remains and any associated grave goods and that the site is secured from further disturbance or vandalism. The USACE shall be responsible for immediately notifying local law enforcement officials, and within 48 hours of the discovery, shall initiate consultation with the SHPO and Tribes to develop a plan for resolving the adverse effects.

The USACE shall treat Native American human remains, objects of cultural patrimony, and sacred objects encountered during any activities of this undertaking on non-federal lands in accordance with the requirements of Section 7050.5 of the California State Health and Human Safety Code, and Section 5097.98 of the Public Resources Code.

C. Dispute Resolution. If, during consultation conducted under paragraphs A and B of Stipulation IV, all consulting parties cannot agree upon a consensus plan for resolving adverse effects, the matter shall be referred to the Council for resolution in accordance with the procedures outlines in 36 CFR 800.9.

VII. Duration

This PA remains in force for a period of fifteen (15) years from the date of its execution by all signatories, unless terminated pursuant to Stipulation VI(C) Sixty (60) days prior to the conclusion of the fifteen (15) year period, the USACE shall notify all signatories in writing of the end of the 15-year period to determine if they have any objections to extending the term of this PA. If there are no objections received prior to expiration, the PA will continue to remain in force for a new fifteen (15) year period.

VIII. Post Review Changes and Discoveries

A. Changes in the Undertaking. If the USACE determines that it will not conduct the undertaking as originally coordinated, the USACE shall reopen consultation pursuant to Stipulation I.

B. Unanticipated Discoveries or Effects. Pursuant to 36 CFR 800.13(b)(3), if cultural resources are discovered or unanticipated effects on historic properties are found after construction on an undertaking has commenced, the USACE shall stop construction in the affected area and notify the SHPO, Tribes, and the Council within 48 hours of the discovery. The notification shall include the USACE assessment of the affected properties, a determination of eligibility for inclusion in the NRHP and, if the property is determined to be eligible or if eligibility cannot be determined, recommendations for additional actions. The USACE may assume SHPO, Tribes, and the Council concurrence in its eligibility assessment unless otherwise notified by the SHPO, Tribes, and the Council within 48 hours of notification. If, in consultation with the SHPO, Tribes, and the Council, additional actions are recommended, the USACE shall develop a treatment plan to evaluate eligibility and/or resolve any adverse effects. The USACE shall submit the draft treatment plan to the SHPO, Tribes, and the Council for review and concurrence. USACE shall provide the SHPO, Tribes, and the Council a report documenting all decisions and any actions taken, the results of any investigations, and final determinations when they are completed.

IX. PA Amendments, Disputes and Termination

A. Amendments. Any party to the PA may propose to the other parties that it be amended, whereupon the parties will consult in accordance with 36 CFR 800.6(c)(7) to consider such an amendment. The amendment will be effective on the date a copy signed by all of the signatories is filed with the Council.

B. Disputes. Disputes regarding the completion of the terms of this agreement shall be resolved by the signatories. If the signatories cannot agree regarding a dispute, any one of the signatories may request the participation of the Council in resolving the dispute in accordance with the procedures outlined in 36 CFR 800.9. The USACE shall forward to the Council and all consulting parties within fifteen (15) days of such a request all documentation relevant to the dispute, including the USACE's proposed resolution of the dispute. The Council will respond to the request within thirty (30) days of receiving all documentation. The USACE will take any recommendations or comments from the Council into account in resolving the dispute. In the event that the Council fails to respond to the request within thirty (30) days of receiving all documentation, the USACE may assume the Council's concurrence with its proposed resolution and proceed with resolving the dispute.

C. Termination of PA. Any party to this PA may terminate it by providing a sixty (60) day notice to the other parties, provided that the parties will consult during the period prior to the termination to seek agreement on amendments or other actions that will avoid termination. In the event of termination of this PA the USACE shall comply with the provisions of 36 CFR 800, Subpart B.

Execution of this PA and implementation of its terms evidences that the USACE has afforded the Council an opportunity to comment on the undertaking and its effects on historic properties, and that the USACE has taken into account those effects and fulfilled Section 106 responsibilities regarding the undertaking.

Colonel Timothy P. Hudson, District Engineer **Date**

Signature Page for California State Historic Preservation Officer

PROGRAMMATIC AGREEMENT
REGARDING COMPLIANCE WITH SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT FOR
THE SAN FRANCISCO WATERFRONT STUDY
IN
SAN FRANCISCO COUNTY, CALIFORNIA
AMONG
THE U.S. ARMY CORPS OF ENGINEERS, TULSA DISTRICT,
THE CALIFORNIA STATE HISTORIC PRESERVATION OFFICER,
AND
THE PORT OF SAN FRANCISCO

____

Julianne Polanco, California SHPO **Date**

Signature Page for Port of San Francisco

PROGRAMMATIC AGREEMENT
REGARDING COMPLIANCE WITH SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT FOR
THE SAN FRANCISCO WATERFRONT STUDY
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THE CALIFORNIA STATE HISTORIC PRESERVATION OFFICER,
AND
THE PORT OF SAN FRANCISCO

____

Port of San Francisco **Date**

The San Francisco Waterfront Coastal Flood Study,

San Francisco County, California

Cultural Resources and Project Summary

For the

Programmatic Agreement between the U.S. Army Corps of Engineers, Tulsa District, the California State Historic Preservation Officer, and the Port of San Francisco

1.0 Study Purpose

The US Army Corps of Engineers (USACE) has prepared a Draft Integrated Feasibility Report and Environmental Impact Statement (IFR-EIS) for the San Francisco Waterfront Coastal Flood Study that presents the results of a feasibility study to recommend to Congress coastal flood risk management (CFRM) alternatives on the San Francisco peninsula in San Francisco County, California. The study addresses the feasibility of alternatives that would reduce the risk of coastal flooding to industries and businesses critical to the Nation's economy and protect the health and safety of the coastal community. This study is being conducted under the authority of Section 110 of Rivers and Harbors Act of 1950, Section 142 of Water Resources Development Act (WRDA) 1976 as amended by Section 705 of WRDA 1986 and Section 8325 of WRDA 2022, and Section 203 of WRDA 2020 that authorize an investigation of the feasibility of providing protection against tidal and fluvial flooding and measures to adapt to rising sea levels in the City and County of San Francisco. Section 110 of the Rivers and Harbors Act of 1950 states:

> *The Secretary of the Army is hereby authorized and directed to cause preliminary examinations and surveys to be made at the following-named localities, the cost thereof to be paid from appropriations heretofore or hereafter made for such purposes : Provided, That no preliminary examination, survey, project, or estimate for new works other than those designated in this title or some prior Act or joint resolution shall be made: Provided further, That after the regular or formal reports made as required by law on any examination, survey, project, or work under way or proposed are submitted, no supplemental or additional report or estimate shall be made unless authorized by law: Provided further, That the Government shall not be deemed to have entered upon any project for the improvement of any waterway or harbor mentioned in this title until the project for the proposed work shall have been adopted by law: Provided further, That reports of surveys on beach erosion and shore protection shall include an estimate of the public interests involved, and such plan of improvement as is found justified, together with the equitable distribution of costs in each case: And provided further, That this section shall not be construed to interfere with the performance of any duties vested in the Federal Power Commission under existing law: ...San Francisco Bay, including San Pablo Bay, Suisun Bay, and other adjacent bays, and tributaries thereto, California.*

Section 142 of WRDA 1986, as amended, states:

> *SEC. 142. The Secretary of the Army, acting through the Chief of Engineers, is authorized and directed to investigate the flood and related problems to those lands lying below the plane of mean higher high water along the San Francisco Bay shoreline of San Mateo, Santa Clara, Alameda, Napa, San Francisco, Marin, Sonoma and Solano Counties to the confluence of the Sacramento and San Joaquin Rivers with a view toward determining the feasibility of and the Federal interest in providing protection against tidal and fluvial flooding. The investigation shall evaluate the effects of any proposed improvements on wildlife preservation, agriculture, municipal and urban interests in coordination with Federal, State, regional, and local agencies with particular reference to preservation of existing marshland in the San Francisco Bay region.*

Section 8325(b) of WRDA 2022 also states:

> *"(b) IMPLEMENTATION. — In carrying out a study under section 142 of the Water Resources Development Act of 1976 (90 Stat. 2930; 100 Stat. 4158), pursuant to section 203(a)(1)(A) of the Water Resources Development Act of 2020 (as amended by this section), the Secretary shall not differentiate between damages related to high tide flooding and coastal storm flooding for the purposes of determining the Federal interest or cost share."*

Section 203 of WRDA 2020, as amended, states:

> *San Francisco Waterfront Coastal Flood Study Draft Integrated Feasibility Report and Programmatic EIS Page 4 "a) the Secretary shall expedite the completion of the following feasibility studies, as modified by this section, and if the Secretary determines that a project that is the subject of the feasibility study is justified in a completed report, may proceed directly to preconstruction planning, engineering, and design of the project*
>
> 1. *San Francisco Bay, California – The study for flood risk reduction authorized by section 142 of the Water Resources Development Act of 1976 (90 Stat. 2930), is modified to authorize the Secretary to—*
>   a. *investigate the bay and ocean shorelines of San Mateo, San Francisco, and Marin Counties for the purposes of providing flood protection against tidal and fluvial flooding;*
>   b. *with respect to the bay and ocean shorelines of San Mateo, San Francisco, and Marin Counties, investigate measures to adapt to rising sea levels; and*
>   c. *with respect to the bay and ocean shorelines, and streams running to the bay and ocean shorelines, of San Mateo, San Francisco, and Marin Counties, investigate the effects of proposed flood protection and other measures or improvements on—*
>   i. *the local economy;*
>   ii. *habitat restoration, enhancement, or expansion efforts or opportunities;*
>   iii. *public infrastructure protection and improvement;*
>   iv. *stormwater runoff capacity and control measures, including those that may mitigate flooding;*

v. *erosion of beaches and coasts; and*

vi. *any other measures or improvements relevant to adapting to rising sea levels.*

The study fits into the overall concept of the authorization to conduct an integrated and coordinated approach for reducing coastal flood risk through structural measures, including berms, floodwalls, tide gates, and elevating structures and buildings, and nonstructural measures, including floodproofing or relocating buildings and structures, and property acquisition. The Port of San Francisco is participating as a non-Federal sponsor. This document has been prepared to provide background information supporting coordination of a draft Cultural Resources Programmatic Agreement. Information is presented on the proposed project, the area of potential effects (APE), cultural resources in the study area, and potential project effects on these properties.

2.0 Environmental Setting

The study area is at the northern margin of the San Francisco Peninsula, a landform that is composed primarily of uplifted marine sedimentary rock, with local accumulations of Holocene-age alluvial (transported by the movement of water) and aeolian (transported by wind) deposits. During the period for which there is scientific consensus regarding human occupation of North America, a period that roughly coincides with the Holocene epoch (around 12,000 years ago), the area underwent a series of geomorphic changes with the potential to affect archaeological resource preservation and visibility. These changes were induced by sea-level rise, intertidal oscillation, wind movement of sand, and anthropogenic filling, as briefly discussed below.

At the beginning of the Holocene epoch (around 12,000 years ago), when local sea levels were significantly lower, the San Francisco Bay Area, including the APE, was a large valley with stands of trees and grassy meadows along the valley floor (Masters and Aiello 2007). The Pacific Ocean shoreline lay 30 miles west of the modern shore, just past the Farallon Islands; San Francisco Bay did not yet exist. At the beginning of the Holocene epoch, worldwide sea levels rose rapidly. Around 5,000 years ago, sea levels approached their near-modern elevations. Beginning around 10,000 to 12,000 years ago, the previously dry valley was inundated by marine water as San Francisco Bay formed. As the valley became an embayment, sediments were transported and deposited on the bay floor and bay margins by the daily oscillation of the tides (Atwater et al. 1977; Peterson et al. 2015). As the rate of sea-level rise slowed, around 4,000 years ago, silty and sandy tidal flats and marshes formed along the bay margins. While this was occurring, sands formed in dunes along the ocean coast of the San Francisco Peninsula; these were carried eastward and across the peninsula, forming a large sand dune complex over much of what is now the city of San Francisco (Peterson et al. 2015).

Wind and water continued to be the primary mechanisms for sediment transport and deposition in the APE until the middle of the nineteenth century. At that time, inhabitants of the San Francisco Peninsula began to systematically fill the shoreline to make it level for development. This extended the shoreline bayward from its pre-development location, ultimately filling the former Yerba Buena Cove in what is now the Financial District as well as Mission Bay in what is now the South of Market district (U.S. Coast and Geodetic Survey Map 1853; U.S. Department of Commerce 1946).

3.0 Cultural Setting

3.1 Prehistoric

Prior to the arrival of European settlers and the development of Spanish missions, Native American groups occupied the San Francisco Peninsula for at least 7,800 years, and probably longer. Our knowledge of the early pre-European contact period of the Bay Area is minimal because early sites along the Bayshore were presumably inundated by the rising bay.

More than 100 years of archaeological research has generated a wealth of information concerning the chronology and characteristics of Native American human adaptations in the San Francisco Bay Area (based on summaries presented in Jones & Stokes 2007; Byrd et al. 2010; ICF 2022). Most known Native American sites in San Francisco are midden deposits of shellfish and occupation debris that accumulated at locations where Native American groups resided or gathered and processed shellfish near the shores of San Francisco Bay or the ocean coast. The first generation of San Francisco Bay archeologists (Nels Nelson, Max Uhle, W. E. Schenk, and L. Loud) recorded more than 425 shellmounds around the San Francisco Bay Area and were among the first to map, excavate and characterize these shellmounds, in the early 20th century. Subsequent development often resulted in these mounds being graded away or buried as the marshy bayshore was raised and the land leveled for buildings and roads. This has resulted in partial or complete destruction or obscuring of many Native American Bay Area sites and a loss of knowledge regarding the location and condition of many sites that once existed (Jones & Stokes 2007; Byrd et al. 2010).

The following summarizes the pre-European contact period of the Bay Area by the geologic time segments Terminal Pleistocene (13,500–11,600 calibrated years before present [cal BP]), Early Holocene (11,600-7700 cal BP), Middle Holocene (7700-3800 cal BP), and Late Holocene (3800 cal BP onward), with further cultural and chronological divisions of the Late Holocene based on recent data. It should be noted that these periods are academic constructs and are not necessarily reflective of the views of the descendants of Native American peoples.

3.1.1 Terminal Pleistocene (13,500-11,600 cal BP)

The Terminal Pleistocene is largely contemporaneous with the Clovis and Folsom periods of the great plains and the southwest, and is generally considered to be represented by mobile, wide-ranging hunters and gatherers who periodically exploited large game (Haynes 2002). Throughout California, Terminal Pleistocene occupation is infrequently encountered and poorly understood and most often represented by isolated fluted points (Erlandson et al. 2007; Rondeau et al. 2007; Byrd et al. 2010); however, no fluted points or archaeological deposits dated to the Terminal Pleistocene have been documented in the Bay Area (Byrd et al. 2010). Several factors have very likely contributed to the lack of evidence of this period in the Bay Region, including what is assumed to be the small, mobile, and quickly moving nature of initial human populations, which would have been less likely to leave archaeological features on the landscape than larger, more sedentary or permanent populations. Factors such as sea level rise, coastal erosion, and localized subsidence in coastal areas, resulting in the destruction or submersal and burial of such sites (Byrd et al. 2010), also contribute to the lack of the knowledge of archaeological deposits dating to this period in the Bay Region.

3.1.2 Early Holocene (11,600-7700 cal BP)

The Early Holocene cultural landscape of Central California was characterized by semimobile hunter-gatherers exploiting a wide range of food resources from marine, lacustrine, and terrestrial contexts (Erlandson et al. 2007; Jones et al. 2002; Moratto 2002); however, little cultural evidence of the Early Holocene has been documented in the Bay Area. There are four known and dated Early Holocene sites in or near the Bay Area. All these sites were found in buried terrestrial contexts (Rosenthal and Meyer 2004:30–32); no such sites have been found to date in San Francisco and none has been documented in other bay or coastal settings (Byrd et al. 2010). This almost certainly is due to the fact that sites along the bay or coast would have been inundated as sea levels rose rapidly during this period. The recent discovery of a submerged shell midden (SFR-220) in the Mission Bay area, dated just subsequent to the end of this period, supports this hypothesis and underscores the importance of continuing geoarchaeological investigations in San Francisco in areas that were submerged pre-European contact and subsequently buried in 19th- and 20th-century land fill.

3.1.3 Middle Holocene (7700-3800 cal BP)

The Middle Holocene was characterized by a diverse range of habitation sites and artifact assemblages, which suggests higher population levels, more complex adaptive strategies, and longer seasonal occupation than during the Early Holocene (Byrd et al. 2010). More than 30 Bay Area archaeological sites have produced radiocarbon dates indicating occupation during this time period. Several isolated human burials, including three on the San Francisco Peninsula (SFR-28, SFR-205, SMA-273), and one submerged shell midden in San Francisco's Mission Bay, SFR-220, have also been dated to the Middle Holocene (Byrd et al. 2010; Lentz et al. 2018). Faunal assemblages at these sites suggest a shift toward a lacustrine and maritime focus, associated with the expansion of San Francisco Bay's estuary, mud flats, and freshwater tidal marshes during this time (Byrd et al. 2010).

3.1.4 Late Holocene (3800-170 cal BP)

The Late Holocene is generally divided into the following five main archaeological time periods: Early (4500/3800–2450 cal BP), Early-Middle Transition (2450–2050 cal BP), Middle (2050–900 cal BP), Middle-Late Transition (900–700 cal BP), and Late (700–170 cal BP). There are more than 200 documented Late Holocene sites in the Bay Area. The Early Period of the Late Holocene marks the establishment of several large shellmounds. Bay margin sites, not surprisingly, revealed a strong emphasis on marine shellfish (particularly bay mussel and oyster), marine fishes, and marine mammals, whereas interior sites revealed a strong emphasis on freshwater fish and shellfish along with terrestrial mammals (Byrd et al. 2010).

Artifacts and exotic material types suggest that an extensive trade network had been established by this time (Byrd et al. 2010). The Middle Period of the Late Holocene is characterized by greater settlement permanence (either sedentary or multi-season occupation), mound building, and increasing social complexity and ritual elaboration (Lightfoot 1997; Lightfoot and Luby 2002). Both marine and terrestrial food resources were exploited, and the consumption of acorns increased (Bartelink 2006; Bickel 1978; Greengo 1951; Wohlgemuth 2004; Byrd et al. 2010). The Late Period of the Late Holocene is the best-documented Late Holocene division. Small seed exploitation increased, as evidenced by archaeobotanical remains, and sea otters, rabbits, deer, clams, and horn snails were frequently exploited as foodstuffs. The bow and arrow first appeared during the Late Period, and extensive trade relations with neighboring groups continued. Funerary rituals were strongly patterned and included flexed interment positions and “killed” grave offerings, along with occasional cremations (Byrd et al. 2010).

3.2 Ethnographic Background

San Francisco was traditionally inhabited by the Yelamu people (Milliken 1995:260), who spoke the Ramaytush dialect of the Costanoan languages. The Costanoan languages are part of the larger Utian language family, which is part of a larger language family—the Penutian—with languages and dialects spoken by groups of Native Americans across California, Oregon, and Washington (Callaghan 1967). The Yelamu were one of eight small tribes (or tribelets) of the Ohlone people, referred to as the Costanoans by the Spanish because they lived near the coast. The territory of the Ohlone people extended along the coast from the Golden Gate Bridge in the north to just below Carmel to the south and along several inland valleys that led from the coastline (Levy 1978:485–486) to the northern tip of the San Francisco Peninsula in the late eighteenth century (Milliken 1995:260).

At the time of contact, the northern portion of the San Francisco Peninsula was composed of wind-swept dunes and coastal prairie. Here, the Yelamu were organized into three small bands who occupied various locations on the peninsula at different times of the year. Each band had its own preferred set of locations and did not appear to occupy locations traditionally inhabited by the other Yelamu bands. For example, one of the bands primarily inhabited two areas near Mission Creek, known as Sitlintac, located near the bay shore at the mouth of Mission Creek, and Chutchui, located 2 or 3 miles inland along the Mission Creek valley (thought to be near the site of Mission San Francisco). Another one of the bands appears to have used the sites Amuctac and Tubsinte, in the Visitation Valley area, and the third band appears to have used a site near the Spanish Presidio compound, near where the Golden Gate Bridge stands today. Mission records indicate that people from each of these villages were present at Mission San Francisco from 1777 to 1787 (Milliken 1995:68, 260).

The Ohlone were politically organized by tribelet, with each having a designated territory. A tribelet consisted of one or more villages and camps within a territory designated by physiographic features. Primary sources describe tribelets as small groups of people, averaging 60 to 90 individuals, located every 3 to 5 miles. As with other Ohlone tribelets, the Yelamu were primarily hunter-gatherers. The Ohlone hunted terrestrial game, such as mule deer, tule elk, pronghorn antelope, and mountain lion, setting traps for smaller game, such as rabbit and quail. Marine resources were hunted along the shores and included sea lions and whales, which were prized for their blubber. Waterfowl, a very important part of the tribal diet, were trapped along the tidal marshes. Other marine resources were collected, such as salmon, steelhead, schooled fish, and shellfish, including mussels, a major dietary staple. Tule boats were utilized to collect both salt- and freshwater marine resources. The Ohlone also used a wide range of other foods, including various seeds (the growth of which was promoted by controlled burning), buckeye, berries, roots, acorns, nuts, fruits, land and sea mammals, waterfowl, reptiles, and insects (Levy 1978:491–493; Milliken 1995:20; Milliken 1991:31; Kroeber 1925:467). To improve and maintain seasonal resource sustainability, the Ohlone actively managed the landscape: clearing the land through controlled burning, tilling, and seed broadcasting, irrigating, weeding, and pruning.

Spanish colonization and subsequent rule by Mexico in 1821 and the United States in 1848 translated into dramatic disruptions in the traditional subsistence patterns, customs, and practices of the Ohlone. In addition, European diseases caused a rapid decline in the Ohlone population (Milliken 1995). Many Native Americans were induced to join the Spanish missions and once they had joined, they were not allowed to leave. Native American neophytes (mission converts) were subject to disrupted traditional subsistence patterns and long-distance trade, physical punishment, new forms of European labor discipline, clerics' efforts to eradicate native religion, and European disease. With the secularization of the missions in Mexico, a new class of Hispanic rancho landowners found a readily exploitable supply of labor in the Indians cut loose from the patriarchal Franciscans; many of these Native Americans occupied the lower social stratum in pueblos such as the one that had taken shape around Mission Dolores.

Although they have yet to receive formal recognition from the federal government, the Ohlone persevered and are actively maintaining their ancestral heritage through political advocacy, education, and working for tribal sovereignty. Ohlone recognition and assertion began to move to the forefront during the early 20th century, enforced by two legal suits brought against the U.S. government by Indians of California (1928–1964) for reparation due them for the loss of traditional lands. The political organization necessary to mount this action on the part of Indians led to the formation of political advocacy groups throughout the state, bringing a new focus on the community and reevaluation of rights (Bean 1994:xxiv).

3.3 Historic Background

3.3.1 San Francisco’s Early Development, 1776–1850

The earliest European attempt to establish a settlement in the vicinity of San Francisco occurred in 1776 when a party led by Juan Bautista de Anza selected a location for a new garrison, or presidio, at the site currently referred to as Fort Point. Anza also selected a location for a mission. The mission site was near a stream, Arroyo de los Delores. Approximately halfway between these two locations, housing for workers was built; this area became known as Yerba Buena. Within months, additional Europeans arrived, and the settlement began to grow (Kyle 2002:350–52; Woodbridge 2006:18–21).

Following Mexico’s seizure of California in 1822, Yerba Buena continued to grow. Spanish colonization of Yerba Buena involved the creation of three types of frontier institutions: a religious complex (the mission), a military garrison (the presidio), and the civilian village (the pueblo). The Presidio of San Francisco was dedicated in September 1766, and Mission San Francisco de Asís (which would become known as Mission Dolores) was dedicated in October (Kyle 2002:350–352; Woodbridge 2006:18–21).

Yerba Buena was formally designated as a civil settlement, or pueblo, in 1835 (Bean and Rawls 2002:56, 58–70, 72; Sandos 2004:11–12, 108–09) and the bayside village grew slowly during the 1830s and early 1840s. The settlement consisted of about 20 houses belonging to foreigners and naturalized Mexican citizens grouped around a cove, an arrangement efficient for use in trade with American, Russian, and British ships (Page & Turnbull, Inc. 2007:25–26, 2009:16–17).

After the United States claimed California during the Mexican-American War in 1846, Yerba Buena’s first American mayor, Lieutenant Washington A. Bartlett, renamed the settlement San Francisco. Following the discovery of gold at Sutter’s Mill in 1848, the settlement’s population rapidly expanded, growing from fewer than 1,000 people in 1848 to nearly 35,000 in 1849. In response to this escalation, the settlement quickly grew; as early as the 1850s, land reclamation began in Mission Bay and along portions of the San Francisco shoreline to make much needed space for buildings and infrastructure (San Francisco Planning Department 2017:4.D-17).

