Appendix J Sea Level Rise

Memo

Date:	March 22, 2024
Project:	Capitol Corridor South Bay Connect Environmental Impact Report
To:	Jelica Arsenijevic and Kelly Czechowski, HDR
From:	Joyce Cheng and Lesley Brooks, HDR|WRECO
RE:	Interim Draft Sea Level Rise Subsection of the Environmental Impact Analysis for the Environmental Impact Report

5 Sea Level Rise

This section describes the regulatory setting and the affected environment for sea level rise (SLR). Project build alternatives, Alternatives, B, C, and D have the same proposed improvements along the Coast Subdivision, which includes an area of improvements potentially located within the San Francisco Bay Conservation and Development Commission's (BCDC) jurisdiction. This location consists of an approximately 4,200 feet long segment of track crossing Estudillo Canal near Heron Bay in San Leandro that may be within BCDC jurisdiction, as it borders a tidal marsh to the west. The railroad alignment is parallel to a channel with an inlet to the marsh farther north, and west of the channel is a berm which separates this channel from the marsh. Alternative E also includes this location within its proposed improvements.

Alternative E proposes additional improvements along the Coast Subdivision, which includes additional areas of improvements potentially located within BCDC jurisdiction as they are adjacent to tidal marsh areas and wetlands. These six locations include:

- an approximately 200-foot-long segment of track crossing San Leandro Creek,
- an approximately 260-foot-long segment of track crossing San Lorenzo Creek,
- an approximately 4,700-foot-long segment of track adjacent to Oro Loma Marsh located within San Lorenzo and Hayward municipal limits where the railroad alignment is parallel to a berm which spans almost the entire length of the trackway and separates the trackway from the marsh,
- an approximately 4,900-foot-long segment of track near Eden Landing in Hayward that borders a tidal marsh to the west, crosses Old Alameda Creek and borders adjacent wetlands south of the creek crossing,

- an approximately 1,000-foot-long segment of track crossing Alameda Creek, and
- an approximately 4,100-foot-long segment crossing an unnamed channel and Newark Slough.

The resource study areas (RSA) include all Union Pacific Railroad (UPRR) right-of-way that is potentially under BCDC jurisdiction within the limits of Project work.

5.1 Regulations and Guidance

This section describes the regulatory setting for SLR according to federal, state, and local guidelines.

5.1.1 FEDERAL PLANS, POLICIES, AND REGULATIONS

Coastal Zone Management Act (16 U.S.C. §§ 1451 et seq.)

The objective of the Coastal Zone Management Act of 1972 is to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone." Coastal zone means "the coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the lands therein and thereunder including the waters therein and thereunder), strongly influenced by each other and close to the shorelines of the several coastal states, and includes islands, transitional and intertidal areas, salt marshes, wetlands and beaches." This act also requires projects to be planned, located, designed, and engineered for the changing water levels and associated impacts that might occur over the duration of the development. The Coastal Zone Management Act is administered by the California Coastal Commission in most areas within California; in the Bay Area, the Coastal Zone Management Act is administered by BCDC, as established by the McAteer-Petris Act. This act is described in the Local Plans, Policies, and Regulations Section (5.1.3), along with more details on BCDC climate change policies.

5.1.2 STATE PLANS, POLICIES, AND REGULATIONS

Executive Order S-13-08: Climate Change Adaptation

On November 14, 2008, then California Governor Arnold Schwarzenegger signed Executive Order S-13-08. This executive order directs all state agencies planning to construct projects in areas vulnerable to future SLR to consider a range of sea level projections for the years 2050 and 2100, assess project vulnerability, and, to the extent feasible, reduce expected risks and increase resiliency to SLR.

State of California Sea-Level Rise Guidance 2018 Update

The State of California SLR Guidance 2018 Update (California Natural Resources Agency and Ocean Protection Council [CNRA & OPC], 2018) provides the best available science to support planning, scenario-based SLR projections at local active tidal gauge locations, how to select SLR projections, and recommendations for SLR planning/adaptation. The 2018 update provides SLR projections in 10-year increments between the years

2030 and 2150. These scenario-based projections do not forecast future changes but describe plausible conditions that support decision-making under uncertainty. This has been adopted by state and local agencies as the guidance to comply with Executive Order S-13-08. The guidance document is updated every 5 years with the next update scheduled for late 2023 or early 2024.

5.1.3 LOCAL PLANS, POLICIES, AND REGULATIONS

McAteer-Petris Act (Gov. Code § 66600 et seq.)