3.3.2 San Francisco: 1860–1906

From 1860, when the first railroad began service on Market Street, to the calamitous earthquake and fire of 1906, development transformed San Francisco from a frontier port city to a modern Victorian city. Private investment in industry, commerce, and improved transportation helped fuel this growth. Although few individuals became truly wealthy from the Gold Rush, those who made fortunes after 1860 from railroad development, real estate, banking, and the Comstock Lode increasingly made San Francisco their homes, including William C. Ralston and Darius O. Mills of the Bank of California and Leland Stanford, one of the "Big Four," who organized the Central Pacific Railroad (later the Southern Pacific Railroad) and completed the first transcontinental railroad in 1869 (Hittell 1878:366, 429; Scott 1959/1985:50–51).

While San Francisco spread to the west and south, with increasing density, Market Street became the grand avenue that Jasper O'Farrell, the city's first surveyor, had envisioned. Although the financial district remained concentrated north of Market Street, by the last decades of the nineteenth century Market Street had come to function as the main circulation artery for both the city's transit system and its commercial culture (Olmsted 1991:14). San Francisco Cable Cars began operations in 1873 and eventually expanded its system to include a powerhouse and car barn, a fleet of cable cars, and embedded tracks and cables. By 1899, cable cars were running on approximately 10 miles of city streets in downtown San Francisco.

The property types that emerged from pre-1906 development in downtown and near the waterfront included the mostly wood-frame commercial buildings that served adjacent transit lines but also masonry buildings, which were constructed with greater regularity near the turn of the twentieth century (Page & Turnbull 2009:46). The Ferry Building (originally known as the Union Depot and Ferry House) was constructed between 1894 and 1903 in the Neoclassical style at Market Street's northeastern terminus. The building marked an entry point to the city for ferry passengers. Industrial, commercial, and shipping development was positioned strategically within proximity to the waterfront. These property types included offices for shipping agents; ship chandlers; working-class residences, mostly lodging houses; suppliers of construction materials, such as coal and lumber; grocery and liquor stores; and buildings for light manufacturing (Sanborn Fire Insurance Maps 1887, Volume 1; Woodbridge 1988:75).

3.3.3 1906 Disaster and Reconstruction, 1906–1920

On April 18, 1906, San Francisco experienced an earthquake that caused a series of devastating fires. Reconstruction efforts included repairing or replacing utility infrastructure throughout San Francisco's core. Along with new streets, sidewalks, and sewers, San Francisco built the Auxiliary Water Supply System (AWSS) between 1908 and 1913. The fire-suppression system relied on high-pressure water hydrants and cisterns, among other elements, to prevent future fires from spreading (no author 1922).

Replacing infrastructure and utilities in downtown San Francisco occurred in tandem with returning the city's transit system to operation as quickly as possible. Market Street's cable car system was swiftly rebuilt (Ute et al. 2011:11–12). In 1909, the first municipally owned streetcar system in the United States was built along Geary Street from Market Street to the Richmond District; by 1913, it extended to the Ferry Building, replacing horse car service on Market Street (Ute et al. 2011:7; Laubscher 2016; Ute et al. 2011:24). Soon after, traffic lights were introduced on Market Street, and the San Francisco Municipal Railway (Muni) expanded rail service into the city's many residential districts (Ute et al. 2011:52). Railroad companies, such as the Southern

Pacific Railroad, also expanded their services in the early twentieth century along San Francisco's ports (Ver Planck Historic Preservation Consulting 2018:4, 28).

Large buildings that survived the 1906 earthquake and fires (such as the Chronicle Building) provided models for resilient construction methods, which were replicated in the new downtown district of San Francisco. After 1906, larger steel-frame buildings with fireproof concrete or masonry skins multiplied dramatically along Market Street and across San Francisco. By 1909, San Francisco had 20,500 new buildings, a large number of which accounted for approximately half of the steel-frame and concrete buildings constructed in the United States by that year (Corbett 1979:27–28, 32, 34; Woodbridge 1988:75–77). Amid the devastation of 1906, financial interests and better-funded surviving businesses were able to acquire new property from less-fortunate owners. The Financial District expanded and pushed the warehouse district along The Embarcadero south of Market Street (Corbett 1979:35; Kelley and VerPlanck 2008:43).

3.3.4 San Francisco Boom to Bust to World War II, 1920–1945

During the economic boom years of the 1920s, nationwide economic growth and business prosperity encouraged Market Street planners to include public spaces that reflected the consumer-oriented mass culture; this continued through World War II (ICF International 2016:4–22). Increasing numbers of white-collar corporate workers occupied the newer and larger office buildings downtown (Faragher et al. 2001:427–35; Tim Kelley Consulting 2011:19, 27–31, 35).

The 1930s and early 1940s are remembered as a period of extensive federally funded public works projects that were associated with President Roosevelt and his close advisers known as the "Brain Trust," the New Deal, and World War II mobilization. However, the built environment of downtown San Francisco was not dramatically altered by public works projects during this period. Two of the most important New Deal–funded projects of the 1930s, construction of the San Francisco-Oakland Bay Bridge (1936) and Golden Gate Bridge (1937), dramatically increased automobile traffic in the city (Faragher et al. 2001:448–54; MIG 2015:20; Scott 1959/1985:234–29, 238; no author 1978:8–24).

Although 24 transit lines operated along Market Street, transit infrastructure remained relatively unchanged from 1920 through 1947. During that time, automobile traffic increased as personal vehicle ownership increased (Laubscher 2016). In 1930, an initiative was passed to give the private Market Street Railway Company a 25-year operating permit extension (Ute et al. 2011:61); however, in 1944, the company was purchased by its public competitor, Muni, for $7.2 million (Vielbaum et al. 2004:7).

3.3.5 Downtown San Francisco Decline and Redevelopment, 1945–1979

Like much of America, by the end of World War II, downtown San Francisco's commerce went into decline as middle-class residents fled the city for the suburbs (Tim Kelley Consulting 2011:61–63, 69–70; Scott 1959/1985:273, 280, 283–84). However, the advent of the information economy and deindustrialization aided the development of new office buildings. Beginning in the 1960s, San Francisco's blue-collar jobs decreased while white-collar jobs increased in finance and related sectors. Between the 1960s and 1980s, downtown San Francisco office space more than doubled with new construction (Godfrey 1997:317–318; Kelley & VerPlanck 2008:44–45). Many new office buildings were designed in the style that came to be known as Corporate Modernism, which favored clean horizontal lines and cubic forms that expressed their structure and function through their use of materials (Brown 2011:167, 135; Kelley and VerPlanck 2008:45).

With the establishment of the San Francisco Redevelopment Agency in 1948, San Francisco became one of the first American cities to plan for large-scale redevelopment initiatives and make use of federal funding to clear areas and neighborhoods that had been classified as slums. However, negative reaction to redevelopment gave birth to an organized opposition movement. Still, between 1948 and 1970, the San Francisco Redevelopment Agency completed eight major redevelopment projects, including Golden Gateway (Brown 2011:41; Kelley & VerPlanck 2008:46–47, 49–51; Page & Turnbull 2009:67–70). The Embarcadero Center formed the southern portion of the five-block Golden Gateway Redevelopment Project—the largest office development in San Francisco. These Modernist buildings departed from the International Style and Corporate Modernism, representing development of Late Modern architecture (Brown 2011:47, 190, 245; Kelley and VerPlanck 2008:45–46). Other San Francisco Redevelopment Agency projects within the APE included the Butchertown (now known as India Basin), Rincon Park and South Beach, and Mission Bay.

Approval of the San Francisco Bay Area Rapid Transit (BART) District in 1962 by voters spurred redevelopment of Market Street, which occurred in conjunction with construction of the BART subway system (City and County of San Francisco [City] 1967:3). The Market Street Redevelopment Plan (MSRP), which was designed and implemented between 1968 and 1979, refers to the designed landscaped areas and plazas for the section of Market Street between The Embarcadero and Octavia Boulevard. The MSRP incorporated Embarcadero Plaza, which was funded as part of the Golden Gateway Redevelopment Project (Brown 2011:148, 150, 153). Embarcadero Plaza, designed by Lawrence Halprin and completed in 1972, connected Market Street to the Ferry Building and other waterfront areas, despite the obstruction presented at the time by the elevated Embarcadero Freeway (Hirsch 2014:17).

3.4 San Francisco Waterfront Development History: 1850–Present

3.4.1 Establishment and Evolution of the Port of San Francisco

Prior to 1850, the State of California (State) controlled the San Francisco waterfront. Under State operations, Yerba Buena Cove was surveyed, divided into water lots, and sold. Wharf construction began soon after through private enterprise. In 1850, as the need for robust infrastructure expanded, waterfront ownership changed hands, with the City taking control. Piers were built as extensions to the adjacent streets and projected into the bay (U.S. Department of the Interior 2006:11). By the 1860s, San Francisco was a well-established port with an increasing need for governance and infrastructure management to keep pace with its growing maritime commerce. To facilitate consistent administration, the State resumed control of the port in 1863 and created an agency known as the Board of State Harbor Commissioners to oversee and approve development along the waterfront (U.S. Department of the Interior 2006:16–22).

By the turn of the century, major projects were approved by the Board of State Harbor Commissioners. These included the Ferry Building in 1891, the San Francisco Seawall in 1903, funding for a second seawall and the purchase of India Basin in 1909, and funding for a third seawall in 1913. The Board of State Harbor Commissioners also enabled pier construction, bulkhead wharf reconstruction, and construction of the final segments of the seawall between 1908 and 1938 (U.S. Department of the Interior 2006:16–22).

During World War II, the Port of San Francisco was the largest part of the San Francisco Port of Embarkation, which included other ports in the region. It also served as the gateway to the Pacific Theater and became the second-largest military port in the United States during the war. However, following the war, profitability declined as competition from other ports in the region, which were faster to adopt containerized shipping technologies, eroded the Port of San Francisco's long-held dominance of the Pacific coast shipping industry. The port also suffered as a result of its disconnection from the rest of the city when, in 1968, the Embarcadero Freeway was completed. The elevated freeway structure created a visual and physical barrier between the waterfront and San Francisco's Financial District. During the 1960s, many of the piers were vacant; others burned down or were demolished (San Francisco Planning Department 2011:5.5–14). In response, the San Francisco Port Authority replaced the Board of State Harbor Commissioners in 1965. In 1968, State management of the port transitioned to a new City agency, the San Francisco Port Commission (San Francisco Planning Department 2011:5.5–14) via the Burton Act.

The 1970s ushered in a new era of adaptive use and rehabilitation for port facilities. In 1989, the Embarcadero Freeway was damaged in the Loma Prieta earthquake; it was demolished by 1991. Today, The Embarcadero is an open street-level boulevard along the San Francisco waterfront. Port property includes mixed uses, such as maritime, recreational, tourism-related, commercial, light-industrial, and storage uses, along a waterfront landscape that has been recognized for its unique historic and architectural significance, including several Historic District listings (see Section 4.5 Aboveground Historic Property Findings) in the NRHP (San Francisco Planning Department 2011:5.5–15).

3.4.1.1 Transportation Development along the San Francisco Waterfront

3.4.1.1.1 Railroad Infrastructure

Initially thousands of miles from the nearest railhead, early San Franciscans relied on maritime commerce to move people and goods to and from the city. That began to change in the 1870s with the arrival of the Southern Pacific Railroad, which approached the city by way of an old San Francisco-San José Railroad right-of-way as well as ferry service from Oakland. The railroad filled in much of the bay in the Mission Bay area and built a network of lead and spur tracks to service the Union Iron Works and other industries along the waterfront. In 1890, the city's bayfront witnessed creation of the State Beltline Railroad, which transported freight along The Embarcadero. The railroad extended along the bayfront from the Presidio to Islais Creek. In 1900, Southern Pacific's monopoly on freight and passenger rail service to San Francisco was broken with the arrival of the Santa Fe Railway, which reached the city by building railheads at Oakland and Richmond, then ferrying its railcars across the bay. Santa Fe also laid tracks down Illinois Street and filled in approximately 40 acres of bay tidelands for a freight railyard. By the mid-1980s, both Southern Pacific and Santa Fe ended freight and passenger service to the city; the city's beltline shut down in 1993 (Ver Planck 2018:12-14, 48; Sanborn Fire Insurance Company n.d.).

3.4.1.1.2 Streetcars and Cable Cars

Cable cars were first introduced in San Francisco in 1873. In the years that followed, San Francisco witnessed a proliferation of cable car operations by various private companies. However, their lines were greatly damaged by the 1906 earthquake. In the years that followed, many of the city's cable car lines were rebuilt for electric streetcars, which proved more economical. Cable car service was retained only on the city's steepest hills. By the early 1940s, the city's various transit lines were consolidated and under the control of two operators: the publicly run Muni and the privately run Market Street Railway. Together, these two entities operated dozens of streetcar and cable car lines, many of which terminated at or graced the city's bayfront. In the mid-1940s, voters approved the City's purchase of the Market Street Railway. In the years that followed, numerous streetcar routes were replaced by bus routes. By the mid-1950s, only a handful of streetcar and cable car lines remained. Today, the city's bayfront is served principally by the F-Market and E-Embarcadero streetcar lines; Aquatic Park can be reached by the Powell-Hyde cable car. The city's surviving cable car infrastructure was designated a National Historic Landmark in 1964 (Arvin 2020; San Francisco Municipal Transportation Agency 2020; Dillon 1964).

3.4.1.1.3 Bridges and Freeways

Following the stock-market crash in 1929, the 1930s and early 1940s saw extensive federally funded public works projects that were associated with President Roosevelt, the New Deal, and World War II mobilization. Two of the most important New Deal–funded projects in California, the San Francisco-Oakland Bay Bridge (1936) and Golden Gate Bridge (1937), dramatically increased automobile traffic in San Francisco. In response, State and local traffic engineers hatched plans for a dramatic network of freeways and expressways that would blanket the city. Included in these plans was a freeway to be built along The Embarcadero and through North Beach and the Marina District to provide access to the Golden Gate Bridge. However, in the face of widespread community opposition in the 1950s and 1960s, only portions of the plans were realized. This included a portion of the Embarcadero Freeway, which was built in 1959. However, the freeway was damaged in the 1989 Loma Prieta earthquake and subsequently removed in the early 1990s. It was replaced by a wide multi-use urban boulevard, The Embarcadero (De Leuw, Cather & Company 1948; Congress for the New Urbanism n.d.).

3.4.1.1.4 Ferry Service

The first ferry service in San Francisco was established in 1850; it provided service to Oakland. Over the next century, ferry service expanded, with more than two dozen major transbay ferry lines serving nearly 30 destinations. The proliferation of ferry service eventually led to construction of the Union Depot and Ferry House (now the Ferry Building), located on The Embarcadero at Market Street. The depot opened in 1898 and was completed in 1903. It served as the primary hub for ferry service to and from the city. With eight ferry slips, the depot served approximately 50 million commuters and visitors every year—more than 130,000 per day. Ferry service to the city peaked in the 1930s but then declined sharply after the Bay Bridge and Golden Gate Bridge opened in 1936 and 1937, respectively. Both bridges induced more automobile travel to the city and undercut demand for ferry service. In 1978, the Ferry Building was listed in the NRHP (Carlsson n.d.; McGuire 1977).

3.4.2 Commercial and Industrial Land Use: Northeast Waterfront, Mission Bay, Dogpatch, and India Basin

Waters east of Black Point on the north shore of the peninsula lacked the deep water needed to support substantial port operations. Although the commercial and industrial businesses that began to populate the area in the 1850s included some with a less direct association with maritime commerce and more general manufacturing, some businesses did build private wharfs along the north shore. This area continued to support manufacturing as well as commercial fishing through the middle of the twentieth century (San Francisco Planning Department 2011:5.5–16, 17).

Closer to the port in Yerba Buena Cove, the Northeast Waterfront, located in the area now bound by The Embarcadero on the east, Sansome Street on the west, Broadway on the south, and Union Street on the north, was populated with commercial warehouse storage and industrial buildings for maritime uses as early as the 1850s (San Francisco Planning Department 2011:5.5–15). Brick and concrete industrial buildings associated with maritime uses were built throughout the 1960s (City of San Francisco 1983).

By the middle of the nineteenth century, waterfront development began to extend to the south, and ports and piers for shipping populated Mission Bay. Use of the area expanded quickly and included railroads and warehouses that provided land transport and storage in support of the break-bulk cargo port (Olmsted 1991:14). South of Mission Bay, Dogpatch (sometimes referred to as the Central Waterfront) was a center of industrial development early on because it was near a deep-water anchorage and, at the time, in a relatively remote location compared to the settlement of Yerba Buena.

Some of the earliest industries to populate the shoreline included a black powder factory (1854); a cordage factory (1857); several ship builders (after 1862); a rolling mill (1868); slaughterhouses, tanneries, tallow works, and butchers (after 1865); and the Union Iron Works (1883). Industrial growth along the waterfront continued prior to the turn of the century with the construction of gasworks, ironworks, food and fertilizer companies, barrel manufacturers, and canneries (San Francisco Planning Department 2001; Olmstead and Olmstead 1977).

Substantial waterfront development south of Mission Bay did not begin until the twentieth century. In 1908, Union Iron Works brought large-scale industry to Potrero Point. It was later acquired by the United States Shipbuilding Company, renamed the San Francisco Yard, and subsequently combined with the neighboring Risdon Iron & Locomotive Shipbuilding Works to create an even larger shipbuilding operation. The San Francisco Yard continued to expand its facilities through World War I (San Francisco Planning Department 2001).

At Islais Creek, marshland restricted development until 1925 when the Islais Creek Reclamation District was formed. Marshes and tidelands were filled, Islais Creek was dredged, a turning basin at the western end of the creek was created to allow ships to maneuver, and a bulkhead was constructed (San Francisco Planning Department 2001:16, 17). Farther south, India Basin developed slowly. Although there was a concentration of Chinese fishing camps from the 1860s to the 1950s, as well as various other small industries (e.g., slaughterhouses, tanneries, tallow works, butcher, shipyards, dry docks), this part of the waterfront remained relatively rural into the twentieth century (AECOM 2017:14).

During World War II, waterfront industrial facilities expanded to meet military demand. The San Francisco Yard expanded operations to provide ships and submarines in support of the war effort. At that time, it had one of the largest labor forces in the region, employing more than 18,500 workers. During that same period, several small oil companies also built facilities along the waterfront (San Francisco Planning Department 2001). Rural land around India Basin was used to build temporary housing, which accommodated the influx of labor in the shipyards during World War II (AECOM 2017:14).

Despite this war-time boom, after World War II, orders for ships at the San Francisco Yard decreased, and other industries began to shutter as manufacturing jobs moved overseas, reducing demand for industrial jobs in the region (San Francisco Planning Department 2001). Although many warehouse and manufacturing facilities associated with the city's industrial legacy were demolished, some were retained into the twenty-first century through efforts to adapt the buildings for commercial or multi-family residential uses (Port of San Francisco 2010).

3.4.3 Military Occupation and Public Recreation along the Northern Waterfront

Military occupation of Black Point began following an 1850 executive order that identified 10,000 acres of land on the San Francisco Peninsula for U.S. military use. However, it was not until 1882 that the fortification on the point became known as Fort Mason. Although the landscape was improved for new military facilities during the Civil War, the site was not ideal for defense relative to the battery fortifications farther west. As such, Fort Mason was used as a site for temporary housing for displaced citizens after the 1906 earthquake as well as used as the site for the Panama Pacific International Exposition. The fort was active during World War I and World War II, but its relevance diminished during the twentieth century. However, in 1972, Fort Mason was transitioned to the National Park Service (NPS) for recreational use. It includes an NRHP Historic District. In addition, a portion is designated as a National Historic Landmark District (National Park Service [Pacific West Region] 2010; San Francisco Planning Department 2011:5.5–18).

Use of the northern waterfront for recreation had a legacy that began in the 1880s when Black Point Cove first became a popular bathing site. As early as 1866, landscape architect Fredrick Law Olmsted advocated for creation of an aquatic park at Black Point Cove, seeing it as an ideal location for public recreational amenities. By 1931, construction of Aquatic Park began with a municipal pier, followed by facilities built by the Works Progress Administration from 1935 to 1939, including the Aquatic Park Bathhouse, amphitheater, speaker towers, convenience stations, a seawall, and promenade. In the late 1950s, the Maritime State Park was formed. In 1988, Maritime State Park and Aquatic Park were designated the San Francisco Maritime National Historical Park by the National Park Service. Much of this area was also designated as the Aquatic Park National Historic Landmark District and listed as an NRHP Historic District (San Francisco Planning Department 2011:5.5–17).

4.0 Previously Identified Resources

For the purposes of this project the USACE developed a study area that includes all areas within 1,000 feet (~300 meters) of the proposed alternatives. The study area Figure 1) is entirely within the city and county of San Francisco and extends for 7.5 miles along the waterfront between Fort Mason and Heron's Head Park, with expanded areas around Mission and Islais Creeks.

4.1 Records Search Summary

There were two records search efforts for this study to date. On July 17, 2020, a historic property records search for the study was conducted by staff of the Northwest Information Center (NWIC). The NWIC is the California Historical Resources Information System (CHRIS) repository, which houses records of previously recorded historic properties and other historical information on the APE and vicinity. The 2020

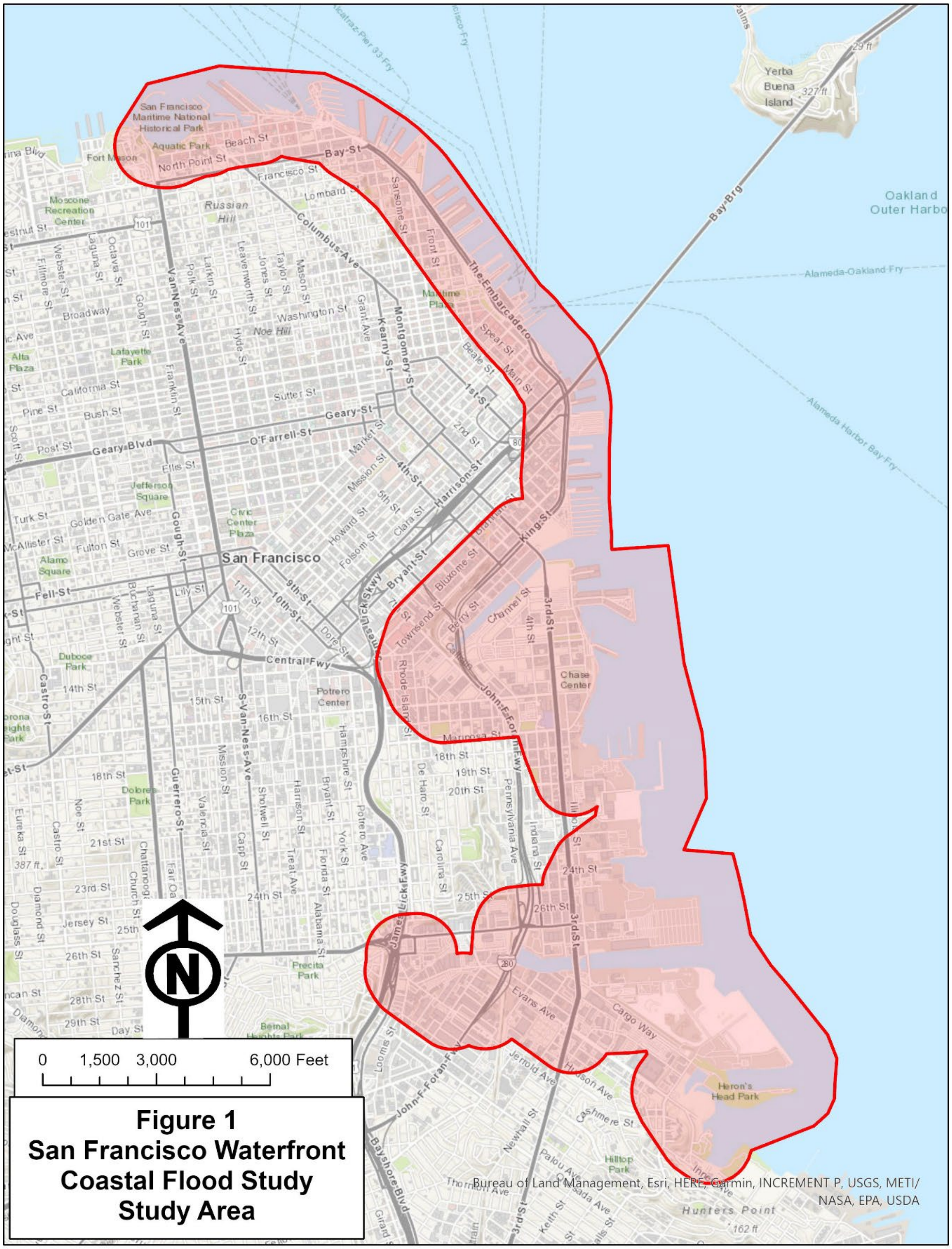

Figure 1
San Francisco Waterfront Coastal Flood Study
Study Area

records search identified previously recorded archaeological and aboveground historic properties within ⅛ mile of the alternatives footprint. This effort was repeated on March 2, 2023 for the expanded APE.

The records search was performed using data from the following sources:

- National Register of Historic Places
- California Register of Historical Resources (CRHR)
- California Inventory of Historic Resources (1976)
- California State Historical Landmarks (1996)
- San Francisco Property Information Map (PIM)
- San Francisco Built Environment Records Database (BERD)
- The results of the records search were provided in the following forms:
- Mapped locations of
- Previously recorded archaeological resources
- Previously recorded architectural resources
- Copies of Resource records for previously recorded archaeological resources
- Resource records for previously recorded architectural resources.

4.2 Background Literature Review

Recent and relevant research efforts in San Francisco were used to compile historic context statements and identify historic properties in the APE. The 2016 Cultural Landscape Evaluation, the Better Market Street Environmental Impact Report, and the NRHP informed the physical development and social contexts related to the Market Street corridor and adjacent buildings located within the APE. This research effort was performed using materials received from the San Francisco Planning Department, which included local landmark designation reports, historic maps and images, and original plans and drawings of City-owned properties located in the APE. Available surveys and historic documentation for the APE were also collected which included current and completed surveys, NRHP and CRHR historic district context statements, and Department of Parks and Recreation (DPR) 523 form sets for previously identified properties in the APE, through the San Francisco Planning Department website and through the online San Francisco Property Information Map.

The 2020 background literature review for the Auxiliary Water Supply System (AWSS) NRHP evaluation also informed the current study. The AWSS is a historic-age utility system that extends into the APE. In that study, primary and secondary sources associated with physical development of the AWSS and its historic context of fire-suppression infrastructure in San Francisco were referenced. Primary sources consulted included the following: the *San Francisco Chronicle* and *San Francisco Call*, available online through the San Francisco Public Library (SFPL) website and the California Digital Newspaper Collection, respectively; AWSS-related materials available in the SFPL Ephemera Collection; administrative materials contained in the San Francisco Public Works (SFPW) Bureau of Engineering Records collection, held by the SFPL; and scanned historical maps provided by SFPW. Secondary historical sources, recent planning studies, environmental compliance documents, and equipment/systems operations manuals prepared for City agencies, including SFPW, the San Francisco Public Utilities Commission, and the San Francisco Fire Department were also consulted.

An updated search was conducted in 2023 to inventory properties within a study area that was expanded relative to the study area that had been established in 2020. This included properties in the following categories: listed, eligible, undetermined, historic-age, and not-eligible properties. Historic contexts were not developed for all captured resources at the time. It is expected that another property identification will be necessary closer to the anticipated construction start date. All resources built up to 1990 were included as historic-age resources and therefore undetermined for listing by 2040. Chapter 6, Expectations and Methods, summarizes the process for identifying historic properties within the APE, and Chapter 7, Findings, details the results.

4.3 Methods & Findings

This chapter presents the identification methods for known historic properties within the APE, which included NWIC CHRIS record searches, San Francisco Property Information Map record review, and review of documentation available in the NPS NRHP database. Also, an analysis of archaeological sensitivity to determine as-yet unrecorded resources is presented by reach sections. This chapter also presents the findings of historic property identification yielded from identification methods, and are summarized by archaeological resources, TCPs, and aboveground historic properties. Finally, evaluation methods for the assessment of impacts on previously identified resources are introduced. Further discussion of impact and prosed alternatives are discussed in the next chapter.

4.3.1 Identification of Archaeological Historic Properties

This section provides information regarding known archaeological sites identified in the APE, based on findings from the July 17, 2020 and March 2, 2023 NWIC record searches. To facilitate review, the areas of the coast are broken down into the planning districts that the City of San Francisco established for the San Francisco Housing Element 2022 Update (ICF 2022). The section also includes an analysis of archaeological sensitivity and describes where as-yet unrecorded resources may be found. Most of the sites are categorized as “Undetermined” under the NRHP eligibility criteria. When archaeological sites are inadvertently discovered in the course of construction or utility work, they are given a unique reference number. Beyond excavation within the area to be disturbed by an alternative, inadvertently discovered sites are rarely fully excavated to determine historic significance or evaluate potential eligibility to the CRHR/NRHP.

4.3.1.1 Archaeological Sensitivity

To understand the archaeological character of the APE, this study reviews the existing literature, archival city maps, historical maps, geological reports, an updated archaeological records search, archaeological reports, and site records. For an understanding of more modern development, it reviews aerial imagery, the San Francisco Property Information Map, and records of ground disturbance and foundation types from recent building projects. These data are then used to characterize the potential archaeological resources and relative archaeological sensitivity of the study area.

A review of the Geoarchaeological Assessment and Prehistoric Site Sensitivity Model for the City and County of San Francisco, California (Meyer and Brandy 2019), reveals that much of the APE has moderate to high sensitivity for both buried and submerged prehistoric archaeological resources and low sensitivity for surface-exposed prehistoric archaeological resources. This study used a variety of factors, including pre-development distance to water, landform age, topography, and the timing of local sea-level rise. The model does not generally consider factors like the depth of historic-period ground disturbance at specific locations and therefore may not accurately reflect the archaeological site sensitivity. A more detailed project-specific analysis must be performed to define precisely archaeological site sensitivity when additional information becomes available. Furthermore, an analysis of the potential for a project to result in impacts on archaeological sites is based on the extent and depth of proposed construction-related ground disturbance relative to the potential depth at which resources may occur.

4.3.1.1.1 Marina Planning District

The Marina planning district is situated in the center of the northern end of the San Francisco Peninsula, roughly bounded by Lyon Street, California Street, Van Ness Avenue, and the shore. Only the northeast corner of this planning district is included in the APE.

There are four archaeological sites within the APE in the Marina planning district. Given the existence of these pre-European contact archaeological resources, as well as the Marina’s proximity to the shoreline, freshwater sources, and food sources, there is high likelihood for additional Native American resources to be present (Meyer and Brandy 2019). The Marina appears to have moderate to high sensitivity for pre-European contact and historic-era archaeological resources. In addition, the Marina contains areas of moderate, high, and highest near-surface, buried, and submerged resource sensitivity, especially along the shoreline.

4.3.1.1.2 Northeast Planning District

The Northeast planning district is located on the northeast edge of the San Francisco Peninsula, roughly bounded by Van Ness Avenue, Bush Street, and San Francisco Bay. The pre-European contact sensitivity analysis assessed the Northeast planning district's sensitivity for near-surface and buried sites along the original shoreline as ranging from low sensitivity to the highest level of sensitivity (Meyer and Brandy 2019). Some areas along the historic shoreline are also sensitive for potential submerged pre-European contact resources.

The historical shoreline at the base of Telegraph Hill and the original Yerba Buena Cove shoreline are considered areas with the highest levels of sensitivity; the hilltops are assessed as having the lowest pre-European contact sensitivity. Expected Native American site types for the Northeast planning district include shell middens. Isolates, such as projectile points and burials, could also be encountered. Potential historic archaeological resources include features and deposits associated with the Juana Briones adobe, early unmarked cemeteries, buried ships, wharves and piers, and 19th-century privies, wells, and trash features. Historical research themes might include maritime industries, immigration, and the gold rush. Despite the area being subject to early development, there is a potential for undocumented buried Native American archaeological sites. At least one shell midden (P-38-000023) has been noted as having been present in the planning district. The predevelopment shoreline and the area around historic freshwater sources are expected to have higher probability of containing buried undocumented Native American archaeological sites.

4.3.1.1.3 Downtown Planning District

The Downtown planning district is roughly bounded by Van Ness Avenue, Howard Street, Bush Street, and San Francisco Bay. As a result of the heightened intensity of development within the Downtown planning district, including a number of large infrastructure projects, many archaeological investigations have been conducted in recent decades. However, given the developed nature of the planning district, as well as the history of development, archaeological investigation is challenging. Most—but not all—archaeological sites or features have been disturbed by historic and modern development. Given the number of known historic-era and Native American archaeological resources present within the Downtown planning district, the planning district appears to have high sensitivity for both historic-era and Native American archaeological resources.

4.3.1.1.4 Mission Planning District

The Mission planning district is bounded by Market Street to the north, 11th Street and Central Freeway/James Lick Freeway to the east, I-280 to the south, and Dolores Street to the west. In the late 19th century, uses of the area included industrial activities, which may be reflected in sites shown on historic mapping in the eastern part of the area, including a match factory, Chinese laundry(s), and at least one lumberyard. Residences were present throughout the area by the end of the 19th century. Associated historical property types could include refuse features such as pits, privies, and wells.

Far Western's pre-European contact sensitivity model shows that the part of the Mission planning district within the APE has the highest probability with respect to finding near-surface pre-European contact deposits, due to its proximity to historical water sources. Expected Native American site types include shell middens, including sites of the ethnohistoric period. Cultural deposits from sites occupied by Native American converts may provide insights into diet, material culture, cultural change, and even social and religious life.

4.3.1.1.5 South of Market Street Planning District

The South of Market (SoMa) planning district is immediately east of the Mission planning district, roughly between U.S. 101, 25th Street, San Francisco Bay, and Howard Street. Both Yerba Buena Cove and Mission Bay were filled in to accommodate historic development; some maritime resources such as piers, wharves, or scuttled ships also may therefore be present within the former waters of Mission Bay and Yerba Buena Cove in the SoMa planning district. There is high sensitivity for submerged sites east of the historical bayshore and along the former course of Mission Creek. The highest potential is assigned to the zone within 1,225 feet (375 meters) of the pre-gold rush shoreline; high potential is assigned to the zone 1,225 feet (375 meters) to 2,500 feet (750 meters) from that historic shoreline. The Central SoMa Plan Environmental Impact Report indicates that expected Native American site types may include villages; special-use sites, such as shellfish collection camps; as well as isolated artifacts, cemeteries, and deep Early Holocene burials (Byrd et al. 2014).

Given the number of known historic-era and Native American archaeological resources present within the SoMa planning district, as well as the lack of study that has been conducted in the southern portion, the SoMa planning district appears to have a high sensitivity for both historic-era and Native American archaeological resources.

4.3.1.1.6 South Bayshore Planning District

The South Bayshore planning district is immediately south of the SoMa planning district, located between U.S. 101, San Francisco Bay, and 25th Street. Much of the original shoreline, as well as the land adjacent to freshwater sources, has high to highest potential for the discovery of pre-European contact archaeological sites; higher elevations, such as Hilltop Park, have the lowest potential (Meyer and Brandy 2019). The South Bayshore planning district is believed to include a number of near-surface Native American shell midden deposits.

The South Bayshore planning district has one of the highest concentrations of historically documented Native American archaeological sites in San Francisco. Reclaimed areas of land along the Islais Creek drainage and Yosemite Slough are highly sensitive for submerged pre-European contact sites (Byrd et al. 2014). It was also the location of significant historic-era developments during the late nineteenth and early twentieth centuries. Consequently, this planning district appears to have high sensitivity for both Native American and historical archaeological resources.

4.3.2 Identification of Aboveground Historic Properties

This section provides information on the buildings, structures, objects, sites, and districts identified in the APE. This information is based on findings from July 17, 2020, and March 2, 2023, NWIC CHRIS record searches; San Francisco Property Information Map record review; and review of documentation available in the NPS NRHP database. Aboveground historic properties identified from the San Francisco Property Information Map as being 33 years old or older (i.e., built in or before 1990) meet the NRHP age-eligibility threshold for the purposes of this study.

The first identification effort in 2020 encompassed a large portion of the current APE (refer to Figure 3). Resources were categorized as listed, historic Undetermined, or ineligible. The 2023 identification effort broadened the APE and includes resources that qualify as Section 106 historic properties (NRHP listed, NRHP eligible), resources with potential to qualify as historic properties in the future (CRHR listed, CRHR eligible, CEQA assumed eligible, historic age [Undetermined]) and resources that are not NRHP-eligible, exempt, or unknown.

4.4 Archaeological Resources Findings

This section on archaeological resources provides information on the known archaeological sites identified in the APE, based on findings from the NWIC record searches. The section also includes an analysis of archaeological sensitivity, which describes where as-yet unrecorded resources may be found. Based on the records searches, a total of 45 previously identified archaeological resources are located in or adjacent to the APE. Of these, 38 are historic-age archaeological resources 7 are prehistoric age. Table 1 summarizes the key attributes of these resources. Due to the sensitive nature of archaeological sites, each resource is categorized by planning district and ordered north to south in the table. Each resource is further categorized by NRHP eligibility.

Table 1: Archaeological Resources Summary

Planning District	State Resource Identifier (P#)	Period	Name or Description	NRHP Eligibility
Marina	P-38-000031	Prehistoric	Black, sandy midden	Undetermined
Marina	P-38-000030	Prehistoric/ Historic	Shell midden with hearths, bone, fire affected rock.	Undetermined
Marina	P-38-000075	Historic	Built in 1912, Pumping Station No. 2, San Francisco Fire Dept Auxiliary Water Supply System is Mission Revival style.	Listed

Planning District	State Resource Identifier (P#)	Period	Name or Description	NRHP Eligibility
Marina	P-38-005647	Prehistoric	Franklin Street Midden	Undetermined
Northeast	P-38-000023	Prehistoric/ Historic	Circular, fire-burnt rock, with quantities of decayed fish bones and crushed shells.	Undetermined
Northeast	P-38-000088	Historic	Tubbs Cordage Co building	Listed
Northeast	P-38-005444	Historic	N-5 Dump	Undetermined
Northeast	P-38-000095	Historic	Frederick Griffing's ship	Listed
Northeast	P-38-005499	Historic	240 Pacific Avenue	Undetermined
Northeast	P-38-004965	Historic	Thompson's Cove	Undetermined
Northeast	P-38-000126	Historic	Mid-Embarcadero Roadway Project	Eligible
Northeast	P-38-001318	Historic	*SS Jeremiah O'Brien*	Undetermined
Northeast	P-38-005450	Historic	*MV Santa Rosa* Ferryboat	Undetermined
Northeast	P-38-005683	Historic	Broadway-Vallejo Street Block (Temp No. 17-124-01)	Undetermined
Downtown	P-38-002324	Historic	The site includes two early wharf piles from the 1850s and a historic-era domestic artifact deposit from the mid-1860s.	Ineligible
Downtown	P-38-000105	Historic	1925 YMCA building in the Renaissance style with some late Italian Gothic and Moorish touches, standing eight stories tall.	Undetermined
South of Market	P-38-004306	Historic	Buried remains of a historic city block, developed as Butchertown in 1853, used for industrial purposes through 1950.	Undetermined
South of Market	P-38-004304	Historic	Bayshore Viaduct Block 5	Undetermined
South of Market	P-38-004327	Historic	SFWBA Block 7; St. Mary's Hospital	Undetermined
South of Market	P-38-005033	Historic	399 Fremont Street Privy 1	Undetermined
South of Market	P-38-004926	Historic	333 Fremont Street Feature 100	Undetermined

Planning District	State Resource Identifier (P#)	Period	Name or Description	NRHP Eligibility
South of Market	P-38-005247	Prehistoric/ Historic	201 Folsom Street	Potentially Eligible
South of Market	P-38-004493	Historic	300 Spear Street	Undetermined
South of Market	P-38-004884	Historic	Rincon Point South Beach	Undetermined
South of Market	P-38-000163	Historic	Three archaeological features associated with the marine railway operated by Henry Tichenor from 1851 to 1868.	Ineligible
South of Market	P-38-000085	Historic	The *Lydia*	Eligible
South of Market	P-38-004367	Historic	Coal Gasification Facility	Undetermined
South of Market	P-38-004368	Historic	Built between 1887 and 1889, a brick foundation wall and office floor at 170 King Street, San Francisco.	Undetermined
South of Market	P-38-004294	Historic	San Francisco Glass Works	Ineligible
South of Market	P-38-005151	Historic	The Crystal Hotel Site	Undetermined
South of Market	P-38-005501	Historic	Mission Bay Fourth Street Streetscape	Ineligible
South of Market	P-38-005101	Historic	Pier 68	Ineligible
South of Market	P-38-005102	Historic	Pier 68, Pier 3	Ineligible
South of Market	P-38-005103	Historic	Pier 68, Pier 4	Undetermined
South of Market	P-38-005452	Historic	1913 Potrero Power Plant Wharf	Undetermined
South of Market	P-38-005453	Historic	Sugar Refinery East Wharf	Undetermined
South of Market	P-38-005641	Historic	Chase Center Railcar	Undetermined
South of Market	P-38-005517	Historic	Abandoned Railroad Spurs	Undetermined
Mission	P-38-004307	Historic	Bayshore Viaduct Block 8	Undetermined
Mission	P-38-004308	Historic	Bayshore Viaduct Block 9	Undetermined
Mission	P-38-004309	Historic	Bayshore Viaduct Block 10	Undetermined
South Bayshore	P-38-005504	Historic	Core 17 historic dump	Undetermined

Planning District	State Resource Identifier (P#)	Period	Name or Description	NRHP Eligibility
South Bayshore	P-38-005445	Prehistoric	Submerged Flake	Undetermined
South Bayshore	P-38-004638	Prehistoric	Quint Street Site	Undetermined
South Bayshore	P-38-004361	Historic	Middle Point War Dwellings	Undetermined

4.5 Aboveground Historic Property Findings

This section provides information on the buildings, structures, objects, sites, and districts identified in the APE, based on findings from July 17, 2020, and March 2, 2023, NWIC CHRIS record searches, San Francisco Property Information Map record review, and review of documentation available in the NPS NRHP database. Built resources identified from the San Francisco Property Information Map as being 33 years old or older (i.e., built in or before 1990) meet the NRHP age-eligibility threshold and may be resources that will require further evaluation at a future date. Table 2 provides a summary of these resources.

Table 2: Summary of Aboveground Historic Properties

Historic Property Category	Number within the APE
NRHP Individually Listed Structures and Properties	17
NRHP Listed Districts	9
NRHP Eligible Structures	3
NRHP Eligible Districts	5
CRHR Eligible Districts	10
CEQA Historical Resources Not Yet Evaluated for NRHP Eligibility	544
Determined Not Eligible*	306
Historic Age (Undetermined)	1,191
Exempt (past 1990)	214
Exempt (vacant lots)	528

Historic Property Category	Number within the APE
Unknown (unable to identify)	8
See subsequent tables for more details regarding historic built-resource status. *Determination by San Francisco Planning Department, 2008–present.	

A total of 2,846 parcels were identified in the APE. This includes resources listed in or eligible for listing in the NRHP as well as resources listed in or eligible for listing in the CRHR, as follows:

- 17 NRHP-listed properties, and nine NRHP-listed districts;
- Three NRHP-eligible structures (bridges), and five NRHP-eligible districts;
- Nine CRHR-eligible districts;
- 544 parcels with CEQA historical resources not yet evaluated for NRHP eligibility;
- 306 properties determined not eligible for the NRHP;
- 1,191 parcels that require further research to classify them among the preceding categories because they are of historic age (i.e., constructed in 1990 or earlier) and unevaluated;
- 214 parcels exempt because parcel data indicates that they are not recorded as historic age (i.e., constructed in 1990 or later);
- 528 parcels exempt because they are vacant; and
- Eight parcels that are unknown because their geospatial location could not be determined.

Fourteen of the NRHP-listed or NRHP-eligible properties within the APE are historic districts. Four of the NRHP-listed districts are also designated as National Historic Landmarks. Of the properties that are assumed to be NRHP eligible, five are districts. Examples of the types of historic properties within the APE include maritime infrastructure such as piers, wharfs, bulkheads, and seawalls; boats; commercial and industrial buildings; transportation infrastructure; utility infrastructure; a military landscape; and recreational facilities.

4.5.1 NRHP-Listed Historic Properties

There are 28 aboveground historic properties in the APE that are listed in the NRHP, including nine historic districts and one bridge. Table 3 and Table 4 provide a summary of these resources, including the historic districts, properties, and bridge. Additional NRHP-listed properties are within some of the NRHP-listed districts. Additionally, there are five maritime NHLs (ships) within San Francisco Maritime National Historical Park and two maritime NHLs (ships) within the Port of San Francisco Embarcadero Historic District.

Table 3. NRHP-Listed Districts

Historic Property Name	NRIS Number	Number of Significant Features
Aquatic Park Historic District (NHL)	84001183	9
Central Embarcadero Piers Historic District	02001390	5
Fort Mason Historic District	72000109	9
Market Street Theatre and Loft District	86000729	32
Port of San Francisco Embarcadero Historic District	06000372	47
San Francisco Cable Car Historic District (NHL)	66000233	48
San Francisco Maritime National Historical Park (NHL)	01000281	11
San Francisco Port of Embarkation, U.S. Army Historic District (NHL)	85002433	19
Union Iron Works Historic District	14000150	33
NRIS = National Register Information System; NHL = National Historic Landmark		

Table 4. Additional NRHP Listed Resources

Historic Property Name	NRIS Number	Year Built	Resource Type	NRHP Area of Significance
San Francisco–Oakland Bay Bridge	00000525	1935	Bridge	Architecture; Engineering
Baker and Hamilton	05000001	1905	Property	Architecture

Historic Property Name	NRIS Number	Year Built	Resource Type	NRHP Area of Significance
Haslett Warehouse	75000172	1907	Property	Industry, Community Planning and Development, Commerce, Architecture
Audiffred Building	79000528	1889	Property	Commerce, Architecture
Coit Memorial Tower	07001468	1933	Property	Art
Armour & Co. Building	09001117	1900	Property	Commerce, Architecture
Fuller Company Glass Warehouse	01001101	1907	Property	Architecture
Gibb, Daniel, & Co. Warehouse	97001189	1906	Property	Architecture, Commerce, Community Planning and Development
House at 1254–1256 Montgomery Street	79000532	1962	Property	Architecture
One Lombard Street	09001300	1904	Property	Architecture
Otis Elevator Company Building	99001265	1971	Property	Engineering, Industry

Historic Property Name	NRIS Number	Year Built	Resource Type	NRHP Area of Significance
Pioneer Woolen Mills and D. Ghirardelli Company	82002249	1858; 1893; 1962	Property	Industry, Landscape Architecture, Commerce, Art, Conservation, Architecture
Pumping Station No. 2, San Francisco Fire Department AWSS	76000177	1900	Property	Community Planning and Development, Engineering
Rincon Annex	79000537	1925	Property	Art, Architecture
Irving Murray Scott School	85000714	1900	Property	Education
U.S. Customhouse	75000476	1974	Property	Architecture
Matson Building and Annex	95001384	1921	Property	Transportation, Architecture
NRIS = National Register Information System				

4.5.2 NRHP-Eligible Properties

There are five NRHP-eligible districts and three individual aboveground historic properties in the APE that are determined eligible for listing in the NRHP. All are considered historic properties under Section 106. Table 5 and Table 6 provide a summary of these resources, including historic districts and bridges.

Table 5. NRHP-Eligible Districts

Historic Property Name	Documentation	Number of Significant Features
North Point Sewage Treatment Plant Historic District	DPR 523 form set (Carey & Co. 2015)	14
Bluxome Townsend Historic District	DPR 523 form set (Page & Turnbull 2009)	9
Auxiliary Water Supply System (discontiguous)	Historical Resources Evaluation (Tetra Tech, Inc. 2009)	5
South End Historic District Addition	DPR 523 form set (Page & Turnbull 2009)	12
Bridges and Tunnels	DPR 523 form set (San Francisco Planning Department 2001)	N/A

Table 6. Additional NRHP-Eligible Properties

Historic Property Name	State Resource Identifier (P#)	Year Built	NRHP Eligibility Criteria
Channel Street Waterway (Bridge #34-C0027)	None	1917	Criterion C
Islais Creek (Bridge #34C-0024)	None	1945	Criterion B Criterion C
3rd Street Bridge/Lefty O'Doul Bridge (Bridge #34-C0025)	None	1932	Criterion B Criterion C

4.5.3 CRHR-Eligible Districts

For the purposes of this study, 10 historic districts in the APE are considered eligible for listing in the CRHR because they have been designated historic districts for the purposes and standards of Article 10 of the City Planning Code. Pursuant to Section 1004 of the City Planning Code, Chapter II, Part II, of the San Francisco Municipal Code, the resources outlined below have been designated as historic districts and approved by resolution of the of the City Planning Commission. Table 7 provides a summary of these resources.

Table 7. CRHR-Eligible Districts

Historic Property Name	Documentation Source	Number of Significant Features
Dogpatch Historic District	Resolution No. 16518	N/A. Boundaries are between Indiana and Third Streets, with odd and even addresses from 18th to Tubbs Street. See document for block and lot numbers.
Telegraph Hill Historic District	Resolution No. 10786	N/A
Northeast Waterfront Historic District	Resolution No. 9517	Unknown. Boundaries are between Greenwich Street, Embarcadero, Montgomery Street, and Broadway. See document for block and lot numbers.
Clyde and Crooks Historic District	Resolution No. 955	Unknown. Boundaries are between Brannan Street, Third Street, Townsend Street, and Lusk Street. See document for block and lot numbers.
Central Waterfront: Third Street Industrial District/Potrero Point Historic District	DPR 523 form set (Kelley & VerPlanck 2009 and Page & Turnbull, Inc. 2008)	N/A
India Basin Scow Schooner Boatyard Vernacular Cultural Landscape	San Francisco Planning Department Case No. 2014-002541ENV	N/A
Showplace Square Heavy Timber and Steel-frame Brick Warehouse and Factory Historic District	DPR 523 form set (Kelley & VerPlanck Historical Resources Consulting, LLC 2009)	N/A
Gardner Dailey/Telegraph Hill Historic District	San Francisco Planning Department Case No. 2014-003288ENV	N/A
North Point Historic District	San Francisco Planning Department Case No. 2013.0788E	N/A

Historic Property Name	Documentation Source	Number of Significant Features
South End Historic District	Resolution No. 11869	Unknown. Boundaries are between Stillman Street, First Street, Ritch Street, and King Street. See document for block and lot numbers.