The McAteer-Petris Act was enacted September 17, 1965, and created the San Francisco BCDC as a temporary state agency charged with preparing a plan for the long-term use of the Bay. The act was amended in 1969 and established BCDC as a permanent agency. BCDC in 1972 incorporates sections of the McAteer-Petris Act to administer the policies of the federal Coastal Zone Management Act (CZMA) by regulating the use of land and water in the coastal zone of San Francisco Bay. The act is a state law, but it is administered locally through BCDC. BCDC regulates nearly all work, including grading, on land within 100 feet of San Francisco Bay shoreline (what BCDC calls the shoreline band), all areas subject to tidal action, such as sloughs and marshes, and certain designated waterways. BCDC carries out its “federal consistency” responsibilities by reviewing projects much as it reviews permit applications. BCDC issues four types of permits: major permits, administrative permits, emergency permits, and region-wide permits.

Section 66632 requires that projects obtain permits from BCDC to fill, to extract materials, and to make substantial changes in use of land, water, or existing structures in the shoreline band. In determining whether to issue permits, BCDC looks to policies set forth in the act and in the San Francisco Bay Plan. In general, these policies authorize fill or excavation of wetlands only for water-dependent projects where no feasible upland alternatives exist, and only if wetlands impacts are mitigated.

San Francisco Bay Plan Climate Change Policy Guidance

BCDC requires those portions of a project in San Francisco Bay and the shoreline band to plan for and adapt to SLR caused by global climate change. BCDC updated their San Francisco Bay Plan Climate Change Policy Guidance (Guidance) in July 2021. The Guidance provides non-regulatory, but interpretive, information to assist in the development of prospective projects in relation to the requirements of the Climate Change policies with permit applicants, local jurisdictions, and the public at large. Climate Change Policy 2 – Risk Assessment of the Guidance states:

> When planning shoreline areas or designing larger shoreline projects, a risk assessment should be prepared by a qualified engineer and should be based on the estimated 100-year flood elevation that takes into account the best estimates of future SLR and current flood protection and planned flood protection that will be funded and constructed when needed to provide protection for the proposed project or shoreline area. A range of SLR projections for mid-century and end of century based on the best scientific data available should be used in the risk assessment. Inundation maps used for the

> risk assessment should be prepared under the direction of a qualified engineer. The risk assessment should identify all types of potential flooding, degrees of uncertainty, consequences of defense failure, and risks to existing habitat from proposed flood protection devices.

Climate Change Policy 3 – Resilient to Mid-Century and Adaptable to End of Century states:

> To protect public safety and ecosystem services, within areas that a risk assessment determines are vulnerable to future shoreline flooding that threatens public safety, all projects—other than repairs of existing facilities, small projects that do not increase risks to public safety, interim projects and infill projects in existing urbanized areas—should be designed to be resilient to a mid-century SLR projection. If it is likely the project will remain in place longer than mid-century, an adaptive management plan should be developed to address the long-term impacts that will arise based on a risk assessment using the best available science-based projection for SLR at the end of the century.

If a project has a short lifespan, BCDC Climate Change policies may potentially apply depending on the circumstances. The determination of whether a project is considered a "larger shoreline project" (Climate Change Policy 2) requiring a risk assessment depends more on a project's physical characteristics (e.g., scale or intensity of use) than the life of a project. However, a shorter-term project may not necessarily warrant a risk assessment if it is, for example, a repair to an existing project. If a project is not required to prepare a risk assessment, a project may still be subject to other Bay Plan policies related to SLR and flooding, such as shoreline protection, safety of fills, and habitat projects.

CCJPA SLR Vulnerability Assessment

Capitol Corridor Joint Power Authority (CCJPA) and Adapting to Rising Tides (ART), a program of BCDC that aims to build regional capacity to adapt to climate change, collaborated in 2014 on the CCJPA SLR Vulnerability Assessment to identify vulnerabilities in CCJPA's rail operations and possible adaptation responses from a planning perspective. The report was written prior to the State of California SLR Guidance 2018 update and did not assess areas specific to this Project, however it is referenced in this report because it suggests some adaptation measures that this Project can consider. The assessment concludes that the railroad system has a mix of physical, functional, governance, and information vulnerabilities. The railroad lacks redundancy due to the linear connectivity of the track alignment, and the railroad system is highly dependent on the signal system. The CCJPA SLR Vulnerability Assessment also found that several stations and maintenance facilities are vulnerable to rising sea levels due to their geographic location. It was noted that the multi-agency ownership and management structure of CCJPA may complicate planning processes for adaptation projects, especially due to the lack of information on the railroad infrastructure owned by UPRR.