4.5.4 CEQA Historical Resources Not Yet Evaluated for NRHP Eligibility

For the purposes of the study, 544 parcels identified within the APE comprise resources that met the criteria for a "historical resource," as defined in the CEQA Statutes and Guidelines. The San Francisco Planning Department determined that these properties will be evaluated as historical resources for purposes of CEQA, based on their evaluation and the inclusion of specified registers or surveys. This includes resources listed in or formally eligible for listing in the CRHR, resources within adopted local registers, resources that have been determined to appear eligible, or resources that may become eligible for the CRHR. Resources designated under Articles 10 and 11 of the City Planning Code are also assumed to be historic resources because they have been designated by the City as landmarks, historic districts, or conservation districts. Article 10 contains an adopted local register of historic resources; Article 11 contains an adopted local register of historic resources in the C-3 (Downtown) district. A property may be listed in more than one register or survey and may meet more than one of the aforementioned criteria to be considered an assumed historical resource under CEQA. The parcels comprise primarily commercial and industrial buildings constructed in the first half of the twentieth century.

Recognition of historical significance under CRHR or other local criteria indicates a high potential that these historic properties may possess significance to meet the NRHP threshold. Considering a full NRHP evaluation is not being conducted at this time, it is difficult to speculate as to the level of significance (local, state, or national) for each historic property, or which aspects of integrity are intact. The historic properties in this category will need to be addressed during the phased identification process, which is detailed in the Programmatic Agreement.

4.5.5 Properties Not Eligible for the NRHP

For the purposes of the study, it was determined that the 306 aboveground historic properties identified within the APE are not historical resources under CEQA. The San Francisco Planning Department made a determination through listings in historic registers and surveys that pertain to the City or properties for which the City has no information indicating their qualification as historical resources. Properties that were determined not to be historical resources are listed in the CHRIS database and have a California Historical Resource Status Code of 6, "determined ineligible" for the NRHP.

Credible evidence/research presented by a qualified expert would be needed in order for them to be considered “historical resources.”

4.5.6 Historic Age Undetermined

For the purposes of the study, 261 parcels require further research to classify them among the preceding categories because they are unevaluated and of historic age (i.e., constructed in 1990 or earlier). NPS uses a threshold age of 50 years as a criterion for consideration as to NRHP eligibility (National Park Service 1995:20). For purposes of this report, as well as the flood resilience measures considered for the 2040s, historic property identification within the APE considers resources that would meet the 50-year threshold as of 2040. Thus, buildings constructed in 1990 and before are considered historic-age resources for the study.

4.5.7 Exempt: Properties Constructed Later than 1990 (non-historic age)

For the purposes of the study, 214 parcels are exempt because records indicate that they are not of historic age. San Francisco Planning Department data determined that these properties were constructed later than 1990.

4.5.8 Exempt: Vacant Parcels

For the purposes of the study, 528 parcels are exempt because they are vacant and without aboveground historic properties present. These parcels consist of either water or vacant, vegetated, or paved land.

5.0 Tentatively Selected Plan

The Tentatively Selected Plan (TSP) is the Total Benefits Plan Alternative and the Independent Measures. The TSP is also the preliminary APE for the undertaking. A map of the TSP is provided in Figure 2.

5.1 Embarcadero (Reaches 1 and 2)

In Fisherman’s Wharf, the TSP (Figure 2) initially relies on floodproofing buildings, and later elevates the shoreline with floodwalls. Along the Embarcadero, the TSP elevates the shoreline in place by raising and reconstructing the bulkhead walls and pile-supported wharves north of the Bay Bridge while gradually transitioning down from the new shoreline elevation back to the existing city grade to retain visual and physical access to the waterfront. The plan includes reconstruction and redesign of the Embarcadero roadway – surface design of the Embarcadero roadway and promenade will be determined in future project phases. The Ferry Building and bulkhead buildings are raised in place. Piers are floodproofed with concrete curbs around the perimeter to reduce flood risk.

Figure 2
San Francisco Waterfront Coastal Flood Study
Total Benefits Plan and Independent Measures Footprint

The TSP includes the following **<u>initial actions</u>**:

- From Pier 27-29 to the Bay Bridge, raise the shoreline along the Embarcadero by 3.5 to 7.5 feet to defend against 3.5 feet of sea level rise (finish elevation of 15.5 feet NAVD88) using raised and rebuilt bulkhead walls and wharves, approximately aligned with the location of the existing structures. Provide Embarcadero Promenade and Bay Trail access atop and adjacent to the raised ground and wharves.
- Perform ground improvement to reduce lateral spreading and liquefaction risk along the coastal flood defense alignment to ensure desired seismic performance.
- Construct 2-foot-tall concrete curb around perimeter of piers from Pier 47 to Pier 24.
- Replace existing wharves with new ductile concrete wharves with deck elevation to match top of new bulkhead seawall. Transition grade from raised wharf and bulkhead building to existing pier elevation.
- Raising the shoreline in place requires reconstruction of the full Embarcadero roadway and results in a likely reduction of overall roadway width. Design of the mobility corridor and specific utilization of the available space will be done during the Pre-Construction Engineering and Design (PED) phase.
- Elevate buildings on wharves north of the Bay Bridge, including the Ferry Building, Agriculture Building, bulkhead buildings and more.
- Floodproof a subset of buildings in Fisherman’s Wharf, such as the Dolphin Club and buildings at Pier 45, Pier 39, and Pier 31.
- Consider removal or floodproofing of select additional buildings in Fisherman's Wharf based on risk profile, age, condition, and historic status.
- Build infrastructure to manage stormwater. Coordinate with SFPUC, Public Works, and other stakeholders on changes to the combined sewer system, expanded green corridors, and other features to reduce inland flood risk exacerbated by the coastal flood defense structures.

The TSP includes the following **<u>subsequent actions</u>**:

- North of Pier 27-29, raise the shoreline by 1.5 to 4.5 feet to defend against 3.5 feet of sea level rise (15.5 feet NAVD88) using 1.5 to 4.5-foot-tall floodwalls and raised and rebuilt bulkhead walls and wharves, approximately aligned with the location of these existing structures. Provide Embarcadero Promenade and Bay Trail access along or adjacent to the flood defense structure.
- Perform ground improvement to reduce lateral spreading and liquefaction risk along the coastal flood defense alignment to ensure desired seismic performance.

- Consider elevation, floodproofing, or demolition of buildings bayside of the coastal flood defense in Fisherman's Wharf based on risk profile, age, condition, and historic status.
- Build infrastructure to manage stormwater. Coordinate with SFPUC, Public Works, and other stakeholders on changes to the combined sewer system, new pumps, green infrastructure, and other resilient building and street design opportunities and other features to reduce inland flood risk exacerbated by the coastal flood defense structures.
- As sea levels rise, additional adaptations may be needed before the end of the period of analysis (2140), but these are not anticipated to be included in the project to be authorized for funding at this time. For the purposes of analysis, these are assumed to further raise the coastal flood defense using primarily vertical extension walls.

5.2 Mission Creek / Mission Bay (Reach 3)

In the Mission Creek / Mission Bay geography, the TSP defends existing city and community assets in place by elevating the creek and Bay shorelines with berms, floodwalls, and raised and rebuilt bulkhead walls and wharves. The coastal defense will tie into existing and planned high ground at Bayfront, Agua Vista and Crane Cove Parks, and at the Mission Rock and Pier 70 development areas. The plan also includes partial reconstruction and redesign of the Embarcadero roadway south of the Bay Bridge.

The TSP includes the following **initial actions**:

- Raise the Bay and creek shorelines to defend against 1.5 feet of sea level rise (13.5 feet NAVD88) using a combination of 1.5- to 4.5-foot-tall walls, berms, and raised and rebuilt bulkhead walls and wharves, depending on existing shoreline elevations. Provide Bay Trail access atop and adjacent to bayside berms and wharves.
- Install 2-foot-tall concrete curbs around the perimeters of piers from Pier 26 to Pier 50.
- Perform ground improvement to reduce lateral spreading and liquefaction risk along the coastal flood defense alignment to ensure desired seismic performance.
- Install deployable closure structures at the northern and southern abutments of 3rd and 4th Street bridges over the creek to defend landward buildings and infrastructure from flood damage. Service across bridges will be disrupted for hours to days during high water events. The likelihood of closure is anticipated to

be approximately one closure on average every 25-200 years (0.5-4% annual chance) by 2060.[1]

- Tie measures into existing high ground and planned development projects at Bayfront, Agua Vista and Crane Cove Parks, and at the Mission Rock and Pier 70 development areas.
- Enhance wildlife habitat on berms along the shoreline using engineering with nature features.
- Remove select buildings at Pier 68/70 shipyard for construction of coastal berm or adjust the alignment of coastal berm features to avoid historic resources where the structures have ground floor elevations that are above 13.5 feet NAVD88.
- Build infrastructure to manage stormwater. Coordinate with SFPUC, Public Works, and other stakeholders on changes to the combined sewer system, expanded green corridors, and other features to reduce inland flood risk exacerbated by the coastal flood defense structures.

The TSP includes the following **subsequent actions**:

- Raise the Bay and creek shorelines an additional 2 feet to defend against 3.5 feet of sea level rise (15.5 feet NAVD88) using berms and seawalls, as well as raising and rebuilding bulkhead walls and wharves. Provide Bay Trail access atop and adjacent to the berms and wharves.
- Where required to ensure desired seismic performance, perform additional ground improvement to reduce lateral spreading and liquefaction risk along the coastal flood defense alignment.
- Maintain current roadway capacity along Terry Francois Boulevard and reduce one lane of parking to provide space shoreline elevation and regrading. Final surface design to be conducted in future design phases.
- Consider modest amount of new Bay fill along the Bay edge at Terry Francois Boulevard and north bank of Mission Creek from the 4th Street Bridge to South Beach Harbor.
- Incorporate engineering with nature features along the creek and Bay shorelines to serve a CSRM function by reducing wave runup, while also enhancing public access and wildlife habitat.
- Elevate bulkhead buildings from Pier 26 through Pier 50. Consider elevation, floodproofing, or demolition of other buildings along the bayside shoreline overlapping or adjacent to the coastal flood defense alignment based on risk profile, age, condition, and historic status.

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[1] Based on USACE intermediate and high RSLC.

- Consider building additional infrastructure to manage stormwater and reduce inland flood risk exacerbated by the coastal flood defense structures.
- As sea levels rise, additional adaptations may be needed before the end of the period of analysis (2140), but these are not anticipated to be included in the project to be authorized for funding at this time. For the purposes of analysis, these are assumed to further raise the coastal flood defense using primarily vertical extension walls.

5.3 Islais Creek / Bayview (Reach 4)

In the Islais Creek / Bayview geography, the TSP defends the existing shoreline to retain residential and commercial land uses in place, including Port land uses and maritime facilities. The flood defenses consist of raising the shoreline using berms, bulkhead walls, raising and rebuilding marginal wharves, deployable closure structures, and tying into existing or planned high ground, near Potrero Power Station and behind the Pier 94 Wetlands (Port backlands). This area of the waterfront contains large parcels independent of the combined sewer system, such that the elevated shoreline will require modification to handle stormwater in a safe and effective manner.

The TSP includes the following **initial actions**:

- Elevate the Bay and creek shorelines using a combination of 2.5- to 5.5-foot-tall berms, floodwalls, and curb extensions to defend against 1.5 feet of sea level rise (13.5 feet NAVD88). Defenses tie into high ground at Warm Water Cove, the western end of Islais Creek, Pier 94 Wetlands, Heron's Head Park, and near the southern boundary of the study area.
- Install 2-foot-tall concrete curb at edge of Pier 80 and Pier 94-96 to provide coastal flood protection while maintaining function for maritime uses.
- Perform ground improvement to reduce lateral spreading and liquefaction risk along the coastal flood defense alignment to ensure desired seismic performance.
- Incorporate engineering with nature into Warm Water Cove, at the interface between Pier 94 Wetlands and Pier 96, and along portions of the Islais Creek bank.
- Install deployable closure structures at the north and south abutments of Illinois Street Bridge to be activated in advance of a coastal storm.
- 3rd Street Bridge will be rebuilt at a higher elevation[2] per the SF Public Works existing project, outside of the Flood Study (FWOP Condition).

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[2] Rebuilding of 3rd Street Bridge at higher elevation is external to the Flood Study project (i.e., it is part of the “Future Without Project” condition).

- Reconstruct Pier 90 and 92 wharves at 13.5’ NAVD88 elevation and incorporate them into the coastal defense system.
- Consider removing portions of warehouses near the south banks of Islais Creek and west of the bridges to make room for berm features, as well as portions of the Pier 96 building that extends south of the pier edge, and one building straddling the wharf edge at Pier 90.
- Build infrastructure to manage stormwater. Coordinate with SFPUC, Public Works, and other stakeholders on changes to the combined sewer system, expanded green corridors, and other features to reduce inland flood risk exacerbated by the coastal flood defense structures.

The TSP includes the following **subsequent actions**:

- Elevate the Bay and creek shorelines an additional 2 feet using a combination of berms, floodwalls, and raised bulkhead walls and wharves to defend against 3.5 feet of sea level rise (15.5 feet NAVD88).
- Where required to ensure desired seismic performance, perform additional ground improvement to reduce lateral spreading and liquefaction risk along the coastal flood defense.
- Construct berms along the banks of Islais Creek west of the Illinois Street bridge and from Illinois Street Bridge to Pier 80.
- Incorporate engineering with nature into the shoreline along the banks of Islais Creek and Pier 94 wetlands to serve a CSRM function by breaking and attenuating waves, while also enhancing public access and wildlife habitat.
- Adapt Pier 80 and Piers 94-96 by installing a new raised bulkhead wall and wharves.
- Consider removing buildings that straddle the alignment of the new bulkhead wall based on risk profile, age, condition, and historic status.
- Consider building additional infrastructure to manage stormwater and reduce inland flood risk exacerbated by the coastal flood defense structures.
- As sea levels rise, additional adaptations may be needed before the end of the period of analysis (2140), but these are not anticipated to be included in the project to be authorized for funding at this time. For the purposes of analysis, these are assumed to further raise the coastal flood defense using primarily vertical extension walls.

5.4 Independent Measures

The following list of “independent measures” represents a series of measures for which the PDT has determined the need to be included in the NEPA analysis separately. Each of these measures was included (or was similar to a measure included) in one or more alternatives, but the given alternative as a whole was not proposed for inclusion in the TSP.

- **Living Seawalls** (e.g., textured concrete on a vertical seawall) would be designed to reduce wave hazards while supporting nearshore ecology wherever current maritime uses and pier configurations allow. This measure was originally included in Alternative E (1st action) and is applicable to portions of Reaches 1, 2, and 3. Further detail available in Appendix I: Engineering with Nature
- **2A) Robust Coastal Defense of Ferry Building and Agriculture Building** would be designed to realign the coastal flood defense structure adjacent to the bayside edge of the Ferry Building and Agriculture Building. The structures could be raised in place with a basement structure or some solid fill underneath. This approach is anticipated to be preferable from a cost and engineering perspective. This is comparable to Alternative E (1st action) and may be considered in post-TSP refinement.
- **2B) Coarse Beach at Rincon Park** connecting to Pier 14 would be designed to reduce wave hazards, support nearshore ecology, and provide public water access. Some new Bay fill is included in this measure so as to address space constraints of the transportation network at this site. This measure is similar to the measure for this location included in Alternative F (1st action). Further detail available in Appendix I: Engineering with Nature
- **3A) Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves** from Bay Bridge to the mouth of Mission Creek, raise the current shoreline (rather than extending the shoreline into the Bay). This will require redesign of the northbound lanes of the Embarcadero roadway (in collaboration with SFMTA and the Embarcadero Enhancement Project), and the approach is intended to be designed to avoid reconstruction of the light rail track. This is comparable to Alternative G (2040) for this site.
- **3B) McCovey Cove North Curb Extension** raises the shoreline in line with the current shoreline edge on the north side of McCovey Cove (along the ballpark), rather than adding fill and extending the shoreline into the creek. This is comparable to Alternative G (1st action) for this site and may be considered in post-TSP refinement.
- **3C) Planted Berm on Mission Bay** south of Pier 50 would be designed to reduce wave hazards, support nearshore ecology, and provide public water access. This measure was originally included in alternative F (1st action) and may be considered in post-TSP refinement to reduce impacts to the Bay, potentially reduce cost, and increase comprehensive benefits.
- **4A) Inland Coastal Flood Defense at Southwest Islais Creek** would include conversion of some industrial lands and public facilities to provide public water access, open space, and ecological benefits. It would also result in more permanent flood risk reduction due to a small area of gradual retreat along the creek. This is comparable to Alternative G (2nd action) between 3rd Street

Bridge and the inland extent of the channel and may be considered in post-TSP refinement.

5.5 PED and Construction Sequencing

At the completion of the Feasibility Study, and upon approval by the Chief of Engineers, the Recommended Plan would be provided to Congress for authorization and funding. If authorized and funded by Congress, subsequent phases of the project would include PED, Construction, and Operations and Maintenance.

Completion of PED and construction of the Recommended Plan, specifically the pace of construction, is highly dependent on Congressional approval and funding. Assuming an ample funding stream, the initial actions of the TSP could be designed and then constructed over a period of about 14 years. Different increments of the project may be completed as funding allows during this timeframe. Phased implementation will consider the priorities of the non-Federal sponsor, communities benefitted by the project, resource agencies, and efficiencies in the construction and/or contracting process. Furthermore, construction sequencing will also be dependent on completion of supplemental environmental studies, in accordance with the tiered National Environmental Policy Act (NEPA) approach described more fully in Chapter 1. Ultimately, implementation activities will be optimized to consider the size and frequency of funding infusions, environmental clearance of individual components including the requirements of CEQA, and beneficial sequencing.

USACE will complete detailed analyses and design in the Preconstruction Engineering Design phase that will inform the final design and ultimately construction. Detailed analyses include but are not limited to:

- A review of changed conditions since the completion of the study that may affect project design
- Updated engineering modeling
- Detailed surveys of physical and engineering data
- Detailed environmental and cultural resources surveys
- Detailed assessment of structures identified for nonstructural measures
- Additional environmental coordination that may be required if there are environmental, cultural, and/or historic resource impacts that were not identified during this Study

5.6 Future Optimizations/Adaptations

During the PED phase, the USACE will continue to refine the engineering design to promote broader resilience, improve climate preparedness, and reduce vulnerabilities through adaptation to climate change. The measures included in the TSP, whether they be natural or nature- based features, nonstructural interventions, or structural interventions provide a comprehensive solution that can be adapted in the future to climate change.

However, a realistic view of the long-term challenges facing the area makes it clear that future integrated solutions that promote sustainable communities and ecosystems will be needed in the long term to continue to effectively manage risks associated with sea level rise. Civic and business leaders and citizens must continue to innovate and create solutions that reduce loss of life, economic impacts, and the personal devastation that results from flooding, while still supporting continued economic growth and opportunities for all.

6.0 Area of Potential Effects

The activities associated with the proposed undertaking include all new construction, improvements, and maintenance activities related to the proposed San Francisco Waterfront Coastal Flood Project. The APE includes the footprint of all areas in the tentatively selected plan that will be directly impacted and all areas outside the footprint that may be directly impacted. Direct impacts will include, but are not limited to, physical, visual, and noise impacts resulting from new construction of structures, construction of staging and access areas, construction of ecological mitigation features, relocation or demolition of existing structures, and project maintenance. The APE will also include activities that may be added during Preconstruction Engineering and Design (PED).

7.0 Recommendations

There is a potential for the tentatively selected plan to impact historic properties. The features proposed for this project involve construction activities that have a potential to directly and indirectly affect historic properties in both terrestrial and submerged environments. The entire project area is considered to have a high probability for historic properties to occur. The USACE recommends intensive cultural resources investigations for all proposed project areas to include archeological investigations and historic building and structure investigations to determine the presence or absence of historic properties within the APE. These investigations will be conducted prior to construction during the USACE PED phase. The scope of these investigations will be determined in concert with the California State Historic Preservation Officer, Native American Tribes, and any consulting parties and in accordance with the Programmatic Agreement for this project.

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SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY, CA

DRAFT APPENDIX D-4 CLEAN WATER ACT COMPLIANCE

JANUARY 2024

USACE TULSA DISTRICT | THE PORT OF SAN FRANCISCO

List of Sub-Appendices

D-4-1: 404(b)(1) Analysis

D-4-2: Water Quality Certification Coordination (to be added in the final)

SAN FRANCISCO WATERFRONT COASTAL FLOOD STUDY, CA

DRAFT APPENDIX D-4-1
404(B)(1) ANALYSIS

JANUARY 2024

USACE TULSA DISTRICT | THE PORT OF SAN FRANCISCO

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1 Introduction

The U.S. Army Corps of Engineers, Tulsa District (USACE) and the Port of San Francisco (non-Federal sponsor) are conducting the San Francisco Waterfront Coastal Flood Study (SFWS) feasibility study to investigate and identify ways to reduce coastal flood risk along 7.5 miles of the San Francisco Waterfront by evaluating alternatives to meet current and future coastal flood risk management (CFRM) needs. To evaluate potential environmental impacts, USACE prepared a draft integrated feasibility report and environmental impact statement (DIFR/EIS).

The information contained in this document reflects the findings of the project record. Specific sources of information included the following:

- San Francisco Waterfront Coastal Flood Study DIFR/EIS
- 404(b)(1) Evaluation
- Public Interest Review

This document presents the Clean Water Act (CWA) Section 404(b)(1) evaluation for the study pursuant to Section 404 of the Clean Water Act. This document addresses the substantive compliance issues of the Clean Water Act 404(b)(1) Guidelines (40 Code of Federal Regulations [C.F.R.] § 230.12(a)) and Public Interest Factors (33 C.F.R. § 320.4 as reference). The measurements outlined in this document are based on feasibility level design, which will undergo further design and analysis in the Pre-construction, Engineering, and Design (PED) phase. This document will be updated with any design changes and a wetland delineation during PED phase. This document evaluates the preferred alternative's first action as described below in Section 2.2 – Description of Preferred Alternative. In the future, if USACE gets authority and appropriations to implement any of the proposed second action features, USACE will evaluate those second action features in a separate Clean Water Act Section 404(b)(1) evaluation.

1.1 Study Overview

Low-lying assets and economic activity along the San Francisco Waterfront are at risk of flooding from coastal storms and extreme high tides. As well as at risk from potential failure of the century-old San Francisco seawall, which could result from structural instability, land subsidence, or an earthquake. Without Federal action, it is expected that future sea level change (SLC) will increase the frequency and depth of tidal flooding along the shoreline, thereby increasing economic damages and coastal storm risk to one of the nation's most iconic waterfronts.

This study is being conducted under the authority of Section 110 of the Rivers and Harbors Act of 1950 and Section 142 of Water Resources Development Act (WRDA) 1976, as amended by Section 705 of WRDA 1986, and Section 203 of WRDA 2020.

The purpose of the study is to investigate and identify ways to reduce coastal flood risk along 7.5 miles of the San Francisco Waterfront by evaluating alternatives to meet current and future coastal flood risk management (CFRM) needs.

The non-federal sponsor (NFS) for the study is the Port of San Francisco (Port). The Port oversees the administration of the public trust for the State of California under the Burton Act, ensuring that public trust uses such as maritime, public access, historic resources, visitor-serving uses, and water-related and dependent uses are preserved and maintained along the waterfront.

1.1.1 Study Area

The study area extends approximately 7.5 miles from Aquatic Park in the northeast to just past Heron's Head Park in the south. The study area is divided into four reaches and fifteen sub-reaches for conducting and evaluating coastal process and economic analyses (Figure 1). These reaches were selected based on hydrologic separability, identified geographic references, specific wave action within each reach, and major differences in physical structure inventory within the reach.

Figure 1. San Francisco Waterfront Coastal Flood Study Area, Reaches 1 - 4.

1.1.2 Study Scope

The study scope includes an assessment of existing and future without project conditions under a range of relative sea level change (RSLC) scenarios for a 100-year period of analysis (2040 to 2140). The study will evaluate alternatives that meet current and future coastal flood risk management needs. The Study Team is using a 100-year period of analysis because of the long-lived infrastructure, the sensitivity to RSLC, the level of disruption that may be required for adaptation in a highly urbanized locale, and the need for flexibility, adaptability, and scalability in the alternatives to address uncertain timing of increased flood risk due to RSLC.

1.2 Purpose and Need

This study is prepared as an interim response to the study authority, investigating only a segment of the authorized San Francisco Bay shoreline. The purpose of the SFWS is to investigate the feasibility of managing tidal and fluvial flooding and sea level rise (SLR) along 7.5 miles of the San Francisco Bay shoreline. The project area is at risk of flooding from bay water during coastal storms, extreme tides, and future SLR. Flooding along the waterfront could cause extensive damage to public infrastructure and private property, loss of life and deterioration of public health and safety, degradation of the natural environment, and adverse changes to the social and economic character of the waterfront community. The risk is expected to increase over time as sea levels rise in the bay.

2 Proposed Action Alternatives

In accordance with the National Environmental Policy Act (NEPA), and USACE regulation and policy, the final range of alternatives was developed, utilizing concepts from a variety of sources, including the NEPA scoping process and coordination with stakeholders. This final range of alternatives were formulated to reduce the risk of flooding along the waterfront by considering the three USACE sea level rise curve scenarios (low, intermediate and high), alignment of the line of defense relative to the existing shoreline, and adaptability of the scale of alignment of the measures to address higher sea levels if certain risk thresholds are reached after construction. The array of alternatives are distinctly different alternatives and formulated using three strategies – accommodate, defend, or combination of accommodate and defend/hybrid – to address the problems. The defend strategy is designed to minimize risk at the current shoreline or set back slightly from the shoreline, while accommodate would include measures that allow flood waters to enter the area and people and assets at risk would be moved out of the way of water. The alternatives each include structural, non-structural, and Natural and Nature-Based Features (NNBFs) where appropriate and possible. The adaptability of each measure was considered to establish the first increment of scale and timing of construction to ensure performance over the period of analysis. In addition to the final range, a list of “independent measures” would be additive to the alternative selected for implementation.

The final range of alternatives include the following five alternative and independent measures:

- **No Action (NED Low Curve)**: No action is taken by USACE to reduce flood risks beyond projects that have already been implemented or are approved for implementation along the San Francisco waterfront.
- **Alternative B (NED Intermediate Curve)**: Proposes nonstructural measures such as relocation, raise in place, floodproofing, and zoning in areas identified with frequent flooding.
- **Alternative F**: Uses a combination of structural, nonstructural, and NNBFs to defend at the existing shoreline, except for some managed retreat inland along the southern waterfront and tide gates at the mouths of Islais and Mission creeks. Additional retreat and adaptations are proposed as the rate of SLR increases.
- **Alternative G (NED High Curve)**: Uses a combination of structural, nonstructural, and NNBFs to defend against the high rate of SLR. This alternative concedes the largest area for managed retreat and incorporates more nonstructural and NNBF measures.
- **Total Net Benefits Plan (Preferred Alternative):** Hybridized plan that relies on defend measures, scaled to perform under a lower initial risk and to adapt to risk of a higher rate of RSLC as a potential end point. Initial actions are proposed to delay expenditures and add height or adapt measures as risk increases over later years. This alternative hybridizes nonstructural, structural, and NNBF from multiple action alternatives.
- **Independent Measures for Consideration:** Potential considerations for TSP refinement to further reduce coastal flood and seismic risks, reduce costs and impacts, and gain community benefits. Addresses geographically specific areas with structural and NNBF.

As described in Chapter 3 and Appendix A of SFWS DIFR-EIS, following the evaluation of the final range of alternatives, the study team selected the TNBP, a hybridized plan, as the preferred alternative (Section 2.2), based on how well the measures met the purpose and need statement and study objectives, with consideration of environmental, economic, and social effects. For the purposes of this CWA Section 404(b)(1) evaluation these independent measures are included in the preferred alternative.

Additional details on the plan formulation process, alignments and measures developed for the action alternatives can be found in Appendix A of SFWS DIFR-EIS.

2.1 Availability of Less Environmentally Damaging Practicable Alternatives to Meet the Project Purpose

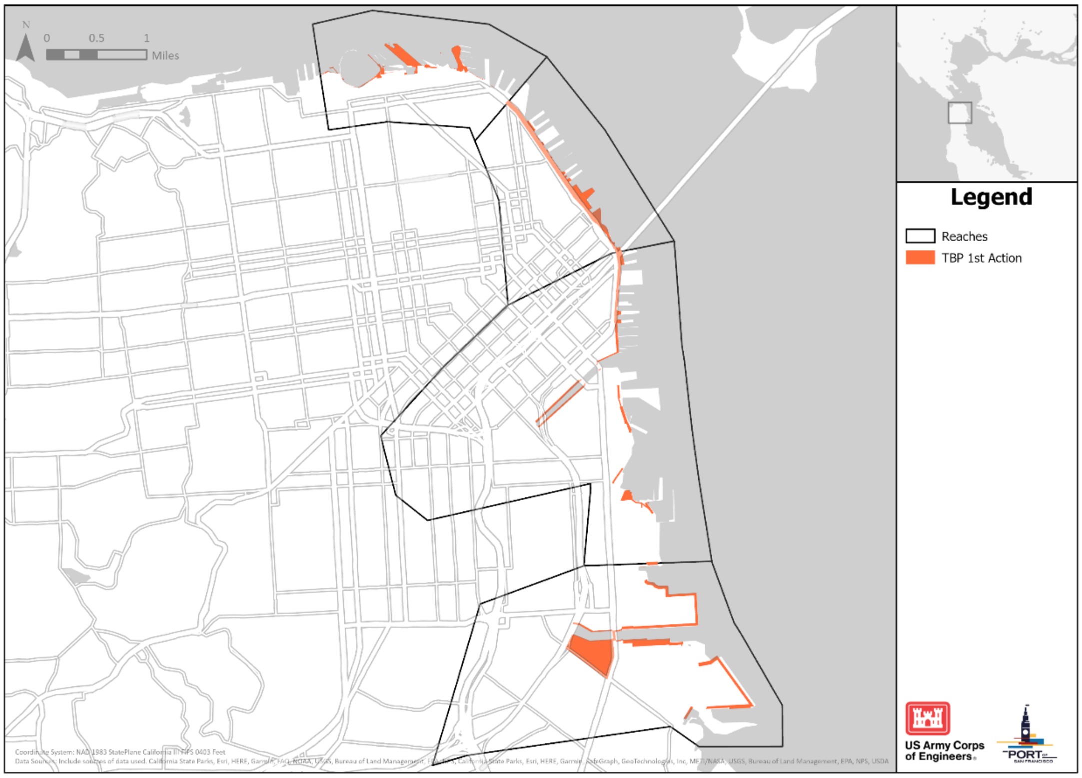
As stated earlier in this Section, this feasibility analysis was conducted using the formulation process for Civil Works projects to identify the TNBP. The analysis was also performed on a regional basis to aid with the identification and comparison of project measures across the project area. The following section documents the analysis which resulted in the identification of the least environmentally damaging practicable alternative (LEDPA).

Alternative A -No Action was eliminated because it would not meet the purpose and need statement and would not meet the project objectives. The action alternatives identified as the final range all performed well in terms of costs and benefits and meeting the study goals and objectives and the purpose and need. Each are considered practicable and reasonable. From these alternatives, the study team determined that the LEDPA is Alternative B- Nonstructural Plan. This plan avoids all beneficial or adverse impacts to aquatic habitats and waters of the U.S. since there would be no in-water work or bay fill. Alternative B was not selected for recommendation because while reasonable and practicable, there would still be life safety risks and disruptions to the daily use of the waterfront (e.g., impacts to the transportation system, movement of people and goods, availability of services, tourism, and recreational opportunities; ability of emergency services to render aid) from allowing floodwaters to enter the study area and defense happens on a structure by structure basis. The remaining three final array alternatives (TNBP, Alternative F, and Alternative G) all minimize life safety risks but each have varying levels of aquatic environment impact.

The PDT reviewed the next least environmentally damaging plan, which was identified as the TNBP. The TNBP has the least amount of aquatic impacts of the plans that defend the waterfront from floodwaters and minimize life safety risks. This alternative avoids and minimizes aquatic impacts to the greatest extent possible by aligning the flood defenses landward of the existing shoreline. The TNBP has approximately 8.0 acres of unavoidable adverse impacts (after other project gains have been accounted for); however, the other two practicable alternatives that minimize life safety risk each have greater unavoidable impacts. Additionally, the TNBP incorporates NNBF into the designs which would improve the quality and increase the quantity of aquatic habitats in the study area over the long-term.

2.2 Description of Preferred Alternative

As mentioned above, the preferred alternative, the TNBP includes a combination of these measures: floodproofing methods (i.e., elevate or demolition buildings), berms, sea wall/ bulkhead walls, raising and rebuilding wharves, deployable flood gates, seismic ground improvement, and Engineering with Nature (EWN) features. The project map provides an overview of where proposed features would occur along the San Francisco waterfront, simplified to polygons of the construction footprint (Figure 2). Detailed maps are provided in Sections 2.2.1 – 2.2.4 that define the measures occurring in each reach, with anticipated construction footprint, and include a description of how measures are assumed to be constructed. Sections 2.2.6 and 2.2.7 outline proposed avoidance and minimization measures, and Best Management Practices (BMPs).



San Francisco Waterfront Resiliency Study
Integrated Feasibility Report/Environmental Impact Statement

Figure 2. Footprint for measures proposed for construction in the first action of the Total Net Benefits Plan.

A description of the construction activities for the proposed action are provided in the following sections below. Approximate spatial extent (e.g., linear feet, acres) for the construction footprint of measures are provided in Table 1. A general description of the construction methods and equipment, as well as anticipated duration for construction is provided below.

Table 1. Total Net Benefits Plan construction footprint quantities.

Measure	Quantities
Bay Fill (ACRES)	9
Levee (LF; ACRES)	17,960; 20+
Bridge Raise/Replacement (LF)	-
Building Demolition (SQFT)	578,500
Building Relocation (SQFT)	641,400
Bulkhead wall/Seawall (LF)	14,105

Deployable Flood Gate (LF)	1,600
Floodproofing (SQFT)	558,905
Pier Demolition (ACRES)	1.0
Roadway Impact (ACRES)	34
Seismic Ground Improvements (ACRES)	90
Sheetpile Wall (LF)	2,165
T-wall (LF)	7,735
Vertical wall (LF)	68,795
Wharf (LF; ACRES)	n/a; 24
EWN* (ACRES)	60
Vertical Shoreline* (LF)	12,100

**Note: acres are rounded to the nearest whole number. LF & SQFT are rounded to the nearest 5. A dash (-) indicates the measure is not included. A "n/a" indicates the value was not available. Levee acreage is denoted with a plus "+" sign because engineering drawings for 3,250 LF of levee did not include the acreage estimate.*

There are common construction techniques that would be applied across an array of measures, thus, are summarized here to avoid repetitive descriptions:

- **Cast-in-place concrete** is poured into removable forms (or castings) erected on site and cured in the concrete's finished position. Temporary forms or castings would be constructed on site and would be reinforced with steel. Most formwork would be composed of steel, aluminum, and wood. Ready mixed concrete would be delivered via large cement trucks and poured into the castings with a truck chute, bucket, or pump. The concrete is left to cure in the castings before removal. Once cured, casting materials would need to be removed and reused for another measure or hauled off and disposed of.

- **Cofferdams** are an enclosure that allows water to be pumped out to establish a dry working environment. A cofferdam would be constructed from steel sheet piles with interior bracing. Sheet piles would be driven into the sediment in the bay through hydraulic or pneumatic tools, braced internally with waler beams and compression struts to keep the wall from collapsing. Braces would be installed using heavy machinery from work barges in the bay. Inside of the cofferdam would be un-watered and dewatered with a combination of surface pumps/sumps and deep wells as necessary to create a dry and stable work environment. Once construction completes, the cofferdam would be disassembled and removed. For simplicity, it was assumed cofferdams would be installed across 50 linear ft at a time.

- **Seismic ground improvements** would be included with several structural measures to address both static and seismic loading conditions as a result of poor soil conditions and the increased weight of the new construction. This could consist of a variety of ground improvement techniques such as deep material mixing (DMM), jet grouting (JG), compaction grouting (CG), or vibro-replacement (VR) of the existing soils.

  DMM is a technique to improve soft, high moisture soils by mechanically mixing them with either a wet or dry cementitious binder (Keller 2022a). A high-speed drill advances a rod with radial mixing paddles located at the posterior of the drill into the ground to shear the soils. The cementitious binder is injected through the rod and mixed with the soil to produce individual or overlapped columns with improved strength and compressibility characteristics.

  JG is a technique that uses high-velocity fluid jets to construct cemented soil (soilcrete) by using a grouting monitor attached to the end of a drill stem. The jet grout monitor is advanced to the maximum depth, then high-velocity jets are used to erode and mix in situ soil with grout as the drill stem and monitor are rotated and raised (Keller 2023a).

  CG, or low mobility grouting, involves injecting a low slump, mortar grout into the subsurface to densify loose, granular soils and stabilize voids or sinkholes. An injection pipe is inserted typically to the maximum depth and the grout is injected as the pipe is slowly removed in segmented lifts, creating a column of overlapping grout bulbs. As the mobility grout bulbs expand, they displace surrounding soils (Keller 2023b).

  VR is a technique that constructs loadbearing columns from gravel or crushed stone with a vibrator to reinforce ambient soils and densify surrounding granular soils (Keller 2022b). A vibrator tool penetrates to the design depth using the vibrator's weight and vibrations, as well as water jets located at its posterior. Stone is then either added using a top-feed method from the ground surface where the stone is allowed to fall into the void created by the vibrator or using a bottom-feed method where the stone is added to a hopper for placement down an attached feed pipe. For either stone placement method, the vibrator is lowered into the placed stone in lifts to densify and displace the underlying stone. These steps are repeated until a dense stone column is constructed from the design depth to the ground surface (Keller 2022b).

2.2.1 Reach 1

Reach 1 focuses on building demolition, floodproofing, and retreat (Figure 3).

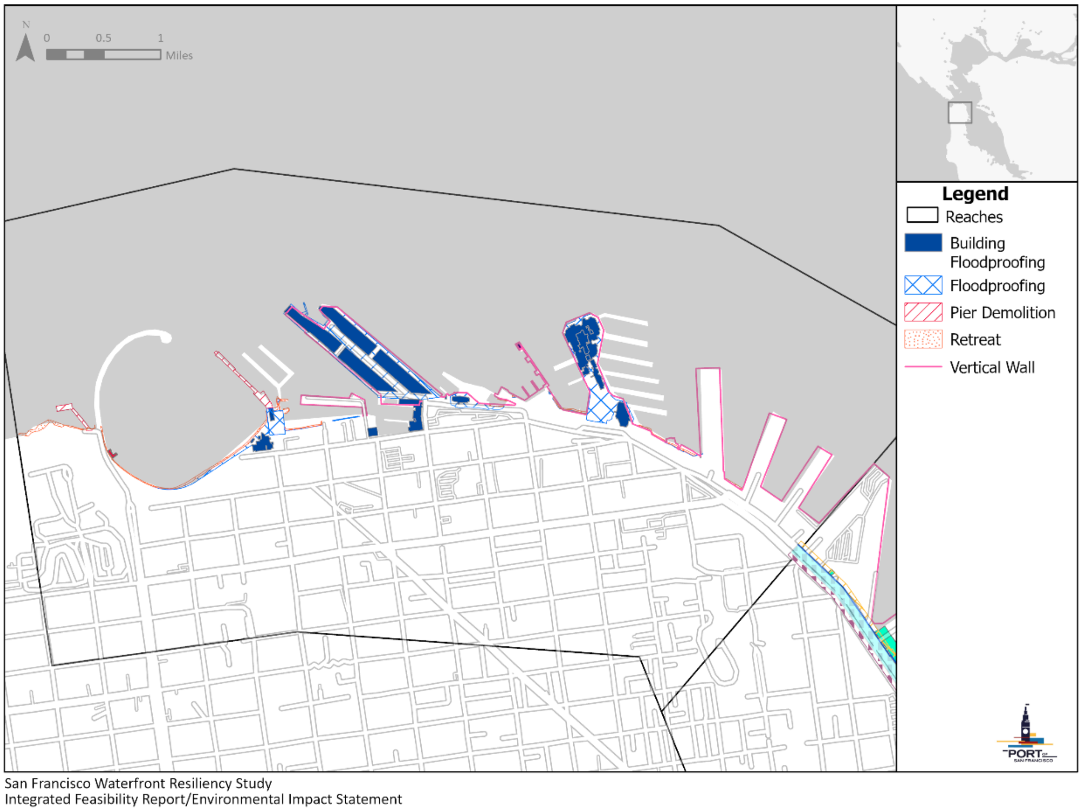


Figure 3.Total Net Benefits Plan, Reach 1.

2.2.1.1 Building Demolition

For buildings requiring demolition with no rebuild, the material would need to be removed and disposed of. This will require heavy machinery such as wrecking balls, excavators, and bulldozers. Additionally, the building debris will need to be hauled off using large trucks or barges.

2.2.1.2 Floodproofing

Dry floodproofing includes a range of strategies that seal the exterior of a building from flood waters and is often used to protect non-residential structures, water supplies, and sewage systems. For example, a measure could include applying a waterproof veneer to the outside surface of an existing structure. Backflow valves could be installed on sewer lines to prevent back up during flooding and storm events. At building openings, deployable gates and shields could be activated during flood events to prevent flood damage to the building interior, while allowing continued use at other times.

The floodproofing is assumed to be either dry-floodproofing or perimeter protection in the form of a ring-wall. The dry-floodproofed structures are assumed to be industrial, generally having lower occupancy, while the structures protected around the perimeter with a ring-wall are assumed to be commercial, institutional, or mixed use in nature.

2.2.1.3 Retreat

A managed retreat approach assumes acquisition or buyout of assets. Buyout/Acquisition involves purchase and elimination of flood damageable structures, allowing for inhabitants to relocate to locations away from flood hazards. In areas of retreat, buyouts would result in building demolition and removal, and conversion of the areas to green space/de-paved surfaces.

2.2.1.4 Vertical Wall

A vertical, concrete, extension wall would be constructed of reinforced concrete using cast-in-place techniques. The wall is intended to be connected to existing gray infrastructure (e.g., wharf, pier, seawall) and will require minimal foundation construction. The height of each vertical wall would be dependent on existing elevation and final design criteria but is not expected to exceed 4 feet (ft).

2.2.2 Reach 2

Reach 2 prioritizes protection at the existing shoreline with several structural measures including wharf replacement, new seawall construction, elevated buildings, and planted levees (Figure 4). Additionally, two areas move bayward and include 9 acres of bay fill total. Four acres of bay fill will be used to accommodate a new seawall section that would be moved bayward of the existing (i.e., bay will be filled between the new and old seawall), while the remaining 5 acres would address space constraints of the transportation network in the area. A coarse beach would be built overtop the bay fill to reduce wave hazards, support nearshore ecology, and provide public water access (shown as EWN in Figure 4). Additionally, a living shoreline in the form of precast molds would be incorporated into the new sections of seawall.

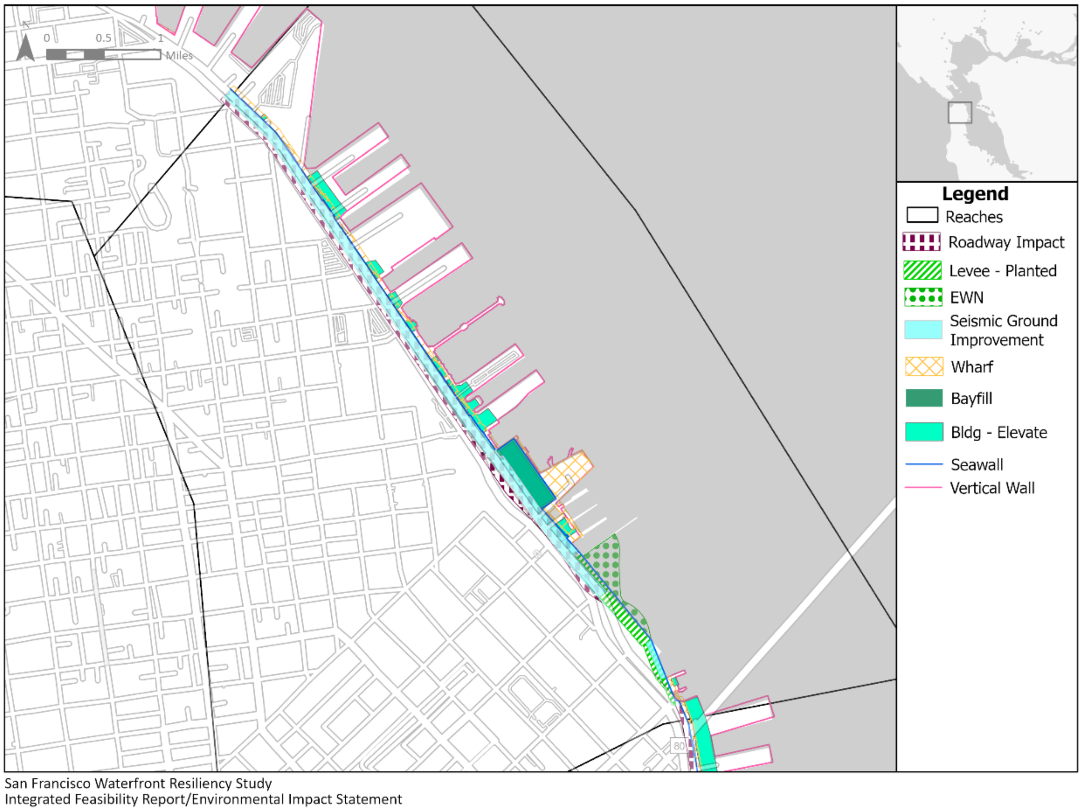


Figure 4. Total Net Benefits Plan, Reach 2.

Note: 5 acres of bay fill is below the EWN (Coarse Beach), and the ferry building would be elevated. Additionally, an EWN Living Shoreline is proposed along the seawall

2.2.2.1 Levee

Levees would be designed as a raised earthen bank with a trapezoidal cross-section. The Levees are constructed with a wider base that slopes up to a narrower crest to fortify against flooding risks (Figure 5). It is assumed levees would be constructed of earthen fill material from a commercial source, and delivered via large trucks. Levees would be graded to either a 12H:1V or 3H:1V slope, depending on the need for handicap accessibility, using heavy machinery (e.g., bull dozers, back hoes).

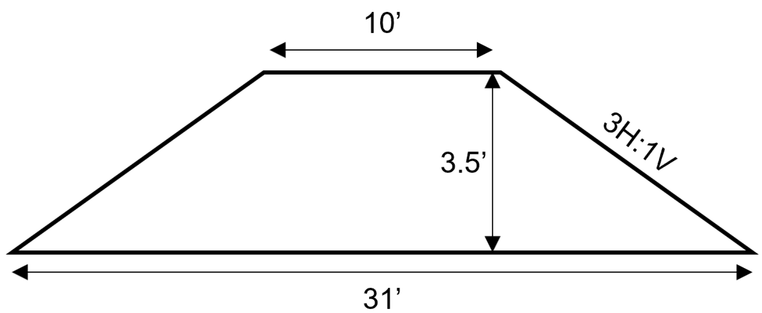


Figure 5.Sketch of Levee with 3H:1V slope.

Existing concrete roadway or parking lot would need to be demolished and material hauled offsite and disposed of. The project site would be prepared for the new construction of the levee which may include but is not limited to grading, adding fill material, earth-moving, excavating, drainage, etc. In some instances, the surface of levees will need to be repaved with asphalt or concrete once construction is complete in order to maintain access or existing functionality. This would occur in areas that already have existing pavement in place.

The side slopes of paved levees differ depending on the location of the measure. The bayside slopes are assumed to be 3H:1V, while roadside slopes are 12H:1V. Any existing bike lanes, bay trails, parking lanes, or roadways would be raised with the levee and repaved after construction. Structures that remain bayside of the line of defense would be floodproofed or raised. It was assumed existing utilities would need to be relocated and/or raised.

Levees may include bedding stone along the shoreline slope to protect the levee and reduce wave attenuation and erosion. Bedding stone is placed along the bayward slope in front of the levee to create a revetment to absorb wave energy. Ground surface elevation would be graded from the base of the levee to sea level using a 3H:1V slope, the length of which is dependent on existing elevations to prepare the site for laying the stone. Rip rap is placed atop the bedding stone to create an additional barrier to attenuate waves. It was assumed, bedding stone would be purchased from a commercial quarry and transported via barge or large truck to the construction site. It was assumed rip rap would also be purchased from a commercial quarry, as well as reused from existing locations where applicable.

Levees with a crest height ≥ 4 ft would require installation of a 20 ft long continuous vinyl sheet pile to act as a groundwater seepage cut-off to prevent undermining of the levee. The sheet pile would be installed using a vibratory hammer or impact hammer.

2.2.2.2 Seawall

A seawall, synonymous with bulkhead wall, is a retaining wall structure that supports earthen fill on one side and protects against erosion caused by a waterway on the other side. Seawalls are subdivided into two categories, 1) seawalls less than 30ft in vertical height, typically denoted as “Bulkhead Wall with Fill” in figures and 2) seawalls greater than 30ft in vertical height, typically denoted as “Bulkhead Wall and wharf” in figures. The two different height groups roughly correspond to the anticipated maritime use along the wall, but also require different means of construction due to their scale and access for construction along the shoreline. In general, it was assumed that all seawalls are constructed of concrete. The seawall is either constructed of precast concrete piles driven along the wall alignment at close spacing, then subsequently followed by driven square piles to fit with the interstitial space to fill the voids and create space for a grout pocket. Voids would be grouted to create a low permeability wall that would retain soils and resist erosion of the shoreline. Construction of the seawall is assumed to be completed from land by using secant pile or diaphragm wall designs. However, in the case of wharf re-construction needed for some locations, this could include in-water work activities for pile driving and platform construction. Seawall locations that require bay fill to back fill voids between the new and existing seawall would be dewatered and controlled for the remainder of the construction process. The need for additional anchorage or tiebacks at the top of the wall using steel rods or soil anchors, as well as but the best technique for installation will be determined during the preconstruction, engineering, and design phase (PED).

Both types of seawall construction would occur in Reach 2.

2.2.2.3 Seawall with Fill

Bay fill is required for the seawall as it is designed at the location just southeast of the Ferry Building (Figure 6). All the area landward of the seawall would be filled with imported material.

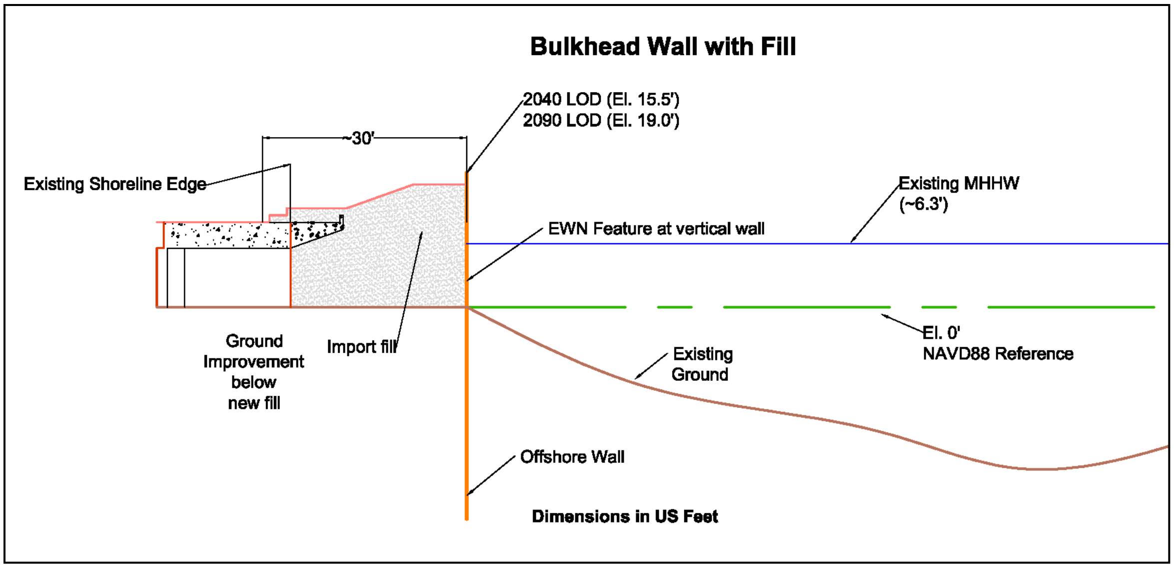


Figure 6. Example of seawall with fill shown in relation to the existing seawall. Dimensions are shown in U.S. feet in reference to NAVD88.

Where fill is installed behind a new wall, seismic ground improvements are expected to mitigate settlement below the new fill and seismic loads on the wall. Ground improvement methods are assumed to be via DMM, JG, CG, or VG. For seismic measures using DMM or VR, it would cover approximately 40 ft wide by 60 ft deep. Once wall construction and ground improvement are complete the surface would be restored with a mixture of landscape and hardscape.

Additionally, a levee would be constructed on existing ground landside of the seawall southeast of the Ferry Building. It would follow similar construction as described above. Following the construction of the wall, levee, and filling the bay, surface restoration will be required to return the construction site to its original condition.

2.2.2.4 Seawall and Wharf

Some areas of seawall construction would include re-construction of the wharf, for example at the Ferry Building (Figure 4). This would require ground improvements, fill to elevate grade, and surface restoration. The wall is assumed to be placed landward of the existing seawall thereby not requiring bay fill. Any existing wharf would need to be replaced and reconstructed to a higher elevation. The wharf would be demolished, material removed, hauled away, and disposed of. This would entail pulling out old pilings and existing concrete deck and surfacing (concrete or asphalt). The new wharf would be constructed of concrete or steel piles driven into the sand dike down to competent soils using marine equipment and impact or vibratory pile driving techniques. The reinforced concrete deck, that extends approximately 80 ft over the bay, could be constructed of pre-cast elements or using cast-in-place construction over the water.

Ground improvements are assumed to be necessary landward of the seawall and would cover an area approximately 20 ft wide and 80 ft deep. Ground improvements bay ward would be 20 ft wide and 100 ft long but would be constructed along a slope to match existing topography, rather than vertically to mitigate the potential for liquefaction within the existing sand dike (Figure 7).

The existing wharf supports several buildings and structures, all of which would need to be removed (permanently or temporarily) and either relocated or demolished and rebuilt. If demolished, the material would be removed and disposed of. For buildings requiring relocation, they would be lifted and placed on a floating barge or other staging location (likely Port of San Francisco owned property) until the new wharf has been constructed. In some instances, buildings being relocated would require modifications to allow for moving, and to make structural improvements to meet current building codes and standards once re-established on their new foundation. This is most likely to apply to historic bulkhead and shed building structures that are part of the Embarcadero Historic District.

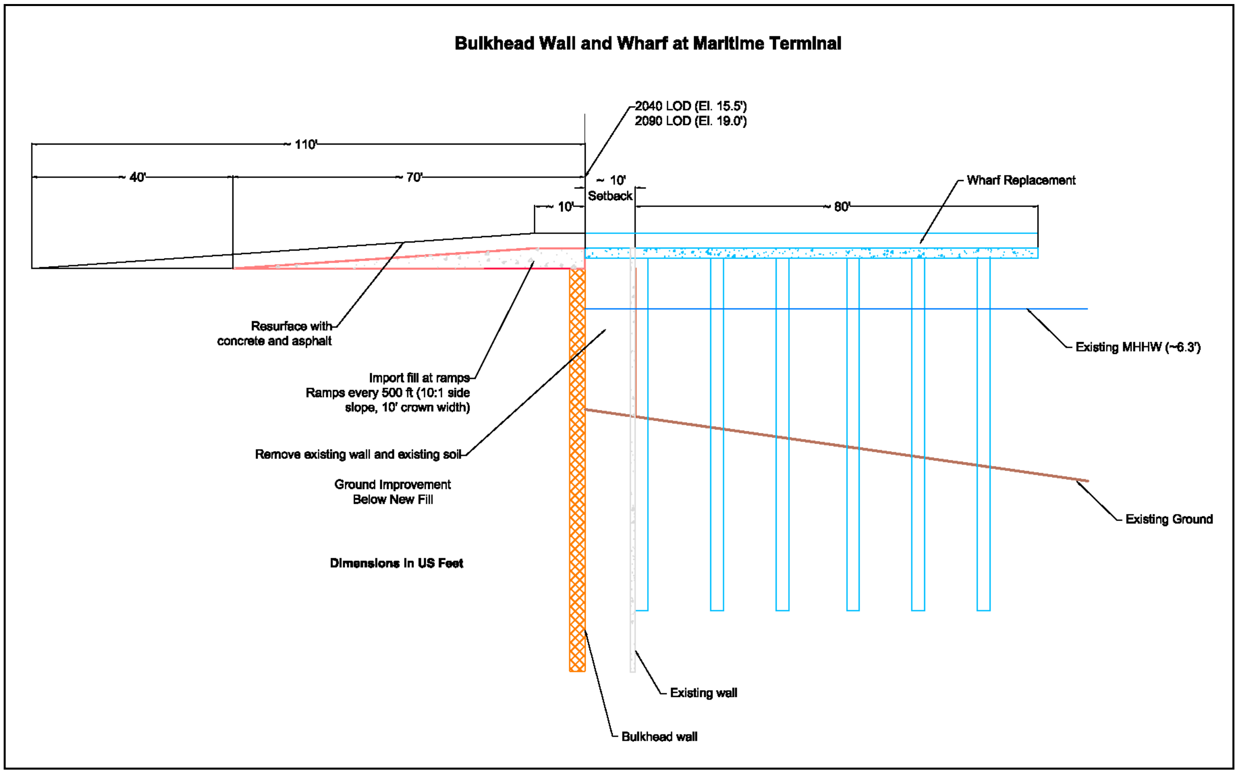


Figure 7. Seawall and wharf example showing ground improvements (red hashed), new wharf replacement (blue bricks), concrete ramp (grey), and seawall (orange hashed).

Ramp and vehicular access are anticipated to be constructed approximately every 500 ft along these areas and would be 20 ft wide with a 10H:1V slope. It is assumed the access routes would be constructed with imported fill material.

2.2.2.5 EWN – Coarse Beach

Construction of coarse beaches would consist of shore-based and in-water construction activities. Shore-based construction would involve grading and excavation and demolition of existing structures. In-water construction activities would include the use of equipment such as support barges, small support vessels, and use of cranes on work barges to place material. For some areas, bay fill would be required to construct the coarse beach further into the bay. Sand or rock material would be placed on top of fill material using heavy machinery to create the coarse beach. During bay fill, a cofferdam would be used to retain material during placement.

2.2.2.6 EWN – Living Shoreline

Living shoreline, synonymously referred to as living seawall, consist of structural elements combined with traditional seawalls that create varied micro-habitat conditions through surface relief and material composition. These elements can be added (i.e., bolt-on rock pools or tiles), or built into the design (i.e., pre-cast concrete). The introduction of surface complexity (e.g., surface texture, grooves, crevices, and nooks) to traditionally smooth surfaces promotes vegetation growth, provides foraging habitat, and creates shelter from predation. Eco-engineered structural elements may include attached panels and/or integrated/attached shelves (Figure 8).

Living shoreline features are assumed to be pre-cast textured tiles/surfaces/pots made with concrete or baycrete, a mixture of concrete and bay mud. They are assumed to be attached to the existing, or newly constructed, seawall structures using steel bolts and/or steel strapping to hold it in place. The additions would require a crane to lift the structures in place and then hand tools operated from in-water work barges to attach above the water line. For areas that reside below MHHW, the tiles would need to be installed in the dry. Thus, a cofferdam would be constructed to de-water the construction area to attach tiles, and then re-watered to move to the next section.

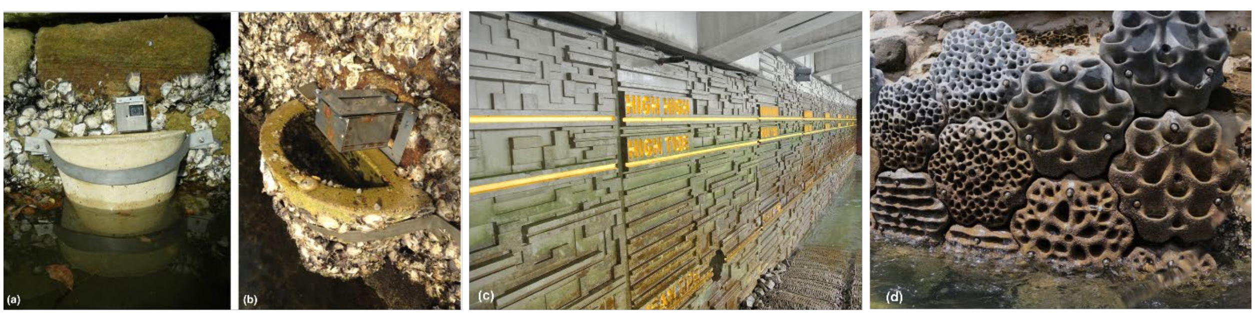


Figure 8. Examples of living seawall/vertical enhancements that could be installed on vertical shorelines. These could consist of pre-cast pots as shown in (a), (b), or (d) and pre-cast panels (c).

Source: Morris et al. 2017; Waterfront Seattle; van Remortel 2022

2.2.3 Reach 3

In Reach 3, the TNBP defends existing city and community assets in place by elevating the creek and Bay shorelines with naturalized or embankment shorelines, floodwalls, and raised and rebuilt bulkhead walls and wharves. The coastal defense will tie into existing and planned high ground at Bayfront, Agua Vista and Crane Cove Parks, and at the Mission Rock and Pier 70 development areas. This reach also includes partial reconstruction and redesign of the Embarcadero roadway south of the Bay Bridge (Figure 9).

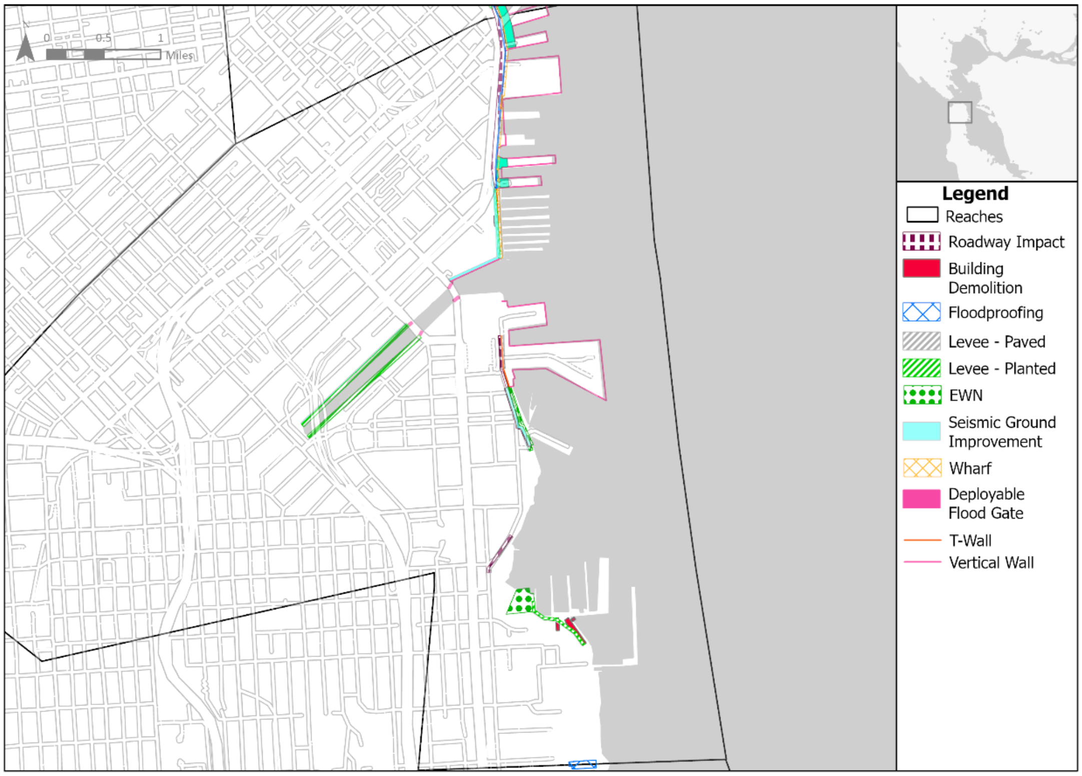


Figure 9. Total Net Benefits Plan, Reach 3.

2.2.3.1 Wharf

In areas that would be requiring wharf replacement, the existing wharf will be demolished, and material would be removed, hauled off, and disposed of. New piles would be installed using a pile driver in the wet, which is assumed to be completed by land operations. The reinforced concrete deck could be constructed of pre-cast elements or using cast-in-place construction over the water. Fill material, assumed to be sourced commercially, would be placed inland of the new wharf to raise elevation and graded using heavy machinery just as bull dozers, backhoes, etc.

2.2.3.2 Deployable Flood Gate

Deployable gates would be used to close the openings at bridges during high water events, while allowing continued vehicular, pedestrian, and rail access across bridges at all other times. These gates are most likely to be rolling gates specifically designed for temporary deployment during storm events or king tides. Rolling gates rest and roll on a ground wheel carrier and can be manually or mechanically operated (Figure 10). Roller gates would tie into the adjacent flood protection measures (i.e., levee and vertical wall) and be deployed during a flood event. Traffic control measures would be added to the bridges to warn of gate deployment when activated.

Figure 10. Example of deployable roller gates.

Source: Myrick et al. 2020

2.2.3.3 T-wall

A T-wall has a cross-section of an inverted "T", and as designed for this project, is configured with a horizontal base. In some areas, a new wharf pile-supported T-wall would be constructed landside of the existing seawall. T-walls would be constructed with concrete using cast-in-place techniques. The area landward of the t-wall would be regraded and is assumed to use imported fill material. After grading, the fill material would be paved to create sidewalks and landscape added. The panel height of each t-wall is dependent upon the existing elevation. The base of each t-wall is constructed wider than typical for the designed panel height to accommodate anticipated adaptability for future height increase.

2.2.3.4 EWN – Marsh Restoration/Enhancement

Restoration and enhancements of existing coastal wetland, tidal marsh, and mudflats includes the conservation of existing wetlands, and the restoration of degrading or degraded wetlands (Figure 11). Coastal wetlands include salt marshes, brackish marshes, and tidal freshwater marshes. Existing marsh measures may involve creating or adding limited features to the existing landscape, such as terracing to reduce erosion and partially attenuate waves, or combined with other structural (e.g., nearshore breakwaters, levees) or EWN measures (e.g., reefs, ecotone levees).

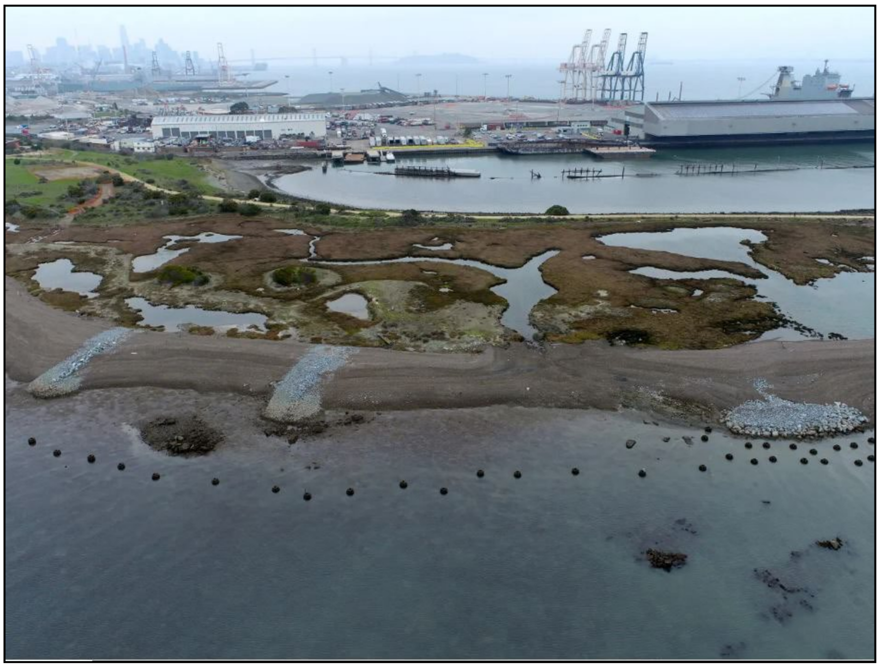


Figure 11. Tidal marsh at Heron's Head in San Francisco, CA.

Source: Port of San Francisco

Marsh improvement would occur at the Pier 94 wetlands to help with wave attenuation and improve coastal habitat availability. Approximately 3 acres of wetland enhancement is planned at Pier 94. It is assumed material used to augment the wetland would be commercially sourced but could be sourced from beneficial use of dredged material (BUDM) if deemed appropriate during PED. Material placed at the marsh would have similar properties to the existing material. Material would be built up to meet existing elevations of marsh, though final project design criteria will be determined during the PED phase. Sediment transport equipment would most likely include pipelines (submerged, floating, and land), and could require cutterhead or hopper dredges and booster pumps if dredged material is used. Heavy machinery would be used to move sediment and facilitate construction which could include bulldozers, front-end loaders, track-hoes, marshbuggy, and backhoes. Marsh restoration would be expected to tie into the adjacent levee.

The vegetated areas would target 60% coverage but can be up to 70% coverage at final settlement. This allows for 30-40% open water cover for suitable salt marsh habitat. Lower elevation marsh areas are expected to be inundated with salt water more frequently and, thus, require saline tolerant vegetation that prefer hydric soils. Higher marsh areas are expected to be inundated with salt water less frequently but still require saline tolerant plants that may be in dryer soils.

Marsh restoration activities would be broken down and divided into multiple confined cells along the proposed work area. Work would begin in an individual cell and continue until that cell is completed. It was assumed marsh-quality material would not be placed in multiple cells/areas at the same time.

2.2.3.5 EWN – Embankment Shoreline

In some locations, particularly along Islais and Mission Creeks, levees include an EWN feature to ameliorate the flood risks, while also providing ecological benefits. Two different EWN solutions have been designed dependent on the existing conditions and predicted future conditions at each site. EWN could be composed of a natural shoreline that has a gentler slope and shallow water and would consist of upland plantings, habitat shelves, tidal marsh, beach, submerged sill, and rock mound (i.e., naturalized shoreline). Alternatively, an embankment shoreline typically has a steeper slope leading to deeper water just offshore and includes upland planting and vegetated rip rap (Figure 12).

Embankment shorelines would require imported fill or rock, as well as terrestrial plantings to vegetate the shoreline. The construction area would require final grading using heavy machinery, followed by planting, or seeding of terrestrial plants. Vegetated rip rap combines rock and native vegetation to armor banks with added protection from root mass, while also improving fish habitat by creating shade, cover, and input of organic debris. Rip rap would be placed using cranes and vegetation would be planted afterwards. Approximately 0.7 acres of embankment shoreline is expected to be constructed at Mission Bay, while another 3 acres is proposed just south of Agua Vista Park.

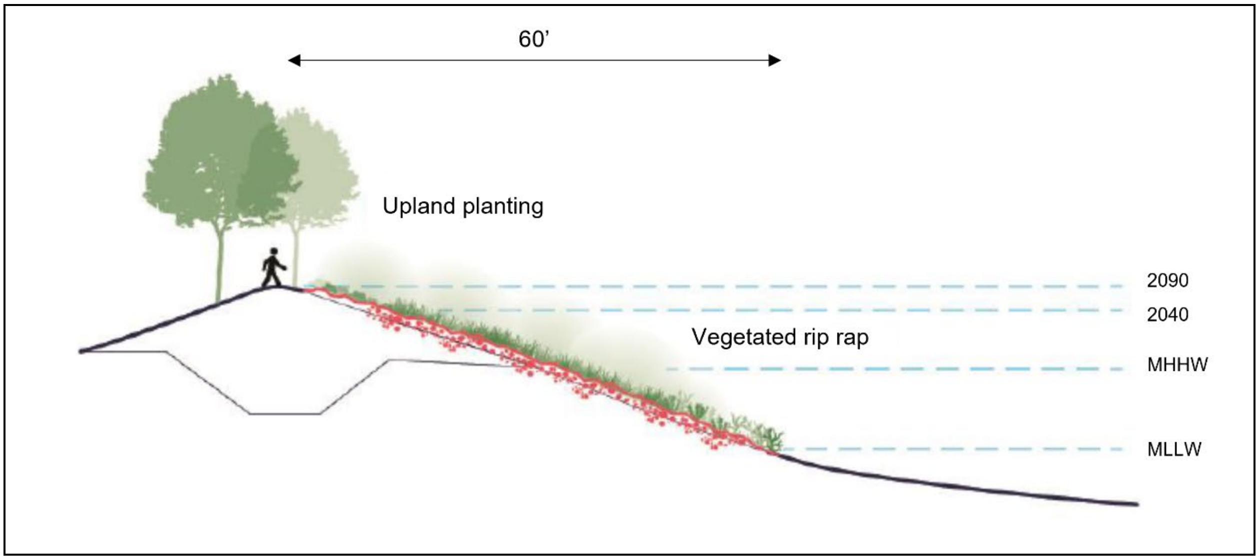


Figure 12. Embankment shoreline example. This includes upland planting and vegetated rip rap.

2.2.4 Reach 4

In Reach 4, the TNBP defends the existing shoreline to retain residential and commercial land uses in place, including Port land uses and maritime facilities. The flood defenses consist of raising the shoreline using naturalized or embankment shorelines, bulkhead walls, raising and rebuilding marginal wharves, deployable gate structures, and tying into existing or planned high ground, near Potrero Power Station and behind the Pier 94 Wetlands.

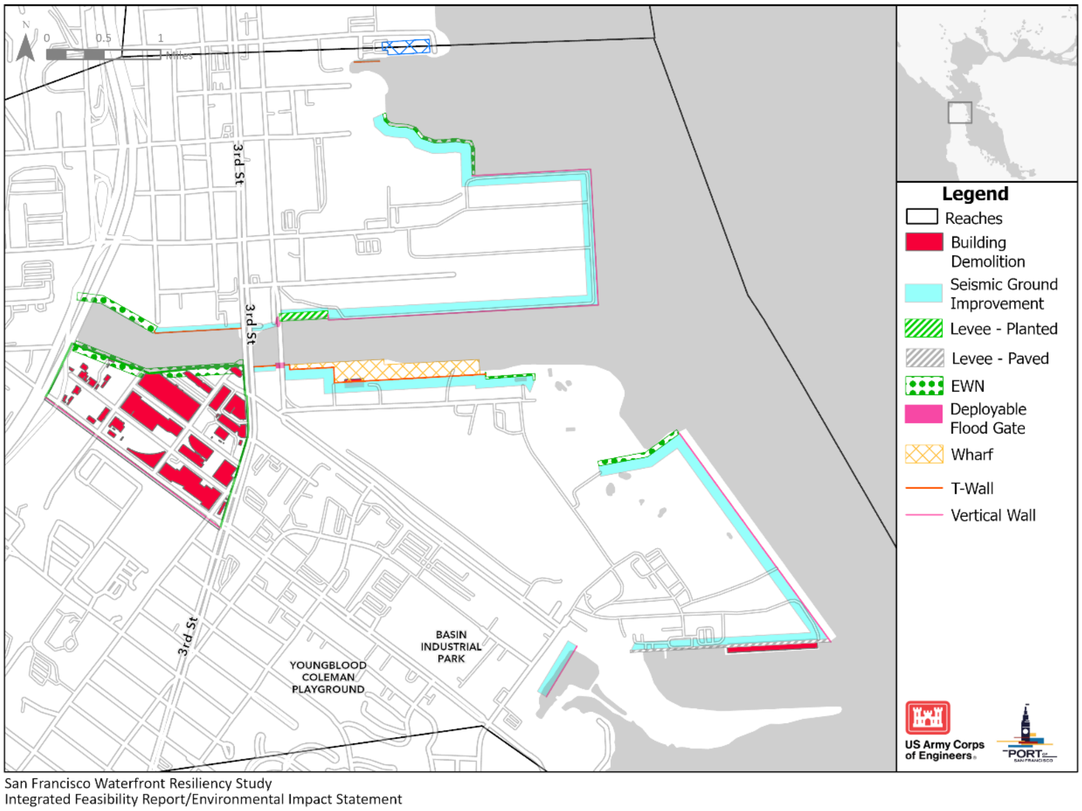


Figure 13. Total Net Benefits Plan, Reach 4.

Figure 13 depicts building demolition along the southern edge of Islais Creek – this is set to occur to accommodate an EWN naturalized shoreline not shown in the image. As such, Figure 14 shows a close up of the EWN proposed along Islais Creek.

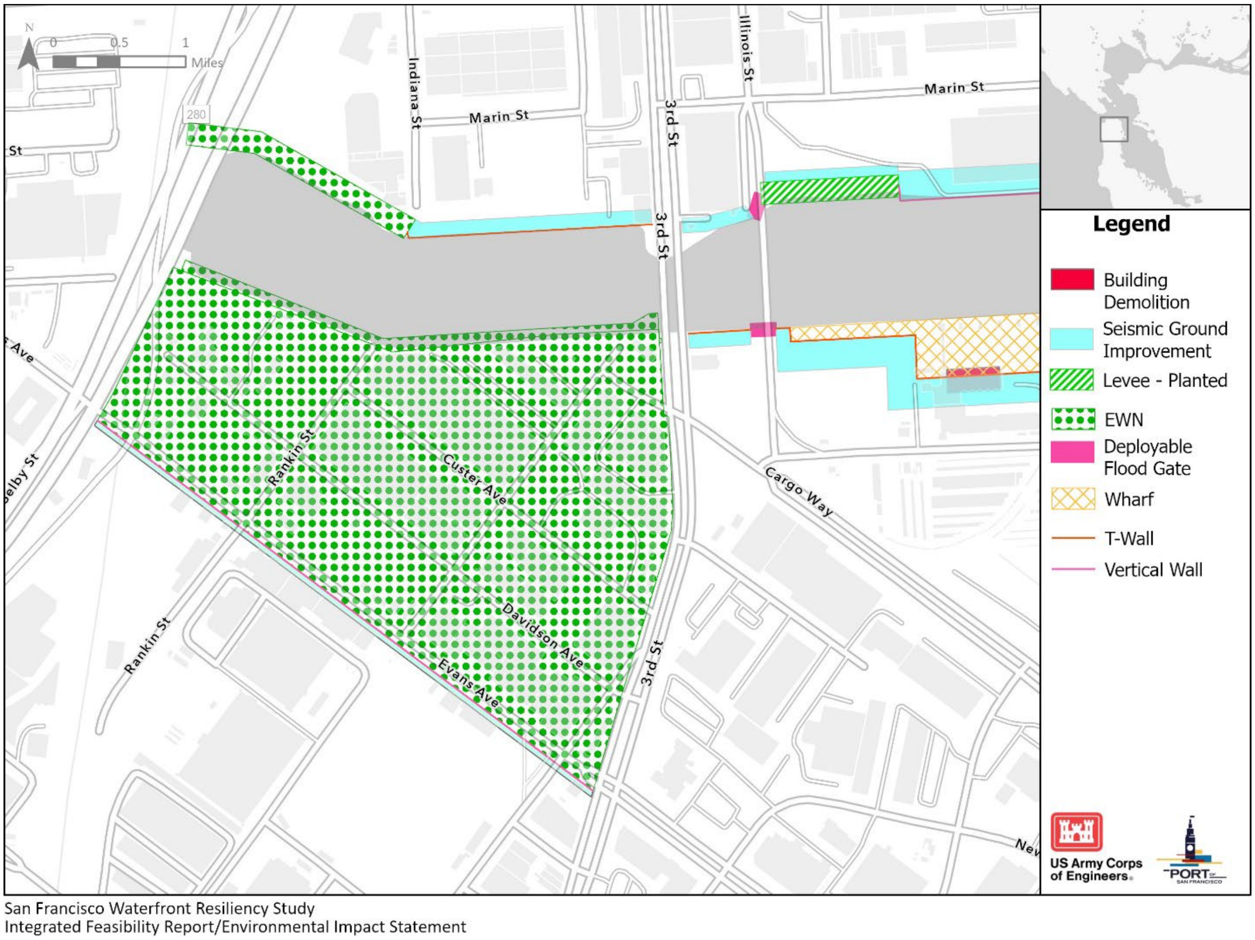


Figure 14. Total Net Benefits Plan, Reach 4 - EWN Naturalized Shoreline.

Measures such as t-walls, vertical walls, deployable flood gates and levees are intended to be constructed similarly to that described for previous reaches. EWN features proposed include naturalized and embankment shorelines, as well as ecological armoring.

2.2.4.1 EWN – Naturalized and Embankment Shorelines

Naturalized shorelines are assumed to require fill material, rock, and terrestrial plantings. Fill material is assumed to be sourced from commercial sources, but could be BUDM if deemed available during PED. Heavy machinery would be used to move sediment and facilitate construction which could include bulldozers, front-end loaders, track-hoes, marshbuggy, and backhoes. Submerged rock sill would be dumped in place to shape the mound below the water line using mechanical dredges or barge mounted excavators. Following this, planting or seeding would occur to establish the tidal and terrestrial vegetation. Additional design details and material needs would be determined during PED.

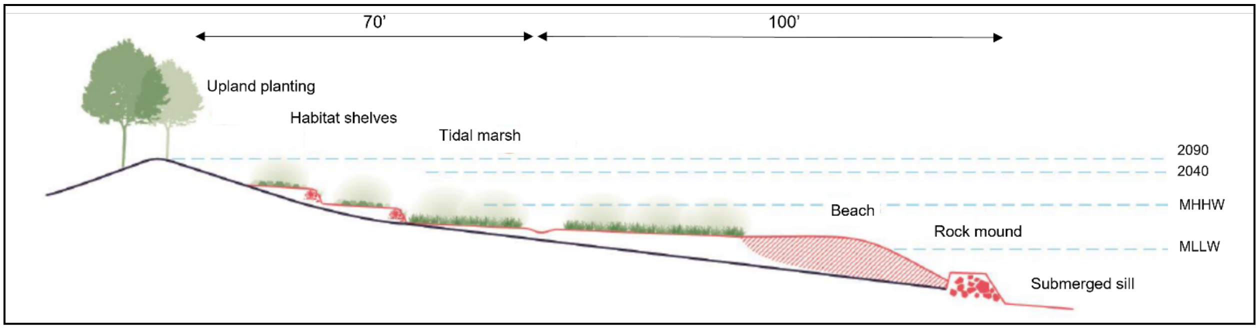


Figure 15. Naturalized shoreline example. This feature could include combinations of upland planting, habitat shelves, tidal marsh, beach, rock mounds, and submerged sill dependent on site conditions.

Naturalized shoreline features are proposed along Islais Creek. The northside of Islais Creek is intended to include 1.4 acres of naturalized shoreline, while the southern shoreline would include 42.3 acres (Figure 15).

2.2.4.2 EWN – Ecological Armoring

Ecological armoring measures aim to replicate the natural processes and functions of rocky intertidal habitat, providing erosion, wave energy protection and ecological benefits along the shoreline. Ecological armoring is a direct replacement for traditional riprap (Figure 16). Interlocking layered armored protection units or differently shaped rip-rap, sometimes with integrated tide pools, are designed to mimic natural intertidal conditions and create micro-habitats, including vegetation establishment while providing the protection and benefits of traditional gray structures. Units can be stone (rip-rap), concrete, or other precast material (including eco-concrete; Perkol-Finkel et al. 2015). In suitable wave environments, the armor units may be vegetated by filling voids in the rock with soil and planting upland, intertidal, and subtidal species (Summers 2010). Design elements include material composition, micro- (rock/unit and void size) and macro- (feature shape and orientation) configuration to reduce wave energy, limit erosion, and target desired species complexity (SFEI 2020).

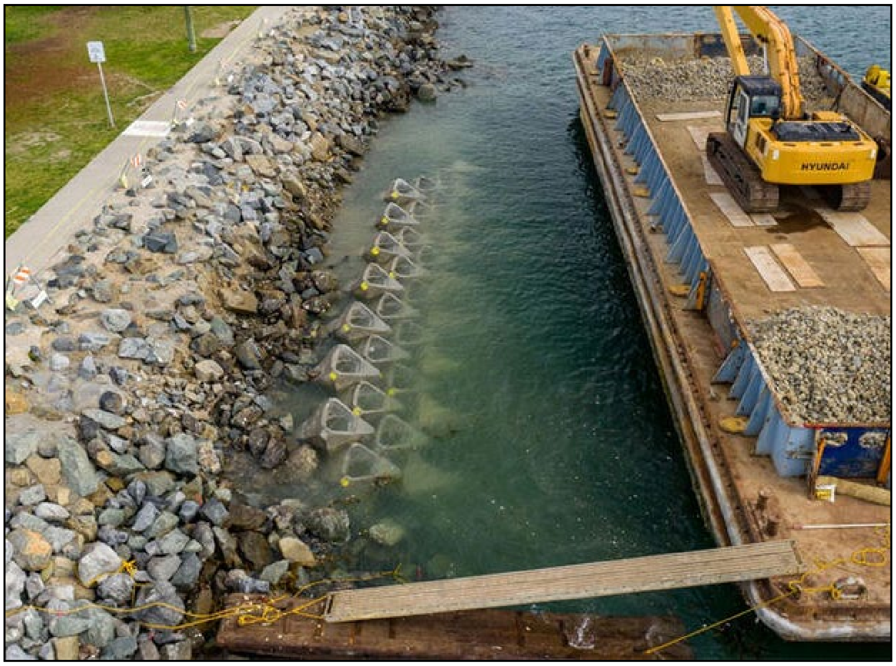


Figure 16. Example of ecological armoring from the ECOncrete Coastalock Blue Economy Pilot Project in San Diego, CA.

Source: Port of San Diego

Ecological armoring in the form of eco rip-rap is proposed to be installed from a work barge in the water to cover approximately 0.9 acres at Warm Water Cove.

2.2.5 Independent Measures for Consideration

The following list of “independent measures” represents a series of measures that could be added, all or some, to the preferred alternative. These measures include:

- **Living Seawalls:** textured concrete bolted onto the existing seawall in portions of Reaches 1, 2, and 3 to reduce wave hazards while supporting nearshore ecology wherever current maritime uses and pier configurations allow.
- **2A) Robust Coastal Defense of Ferry Building and Agriculture Building**: realigns the coastal flood defense structure adjacent to the bayside edge of the Ferry Building and Agriculture Building (i.e., existing wharf would be moved further into the bay).
- **2B) Coarse Beach at Rincon Park connecting to Pier 14:** Coarse beach would be integrated into the design of the flood defense where space constraints require bay fill.
- **3A) Bay Bridge to South Beach Harbor Raised Shoreline with Rebuilt Wharves from Bay Bridge to the mouth of Mission Creek:** raise the current shoreline and redesign of the northbound lanes of the Embarcadero roadway (in collaboration with SFMTA and the Embarcadero Enhancement Project), and the approach is intended to be designed to avoid reconstruction of the light rail track.
- **3B) McCovey Cove North Curb Extension:** raises the shoreline in line with the current shoreline edge on the north side of McCovey Cove (along the ballpark).

- **3C) Planted Naturalized or Embankment Shoreline on Mission Bay south of Pier 50:** integrates NNBF into the flood defense structure design to reduce wave hazards, support nearshore ecology, and provide public water access.
- **4A) Inland Coastal Flood Defense at Southwest Islais Creek:** Gradual area of retreat where the line of defense falls more landward and would convert some industrial and other public lands to open space allowing for more long-term flood defenses.

2.2.6 Avoidance and Minimization Measures

This section outlines avoidance and minimization measure, best management practices (BMPs), and conservation measures proposed by the USACE in order to avoid and minimize potential project effects.

USACE shall minimize impacts on fish, including protected species, by implementing the following measures:

- Prevent fish entrapment and entrainment during dewatering, such that fish rescue operations shall occur where dewatering and resulting isolation of fish may occur. Fish rescue and salvage operations shall occur prior to and during dewatering. If the enclosed area is wadable (less than 3 ft deep), fish can be herded out of the enclosure by dragging a seine (net) through the enclosure, starting from the enclosed end and continuing to the opening. After completing fish herding, the net or an exclusion screen shall be positioned at the opening to prevent fish from reentering the enclosure. Screens shall be checked periodically and cleaned of debris to permit free flow of water.
- Sheetpiles, block nets, or other temporary exclusion methods (e.g., silt curtains) could be used to exclude fish or isolate the construction area prior to a fish removal process.
- A dewatering plan shall be submitted as part of the SWPPP and Water Pollution Control Program, detailing the location of dewatering activities, equipment, and discharge point. Dewatering pump intakes shall be screened to prevent entrainment of fish in accordance with the NMFS screen criteria.
- A qualified fish biologist or fish rescue team shall be onsite during the dewatering process to minimize the number of fish that become trapped in isolated areas or impinged on pump screen(s) or isolation nets.
- Prior to any in-water construction that would require pile driving, a NMFS-approved sound attenuation monitoring plan to protect fish and marine mammals, and the approved plan shall be implemented during construction.
- All in-water construction shall be conducted within the environmental work window between June 1 and November 30, designed to avoid potential impacts to fish species.
- A soft start technique (release of pile-driving hammer without hydraulic pressure) to impact hammer pile driving shall be implemented, at the start of each workday

or after a break in impact hammer driving of 30 minutes or more, to give fish and marine mammals an opportunity to vacate the area.

- During in-water installation of piles, when feasible, vibratory hammers should be used in place of impact hammers, as well as cushion blocks should be used.

USACE shall minimize impacts on waters of the U.S. and waters of the state, including wetlands, by implementing the following measures:

- The proposed action shall be designed to avoid, to the extent practicable, work within wetlands and/or waters under the jurisdiction of the USACE, the regional waterboard, the California Department of Fish and Wildlife, and the Bay Area Conservation and Development Commission. If applicable, permits or approvals shall be sought from the regulating agencies as required. Where wetlands or other water features must be disturbed, the minimum area of disturbance necessary for construction shall be identified and the area outside avoided.
- Prior to construction within 50 ft of any wetlands and drainages, appropriate measures shall be taken to ensure protection of the wetland from construction runoff or direct impact from equipment or materials, such as installation of a silt fence, and signs indicating the require avoidance. No equipment mobilization, grading, clearing, or storage of equipment or machinery, or similar activity, shall occur until a qualified biologist has inspected and approved the fencing installed around these features. The contractor shall ensure the temporary fencing is maintained until construction activities cease.
- Where disturbance to jurisdictional wetlands or waters cannot be avoided, any temporarily affected areas shall be restored to pre-construction conditions or better at the end of construction, in accordance with regulating agencies.

2.2.7 Best Management Practices

This section outlines BMPs proposed by USACE in order to avoid and minimize potential project effects during construction. These are typical BMPs for construction activities to minimize potential short-term impacts. During PED, site specific BMPs would be developed, as appropriate.

BMPs would be used to manage sediment and erosion during the construction of any of the alternatives. Construction period preparedness and weather condition BMPs control erosion and sediment through management and monitoring that includes:

- Ensuring the contractor has the appropriate equipment and materials available at the start of construction to complete the project within the planned time frame.
- All disturbed areas are treated with erosion control measures.
- Coordination between vegetative planting and grading is in place prior to construction.

- Daily weather monitoring for possible precipitation events and a plan in case of significant rainfall.
- Preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP)to control erosion, storm water runoff, sedimentation, and other construction-related pollutants during all phases of construction, until the construction is complete and all disturbed areas are permanently stabilized throughout the project area.
- The short-term increase in sediment would be reduced by implementing the following erosion control measures during construction:
- All soils would be stabilized within 14 days of completed work.
- Construction equipment would be limited to the actual area being disturbed and vehicles may not travel in areas outside of designated staging areas or access routes.
- Short-term staging of soil material (less than 1 week) would be surrounded by a silt fence, fiber rolls, or other perimeter.
- Long-term staging of soil material (longer than 1 week) would be placed away from surface waters, vegetated, and surrounded by a berm perimeter to control runoff and erosion.
- Excavation would be limited to the extent practicable. All excavated material that is not relocated to another portion of the project area will be completely removed to a disposal site located outside the study area.
- Existing vegetation would be left in place to the maximum extent possible.
- Bare ground would be monitored for dryness and watered, if necessary, to reduce wind and water erosion.
- The contractor would be required to conduct water quality tests specifically for increases in turbidity and sedimentation caused by in-water construction activities. Water samples for determining background levels would be collected in San Francisco Bay in the vicinity of the construction site. Testing to establish background levels would be performed at least once per day when construction activity is in progress. The contractor would monitor turbidity and settleable solids at least daily and turbidity at least hourly when a turbidity plume is visible. If turbidity limits are exceeded, the contractor would slow the rate of earthwork or use other means to comply with the requirements, including stopping construction activities until the plume has cleared.
- Sediment barriers would be installed on graded or other disturbed slopes, as needed, to prevent sediment from leaving the project sites and entering nearby surface waters.

- The contractor would have a designated vehicle and equipment maintenance staging area that is self-contained to protect groundwater, surface water, and soils from contamination.
- Construction traffic would be restricted to predetermined routes.
- Traffic during wet weather or within the wet zone would be minimized.
- Pivoting excavators would be used within the wet zone to prevent rutting and excess erosion.
- A spill prevention and containment countermeasure plan that addresses all potential mechanisms of contamination would be developed. Suitable containment materials would be on site in the event of a spill. All discarded material and any accidental spills would be removed and disposed of at approved sites.
- Equipment and vehicles operated within the floodway would be checked and maintained daily to leaks of fuels, lubricants, and other fluids to surface waters. Hardened armoring would be used in areas susceptible to high erosion rates as identified by hydrologic and sedimentation modeling.

In order to avoid and/or minimize potential impacts to waters of the U.S. and state, water quality, and biological resources, the following minimum construction BMPs would be implemented as part of the proposed project. These minimum measures would be subject to modification and additions based upon regulatory and resource agency review.

- Unless otherwise specified in the project biological opinion, in-water construction activities shall be restricted to the NOAA approved environmental work window (June 1 to November 30).
- No debris, trash, creosote-treated wood, soil, silt, cement, concrete, or washings thereof, or other construction-related materials or wastes, oil, or petroleum products shall be placed in a location where it would be subject to erosion by rain, wind, or waves and allowed to enter jurisdictional waters, including as a result of fueling activities and storage of hazardous materials.
- No fresh concrete or concrete washings shall enter into jurisdictional waters. Fresh concrete will be isolated until it no longer poses a threat to water quality using appropriate measures, including exclusion of poured concrete from jurisdictional waters, such as open San Francisco Bay waters. Contractor(s) shall use only designated concrete transit vehicle cleanout stations for cleanout.
- Protective measures shall be utilized to prevent accidental discharges to waters during fueling, cleaning, and maintenance.

- Floating booms shall be used to contain debris discharged into waters and any debris shall be removed as soon as possible, no later than the end of each workday.
- Machinery or construction materials not essential for project improvements shall not be allowed at any time in the intertidal zone. The construction contractor shall be responsible for checking daily tide and current reports.
- Well-maintained equipment shall be used.
- A spill prevention contingency plan for hazardous waste spills into San Francisco Bay shall be prepared for review and approval. The plan shall include, at a minimum, floating booms, and absorbent materials to recover hazardous wastes.
- Contractors shall prepare an anchoring plan that applies to all ships, barges, and other open water vessels and describes procedures for deploying, using, and recovering anchorages.

BMPs for construction water-handling procedures and requirements for dewatering discharges in the study area include:

- Dischargers shall not violate any discharge prohibitions contained in applicable Basin Plans or statewide water quality control panels.
- The discharge does not cause or contribute to a violation of any water quality standard.
- The discharge is not prohibited by the applicable Basin Plan.
- The discharger has included and implemented specific BMPs required by their permit to prevent or reduce the contact of the non-stormwater discharge with construction materials or equipment.
- The discharge does not contain toxic constituents in toxic amounts or (other) significant quantities of pollutants.
- The discharge is monitored and meets the applicable numeric action levels.
- Best practices to minimize construction noise include the following:
- Limiting heavy equipment use to daytime hours not regulated by San Francisco, between 7:00 a.m. and 8:00 p.m.
- Limiting pile driving to times of day that would be least disruptive to residences, hotels, motels, hospitals, or convalescent homes.
- Locating stationary equipment (e.g., generators, pumps, cement mixers, idling trucks) as far as possible from noise-sensitive land uses.
- Requiring that all construction equipment powered by gasoline or diesel engines have sound-control devices, such as exhaust mufflers, that are at

least as effective as those originally provided by the manufacturer and that all equipment be operated and maintained to minimize noise generation.

- Using equipment powered by electric motors instead of gasoline- or diesel-powered engines.
- Preventing excessive noise by shutting down idle vehicles or equipment.
- Using noise-reducing enclosures around noise-generating equipment.
- Using noise-reducing shrouds for impact pile drivers, where feasible.
- Constructing barriers between noise sources and noise-sensitive land uses or taking advantage of existing barrier features (e.g., terrain, structures) to block sound transmission to noise-sensitive land uses. The barriers should be designed to obstruct the line of sight between the noise-sensitive land use and on-site construction equipment.

The following list of BMPs recommended by the Bay Area Air Quality Management District to reduce construction-generated criteria pollutant emissions:

- All exposed surfaces (e.g., unpaved parking and staging areas, soil piles, graded areas, and unpaved access roads) shall be watered two times per day, except during rainy days.
- All haul trucks transporting soil, sand, or other loose material off-site shall be covered.
- All visible mud or dirt track-out onto adjacent public roads shall be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited.
- All vehicle speeds on unpaved roads shall be limited to 15 miles per hour (mph).
- All roadways, driveways, and sidewalks to be paved shall be completed as soon as possible. Building pads shall be laid as soon as possible after grading unless seeding or soil binders are used.
- All excavation, grading, and/or demolition activities shall be suspended when average wind speeds exceed 20 mph.
- All trucks and equipment, including their tires, shall be washed off prior to leaving the active site.
- Unpaved roads providing access to sites located 100 feet or more from a paved road shall be treated with a 6- to 12-inch layer of compacted wood chips, mulch, or gravel.
- Publicly visible signs shall be posted with the telephone number and name of the person to contact at the lead agency regarding dust complaints. This person shall respond and take corrective action within 48 hours. The air

district's general air pollution complaints number shall also be visible to ensure compliance with applicable regulations.

- Limit the simultaneous occurrence of excavation, grading, and ground-disturbing construction activities.
- Install wind breaks (e.g., trees, fences) on the windward side(s) of actively disturbed
- areas of construction. Wind breaks should have a maximum of 50 percent air porosity.
- Plant vegetative ground cover (e.g., fast-germinating native grass seed) in disturbed areas as soon as possible and water appropriately until the vegetation is established.
- Install sandbags or other erosion control measures to prevent silt runoff to public roadways from sites with a slope greater than 1 percent.
- Minimize the amount of excavated material or waste materials stored at the site.
- Hydroseed or apply non-toxic soil stabilizers to construction areas, including previously graded areas, that are inactive for at least 10 calendar days.

3 Significant Degradation, Either Individually or Cumulatively, to the Aquatic Environment of the Preferred Alternative

3.1 Impacts on Ecosystem Function.

Only one structural measure (wharf raise/rebuild) and three EWN features (ecotone levees, marsh enhancements (second action), coarse beach and living seawall) in the preferred alternative (all independent measures) include the discharge of dredged or fill material into waters of the U.S. All other measures were designed and would be constructed landward of the existing shoreline to avoid discharge of fill materials and impacts to waters of the U.S. TNBP and the independent measures have been developed in accordance with the Guidelines.

For the wharf raise/rebuild measures old pier pilings (creosote covered wood or concrete and rebar) and decking (wood, concrete, and rebar) would be removed and replaced with new pilings (concrete) and decking (rebar, concrete, grates, etc.) that would facilitate a higher elevation wharf. There would be no increase in the footprint of the wharf and fewer piles would be necessary per square foot than currently exists resulting in a net decrease in bay fill and overall benefit from removal of old materials (e.g. creosote piles) that contribute to poor water quality and are toxic to marine life. Since the decking footprint would not change, it is anticipated that at a minimum the current light and temperature of the intertidal and subtidal habitat would remain the same. During PED, the designs will be refined to incorporate features that allow more light and air flow, where appropriate, than the current wharf allows, which would also be a long-term benefit to the marine environment.

For the ecotone levees, coarse beach EWN features, fill materials would primarily involve natural materials free of any contaminants or eco-friendly concrete that supports vegetative growth. Fill material would be placed between the MLLW and MHHW water line to achieve the target elevation that would support the desired community, such as tidal marsh or beach. Any existing fringe wetland or intertidal habitat would be filled with material and then restored. The length between loss and restoration is dependent on how long construction takes at the immediate site, type of plants used, and growing conditions, but is anticipated to reach pre-construction conditions or better within one to three growing seasons after a one year period of construction or two to five years. At each of these EWN locations, the purpose of the measure is to support the overall performance of the flood defense feature using natural processes. As a result, these features also provide habitat enhancements that result in a net increase in quantity and quality of intertidal, beach, and marsh habitats and overall benefit to the waters of the U.S. over the life of the project.

For the living seawall EWN feature, the fill material (most likely concrete) would be placed directly onto the existing seawall by bolting on or building into the design of another feature (e.g. new seawall) to create surface complexity (for example, surface texture, grooves, crevices, and nooks) to traditionally smooth surfaces. The living seawall is a relatively flat form of fill that would be placed from the bay bottom elevation to MHHW. This EWN feature will increase habitat diversity to the intertidal and sub-tidal environments where only open water currently exists resulting in an overall net benefit.

One measure (pier demolition) will remove approximately 1.0 acre of fill previously placed in waters of the U.S. including historic piles, bay fill, and pier decking and allow the area to restore to higher quality open water and subtidal habitat.

3.2 Impacts on Recreational, Aesthetic, and Economic Values.

The proposed project would not affect water-related recreation in the long-term; however, during the construction period, people recreating at Aquatic Park would experience construction-related noise and air emissions from operation of equipment. The construction-related activities would have temporary visually and audibly intrusive to the surrounding viewscape during construction (multi-year). Long-term presence of the elevated structures and new features (naturalized or embankment shorelines and pump stations) would change the viewscape; however, design elements of each feature incorporate the use of materials and architecture that blends with the surrounding landscape and with what was historically present, where appropriate (e.g., historic districts, along the Embarcadero). Some coastal views may be impacted or diminished but would still be available from other vantage points along the waterfront. With the design elements, the impacts are to be less than significant over the long-term. There is an expected positive economic impact on the community from the reduction of coastal flooding.

3.3 Findings.

USACE has determined that there would be no major adverse effects to aquatic ecosystem functions and values throughout from the preferred alternative. The preferred alternative would not cause significant degradation, either individually or cumulatively to the aquatic environment.

4 Appropriate and Practicable Measures to Minimize Potential Harm to the Aquatic Ecosystem.

4.1 Impact Avoidance and Minimization Measures

The TNBP, preferred alternative, avoids a significant amount of unavoidable adverse impacts to ecological habitats by placing features at or landward of the existing shoreline and designing the project to avoid bay fill to the greatest extent practicable and integrating engineering with nature where feasible. In addition, USACE would further avoid potential construction related effects to the aquatic ecosystem by timing restrictions and construction sequencing. The following is a brief assessment of the avoidance and minimization measures by reach.

4.1.1 Reach 1

All measures are considered nonstructural, meaning the measure attempts to reduce the flood risk and the damages associated with flooding rather than focusing on reducing or modifying how the water moves through the area. By design, the nonstructural measures realize impacts at the immediate site of the measure which is often isolated to the structure itself (e.g. floodproofing, building demolition) and do not involve disturbance of ecological habitats. Construction of the 2-foot wall around the piers involves minimal construction efforts that would be completed from the pier and would not involve any in-water work which avoids impacts to any aquatic habitats.

4.1.2 Reach 2

Reach 2 would involve constructing a seawall landward of the existing seawall and rebuilding approximately 6.3 acres of wharf. The existing wharf would need to be rebuilt to the higher elevation resulting in temporary localized impacts to the aquatic environment during construction. Because of the design, there would be no increase in the footprint of the wharf, all existing wharf material would need to be removed and replaced with new, more eco-friendly materials, and fewer piles would be necessary per square foot than currently exists.

4.1.3 Reach 3

In Reach 3, all measures are constructed landward of the existing shoreline and would not require any in-water work, thus avoiding the need for bay fill and adverse impacts to aquatic habitats. Additionally, all impacts from construction have been avoided on approximately 7,500 linear feet of shoreline because the design was aligned to take advantage of existing high ground to avoid unnecessary construction of additional features. Instead of raising the bridges, deployables are proposed which avoids a significant amount of in-water work and disturbance associated with replacing two bridges.

4.1.4 Reach 4

Like the other reaches, all measures are constructed landward of the existing shoreline and would not require any in-water work, thus avoiding the need for bay fill and adverse impacts to aquatic habitats. Additionally, all impacts from construction have been avoided on approximately 6,500 linear feet of shoreline because the design was aligned to take advantage of existing high ground to avoid unnecessary construction of additional features. Similar to Reach 3, the impacts of raising of existing bridges would be avoided by relying on deployables for flood defense. Similar to Reach 1, approximately 0.75 acres of building demolition would occur allowing these areas to convert to intertidal or sub-tidal habitat, while an additional 2.0 acres of building demolition would occur and be converted to open space.

4.1.5 Independent Measures for Consideration

All or some of the Independent Measures may be included in the preferred alternative and the following discussion outlines avoidance and minimization actions. All NNBFs minimize the long-term adverse impacts of the engineered structure despite some temporary aquatic impacts during construction. By incorporating NNBF into the design, natural processes and materials are used to reduce wave hazards, support nearshore ecology, and provide public water access in lieu of more traditional engineered designs and materials such as concrete, rip rap, or monoculture turf grass, which do not provide any long-term ecological or recreational benefits and are generally less visually desirable. Additionally, implementation of the NNBF avoids conversion of existing habitats into impervious surfaces.

Similar to other shoreline raises, this measure would be constructed entirely landward of the existing shoreline and avoids any impacts to aquatic habitats. Approximately 4.5 acres of wharf would also need to be rebuilt which would involve some temporary impacts, but overall result in long-term benefits from removal of old construction materials and a reduction in bay fill as described for reach 1 second action. The footprint would not be increased and therefore long-term changes from a footprint increase have been avoided. As well, the modified design in this location avoids disruptions and reconfiguration of the light rail system.

This modification aligns the flood defense with the current shoreline edge on the north side of McCovey Cove (along the ballpark) and avoids needing to add fill or extend the shoreline into the creek, thus avoiding any aquatic impacts.

The modification incorporates a small area of gradual retreat along the creek, resulting in long-term ecological benefits and avoidance of engineered structures and permanent impacts at or near the existing shoreline. These areas would be allowed to flood and be overtaken by RSLC, which is expected to convert to marsh, intertidal or sub-tidal habitat. Long-term conversion of existing habitats into impervious surfaces would be avoided. As well, this conversion of some industrial lands and public facilities would provide public water access and additional open space.

4.2 Compensatory Mitigation Measures

There is no anticipated long-term loss of wetlands that would require compensatory mitigation. Approximately 8.0 acres of bay fill will from construction of the independent measures would require compensatory mitigation in the form of old and unused pier and piling removal. A conceptual compensatory mitigation plan has been developed (Appendix K of IFR/EIS) and will continue to be refined through the final IFR-EIS and in PED as the designs are further refined.

4.3 Findings

Avoidance, minimization, and mitigation measures are conceptual at this stage. Further development would be made during the PED phase. USACE has determined that all appropriate and practicable measures would be taken to minimize potential harm to the environment.

5 Other Factors in the Public Interest

a) *Fish and Wildlife.* USACE is coordinating with Federal and State agencies and tribes to ensure that direct and indirect loss and damage to fish and wildlife resources attributable to the proposed work would be minimized. USACE would continue coordination with Federal and State agencies and tribes during PED. Endangered Species Act (ESA) consultation with National Marine Fisheries Service (NMFS) and US Fish and Wildlife Service (USFWS) is expected to be completed by the final IFR-EIS. USACE is preparing biological assessments to be submitted to both NMFS and USFWS, initiating formal and informal consultation, respectively. In compliance with Magnuson-Stevens Fishery Conservation and Management Act, effects to essential fish habitat will be consulted on in conjunction with the ESA Section 7 consultation and included in the NMFS consultation.

b) *Water Quality*. USACE would obtain a Water Quality Certification under Section 401 of the Clean Water Act during PED when more detailed designs are available.
c) *Historic and Cultural Resources*. USACE will consult with representatives of the interested tribes, the State Historic Preservation Office, and other parties on the preferred alternative. In accordance with 36 CFR 800.14, USACE has prepared a draft Programmatic Agreement to address the identification and discovery of cultural resources that may occur during the construction and maintenance of proposed or existing facilities. It is anticipated that the Programmatic Agreement would be executed prior to the release of the final IFR-EIS.
d) *Environmental Benefits*. Three of the five measures in Reach 1 would provide long-term ecological benefits. Approximately 1.7 acres of land would be allowed to flood and be overtaken by RSLC from implementation of the retreat measure (1.6 acres) and building demolition (0.1 acres). In these locations, it is anticipated that intertidal habitat would be naturally created. Additionally, demolition of two piers would remove approximately 1.0 acre of piles, bay fill, and decking and allow the area to restore to higher quality open water and subtidal habitat. In Reach 2, the overall long-term benefits to the aquatic environment are expected from the net decrease in bay fill and removal of old materials (e.g. creosote piles) that contribute to poor water quality. Any EWN measures would also provide an additional long-term ecological benefit.
e) *Navigation*. No temporary or permanent disruption of navigation traffic is expected from implementation of the preferred alternative.

Findings. USACE have determined that the preferred alternative is within the public interest based on review of the public interest factors.

6 Conclusions

6.1 Clean Water Act Section 404(B)(1) Evaluation [40 C.F.R. Part 230]

Based on the analysis in the SFWS DIFR-EIS, as well as the following 404(b)(1) Evaluation and General Policies for the Evaluation of the Public Interest, USACE finds that this project complies with the substantive elements of Section 404 of the CWA.

6.1.1 Potential Impacts on Physical and Chemical Characteristics (Subpart C)

1. **Substrate [230.20].** Approximately 9.0 acres of bay fill would cover the substrate at that location resulting in permanent loss. To offset this impact, old and unused pier and piling removal is proposed as compensatory mitigation. A conceptual compensatory mitigation plan has been developed (Appendix K of IFR/EIS) and will continue to be refined through the final IFR-EIS and in PED as the designs are further refined.

2. **Suspended Particulate/Turbidity [230.21].** Proposed seawall and wharf construction would cause turbidity, resuspended sediments, and could suspend contamination from underlying sediments or result in debris and release of contaminating materials. Replacement of roadways would lead to changes and expansion in stormwater, sewer, and inland drainage systems. Shore-based measures are expected to have less than significant impacts with temporary increased turbidity and sediment suspension localized to the construction area. Site specific effects regarding suspended particulate and turbidity are not known at this time. As site-specific designs are developed during PED for the implementation of the preferred alternative, details will be available to evaluate site-specific effects.
3. **Water [230.22].** Bay fill, construction of bayward sections of the seawall, roadway construction, and wharf replacement are all anticipated to have significant and unavoidable impacts to water quality. Bay fill permanently removes open water, while seawall and wharf construction would cause turbidity, resuspended sediments, and could suspend contamination from underlying sediments or result in debris and release of contaminating materials. Replacement of roadways would lead to changes and expansion in stormwater, sewer, and inland drainage systems. Shore-based measures are expected to have less than significant impacts with temporary increased turbidity and sediment suspension localized to the construction area.
4. **Current Patterns and Water Circulation [230.23].** Temporary impacts to currents may result during construction of shore-based measures located at the MHHW line, such as levees, and some EWN features such as ecological armoring. Localized, temporary impacts from the in-water measures such as bulkhead walls/seawalls, wharfs, and bay fill are also anticipated to adversely impact currents due to increased velocities at the toe of the structural measures, which may change wave energy in the bay. Wave energies could increase at the hardened structures which may increase tidal current velocities and lead to temporary indirect impacts from sedimentation or scour. The waterfront is highly urbanized at present; however, some new hardened structures may be introduced to protect against flood risks. Temporary impacts during construction include physical seabed disturbance that increase current velocities such as foundation installation, excavation, and fill activities.

   CSRM measures installed in the bay below the high tide line would likely alter the bay shoreline permanently. Such an alteration could affect the movement of water in the bay due to altered circulation patterns, which could substantially change the bay floor adjacent to the new shoreline as a result of sediment scour. Sediment transport induced by waves and currents interacting with the new structures could alter the hydraulic forces exerted on the bay floor and shoreline, thereby inducing changes in scour and deposition.

5. **Normal Water Fluctuations [230.24].** The preferred alternative is not expected to affect normal water level fluctuations such as tidal.

6. **Salinity Gradients [230.25].** No impacts to salinity are anticipated during the construction of shore-based measures. Temporary impacts to salinity would be expected during in-water construction measures, which may occur if there is a physical barrier in the water that prevents full tidal exchange (e.g., cofferdam).

6.1.2 Potential Impacts on Biological Characteristics of the Aquatic Ecosystem (Subpart D)

1. **Threatened and Endangered Species [230.30].** ESA consultation with NMFS and USFWS is expected to be completed by the final IFR-EIS. USACE is preparing biological assessments to be submitted to both NMFS and USFWS, initiating formal and informal consultation, respectively. In compliance with Magnuson-Stevens Fishery Conservation and Management Act, effects to essential fish habitat will be consulted on in conjunction with the ESA Section 7 consultation and included in the NMFS consultation.

2. **Aquatic Food Web [230.31].** Construction activities including turbidity generating and pile removal may interfere with feeding and respiratory mechanisms of aquatic species. Some sessile invertebrates will suffer mortality from these activities. Most of these species are mobile and are expected to escape the immediate area without significant injury. Potential effects would be reduced and/or avoided through avoidance and minimization measures.

3. **Wildlife [230.32].** Noise and air emission associated with construction activities may affect wildlife in the project area. The effects of any disturbance would likely cause displacement of wildlife, but injury is possible for aquatic species from the bay fill activities. Increases in turbidity associated with in-water work could reduce visibility directly below and for a short distance from disturbance, thereby reducing foraging success for any animals in the area. Any reduction in availability of food would be localized and subside rapidly upon completion of the activity.

6.1.3 Potential Impacts to Special Aquatic Sites [Subpart E]

1. **Sanctuaries and Refuges [230.40].** Not applicable.

2. **Wetlands [230.41].** Effects to wetlands have been determined to be construction-related and temporary. No proposed features of the preferred alternative would be constructed within the two wetlands in the project footprint.

3. **Mudflats [230.42].** Effects to mudflats, if present, would be construction-related, short-term and indirect. No proposed features of the preferred alternative are proposed in any mudflats.

4. **Vegetated Shallows [230.43].** No vegetated shallows such as eelgrass are present in the project area.
5. **Coral Reefs [230.44].** Not applicable.
6. **Riffle and Pool Complexes [230.45].** Not applicable.

6.1.4 Potential Effects on Human Use Characteristics (Subpart F)

1. **Municipal and Private Water Supplies [230.50].** Not applicable.
2. **Recreational and Commercial Fisheries [230.51].** Construction of wharf replacement and seawall would have temporary impacts to fisheries through impacts to fish which would lead to avoidance of the construction area. In-bay fill would permanently remove fish habitat which would likely impact fisheries during construction but is not anticipated to have long-term adverse impacts. Overall, the temporary nature of adverse impacts is expected to be less than significant for fisheries.
3. **Water-Related Recreation [230.52].** The proposed project would not affect water-related recreation in the long-term; however, during the construction period, people recreating at Aquatic Park would experience construction-related noise and air emissions from operation of equipment.
4. **Aesthetics [230.53].** The construction-related activities would have temporary visually and audibly intrusive to the surrounding viewscape during construction (multi-year). Long-term presence of the elevated structures and new features (naturalized or embankment shorelines and pump stations) would change the viewscape; however, design elements of each feature incorporate the use of materials and architecture that blends with the surrounding landscape and with what was historically present, where appropriate (e.g., historic districts, along the Embarcadero). Some coastal views may be impacted or diminished but would still be available from other vantage points along the waterfront. With the design elements, the impacts are anticipated to be less than significant over the long-term.
5. **Parks, National and Historic Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves [230.54].** The Preferred Alternative is not expected to adversely affect parks, National and Historic Monuments, National Scenic Areas, National Seashores, Wilderness Areas, research sites, or similar preserves, either because none of these sites are in the study area or any impacts would result in no or negligible change from the existing condition.

6.1.5 Evaluation and Testing (Subpart G)

1. **General Evaluation of Dredged or Fill Material [230.60].** No specific sediment testing has occurred associated with this project, but testing may be done during

the construction phase. No contaminated material would be used as fill, nor would it be sidecast after excavation if found to contain contaminants. Sources of fill would be examined to ensure that any material imported to sites to be used as fill is clean material free of contaminants.

2. **Chemical, Biological, and Physical Evaluation and Testing [230.61].** No specific sediment testing has occurred associated with this project but may be done during the construction phase.

6.1.6 Action to Minimize Adverse Effects (Subpart H)

1. **Actions Concerning the Location of the Discharge [230.70].** Effects of the discharge would be minimized by implementing BMPs, timing of in-water work, and construction sequencing, as described above in Sections 2.2.6, 2.2.7, and 4.1. Exact information about location of discharge is not known at this time. As site-specific designs are developed during PED for the implementation of the preferred alternative, site-specific details will be available.
2. **Actions Concerning the Material to be Discharged [230.71].** Materials to be discharged would be sourced from an approved and permitted sources offsite. USACE would evaluate all materials for suitability. Exact information about material to be discharged is not known at this time. As site-specific designs are developed during PED for the implementation of the preferred alternative, site-specific details will be available.
3. **Actions Controlling the Material after Discharge [230.72].** Implementation of BMPs and construction sequencing, as described above in Sections 2.2.6, 2.2.7, and 4.1 would facilitate controlling material after discharge such as silt fencing. Exact information about how the material will be controlled after discharge is not known at this time. As site-specific designs are developed during PED for the implementation of the preferred alternative, site-specific details will be available.
4. **Actions Affecting the Method of Dispersion [230.73].** Implementation of BMPs and construction sequencing, as described above in Sections 2.2.6, 2.2.7, and 4.1 would facilitate method of dispersion in a controlled manner such as silt fencing. Exact information about method of dispersion is not known at this time. As site-specific designs are developed during PED for the implementation of the preferred alternative, site-specific details will be available.
5. **Actions Related to Technology [230.74].** Appropriate machinery and methods of transport of material for discharge and placement would be employed. All Machinery would be properly maintained and operated. Exact information about machinery and methods of transport is not known at this time. As site-specific designs are developed during PED for the implementation of the preferred alternative, site-specific details will be available.

6. **Actions Affecting Plant and Animal Populations [230.75].** USACE has coordinated with the state and Federal resource agencies to minimize and avoid impacts to the greatest extent possible. Site-specific effects to plant and animal populations are not known at this time. As site-specific designs are developed during PED for the implementation of the preferred alternative, site-specific details will be available.
7. **Actions Affecting Human Use [230.76].** During construction, temporary impacts to the human environment would occur from noise, air emission, and turbidity generating activities. Over the long-term, there are expected to be beneficial effects to the human environment from reduction in coastal flood risk and implementation of EWN. Site specific effects to human use are not known at this time. As site-specific designs are developed during PED for the implementation of the preferred alternative, site-specific details will be available.
8. **Other Actions [230.77].** Not applicable.

6.1.7 Application By Analogy of the General Policies for the Evaluation of Public Interest [33 C.F.R. § 320.4 For Reference]

1. **Public Interest Review [320.4(a)].** USACE finds these actions to be in compliance with the 404(b)(1) guidelines and not contrary to the public interest.
2. **Effects on Wetlands [320.4(b)].** Effects to wetlands have been determined to be construction-related and temporary. No proposed features of the preferred alternative would be constructed within the two wetlands in the project footprint.
3. **Fish and Wildlife [320.4(c)].** USACE is coordinating with Federal and State agencies and tribes to ensure that direct and indirect loss and damage to fish and wildlife resources attributable to the proposed work would be minimized. USACE would continue coordination with Federal and State agencies and tribes during PED.
4. **Water Quality [320.4(d)].** USACE would obtain a Water Quality Certification under Section 401 of the Clean Water Act during PED when more detailed designs are available.
5. **Historic, Cultural, Scenic, and Recreational Values [320.4(e)].** USACE will consult with representatives of the interested tribes, the State Historic Preservation Office, and other parties on the preferred alternative. In accordance with 36 CFR 800.14, USACE has prepared a draft Programmatic Agreement to address the identification and discovery of cultural resources that may occur during the construction and maintenance of proposed or existing facilities. It is anticipated that the Programmatic Agreement would be executed prior to the release of the final IFR-EIS. Measures have been incorporated into the designs during feasibility to avoid and minimize impacts. During PED, through execution of the Programmatic

Agreement, any identified impacts would be further avoided or minimized where possible or compensated if necessary.

Additionally, the Golden Gate National Recreation Area (NRA), the San Francisco Maritime Historical Park, and Aquatic Park National Historic Landmark, all managed by the National Park Service, are found in the study area in reach 1 and could be impacted by the project. For the first action, all proposed measures within the these areas are non-structural in nature and would not affect the operation, character, or value of the park. An additional eight National Historic Landmarks, all historic ships, are found in reaches 1 and 2. Each of these would be protected and avoided during any nearby construction to avoid impacts. All of these sites would also be subject to the requirements of the Programmatic Agreement. No wild and scenic rivers, National Rivers, National Wilderness Areas, National Seashores, National Lakeshores, National Parks, National Monuments, or estuarine and marine sanctuaries would be affected by the preferred alternative.

6. **Effects on Limits of the Territorial Sea [320.4(f)].** Not applicable.
7. **Consideration of Property Ownership [320.4(g)].** Not applicable.
8. **Activities Affecting Coastal Zones [320.4(h)].** It is anticipated that the preferred alternative will be consistent with the policies set forth in the San Francisco Bay Conservation and Development Commission's (BCDC) San Francisco Bay Plan, San Francisco Waterfront Special Area Plan and the San Francisco Bay Seaport Plan and has prepared a draft Consistency Determination for the project with the information available at this time. The draft Consistency Determination will be coordinated with the BCDC between the draft and final IFR-EIS to identify any data gaps or additional conservation or mitigation measures that should be considered. The BCDC has informed the agency that the project design details are not sufficient to support a formal review and issuance of consistency during feasibility and, therefore, compliance with the CZMA is delayed until PED when a greater level of design is available.
9. **Activities in Marine Sanctuaries [320.4(i)].** Not applicable.
10. **Other Federal, State, or Local Requirements [320.4(j)].** USACE has analyzed the Preferred Alternative under all applicable Federal, State, and local requirements and documented this compliance in Section 5 of Appendix D of the SFWS DIFR-EIS.
11. **Safety of Impoundment Structures [320.4(k)].** Not applicable.
12. **Floodplain Management [320.4(l)].** The Preferred Alternative would not alter floodplain areas.
13. **Water Supply and Conservation [320.4(m)].** Not applicable.
14. **Energy Conservation and Development [320.4(n)].** Not applicable.

15. **Navigation [320.4(o)].** Not applicable.

16. **Environmental Benefits [320.4(p)].** Three of the five measures in Reach 1 would provide long-term ecological benefits. Approximately 1.7 acres of land would be allowed to flood and be overtaken by RSLC from implementation of the retreat measure (1.6 acres) and building demolition (0.1 acres). In these locations, it is anticipated that intertidal habitat would be naturally created. Additionally, demolition of two piers would remove approximately 1.0 acre of piles, bay fill, and decking and allow the area to restore to higher quality open water and subtidal habitat. In Reach 2, the overall long-term benefits to the aquatic environment are expected from the net decrease in bay fill and removal of old materials (e.g. creosote piles) that contribute to poor water quality. Any EWN measures would also provide an additional long-term ecological benefits.

17. **Economics [320.4(q)].** The Federal objective is to contribute to the national economic development. The benefit-cost analysis was completed to measure contributions to the nation in terms of goods and services such as reduce the risk of coastal flooding. The economic analysis is documented in the SFWS DIFR-EIS.

18. **Mitigation [320.49(r)].** There is no anticipated long-term loss of wetlands that would require compensatory mitigation. Approximately 8.0 acres of subtidal habitat would be permanently adversely impacted by bay fill from construction of the independent measures and would require compensatory mitigation in the form of old and unused pier and piling removal. A conceptual compensatory mitigation plan has been developed (Appendix K of IFR/EIS) and will continue to be refined through the final IFR-EIS and in PED as the designs are further refined.

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