The 2014 CCJPA SLR Vulnerability Assessment made adaptation recommendations that are relevant to the South Bay Connect (SBC) Project. These recommendations will be discussed further in Section 5.4.2. Recommendations for CCJPA revolve around 1) addressing governance and information vulnerabilities because CCJPA does not own the physical railroad assets, and 2) working with existing stakeholders and community partners to plan future adaptation projects.

5.2 Methods for Evaluating Effects

5.2.1 DEFINITION OF RESOURCE STUDY AREA

This section defines the RSA and describes the methods used to analyze the impacts of SLR on the RSA. As defined in Section 3.1, Introduction, RSAs are the geographic boundaries within which the environmental investigations specific to each resource topic were conducted. The SLR RSA represents the areas of proposed improvements within UPRR right-of-way that are under BCDC jurisdiction.

The limits of proposed improvements on the Coast Subdivision were provided to BCDC for their evaluation to determine which Project improvements were under their jurisdiction before the development of Alternative E. The Coast Subdivision runs along the shoreline of the San Francisco Bay from Fremont to Oakland. One area of proposed improvements for all alternatives and six areas of proposed improvements along the Coast Subdivision for Alternative E could potentially be within BCDC jurisdiction. BCDC regulates nearly all work within 100 feet from the shoreline of the Bay, and their jurisdiction extends to the mean high tide line in areas that do not contain tidal marsh and up to five feet above mean sea level in areas of tidal marsh. The areas identified to potentially be within BCDC jurisdiction were:

- Location 1 – San Leandro Creek: tracks crossing San Leandro Creek PM 14.29 (Alternative E)
- Location 2 – Heron Bay: tracks crossing Estudillo Canal extending to the tracks north of Lewelling Boulevard, parallel to Santa Ynez Street in San Leandro near Heron Bay PM 16.93 to PM 17.92 (All Alternatives)
- Location 3 – San Lorenzo Creek: tracks crossing San Lorenzo Creek PM 18.25 (Alternative E)
- Location 4 – Oro Loma Marsh: tracks south of the Bockman Canal crossing and north of the Sulphur Creek crossing, east of Oro Loma Marsh in San Lorenzo and Hayward PM 18.95 to PM 19.77 (Alternative E)
- Location 5 – Old Alameda Creek: tracks south of SR-92, adjacent to Eden Landing in Hayward PM 23.09 to PM 23.78 & tracks crossing Old Alameda Creek PM 24.18 (Alternative E)
- Location 6 – Alameda Creek: tracks crossing Alameda Creek and unlined channel PM 26.9 to PM 27.3 (Alternative E)
- Location 7 – Newark Slough: tracks crossing Newark Slough and an unnamed channel PM 29.30 to PM 30.20 (Alternative E)

Location 2 was previously reviewed and analyzed by BCDC as part of the coordination for Alternatives B, C, and D and was determined to potentially be within BCDC jurisdiction due to its adjacency to tidal march.

BCDC has indicated that this area is likely in BCDC's 100-foot-shoreline band jurisdiction and possibly in BCDC Bay jurisdiction[1].

Locations 1 and 3 through 7 are part of the Alternative E alignment and were identified to potentially be within BCDC jurisdiction based on their proximity to adjacent marshes or tidal marshes up to 5 feet above mean sea level with jurisdictional determination pending additional coordination with BCDC.

Jurisdictional determinations will be based on BCDC's 100-foot-shoreline band jurisdiction and possibly in BCDC Bay jurisdiction. Bay jurisdiction in a tidal marsh is up to 5 feet above mean sea level, or if a tidal marsh does not reach that elevation, the jurisdiction is the extent of the marsh vegetation. The 100-foot-shoreline band is 100 feet inland from the Bay jurisdiction line. The SLR RSAs are bounded by the UPRR right-of-way between the limits of Project improvements at all locations. The SLR RSA Locations 1 through 7 are shown below in Figure 1 through Figure 7, respectively.

[1] Topographic field survey will be conducted during project design at throughout the Project to confirm that these areas are or are not within BCDC jurisdiction. For the purpose of this Memo, Locations 1 through 7 were evaluated for sea level rise risk and assessment.

Figure 1: RSA Location 1

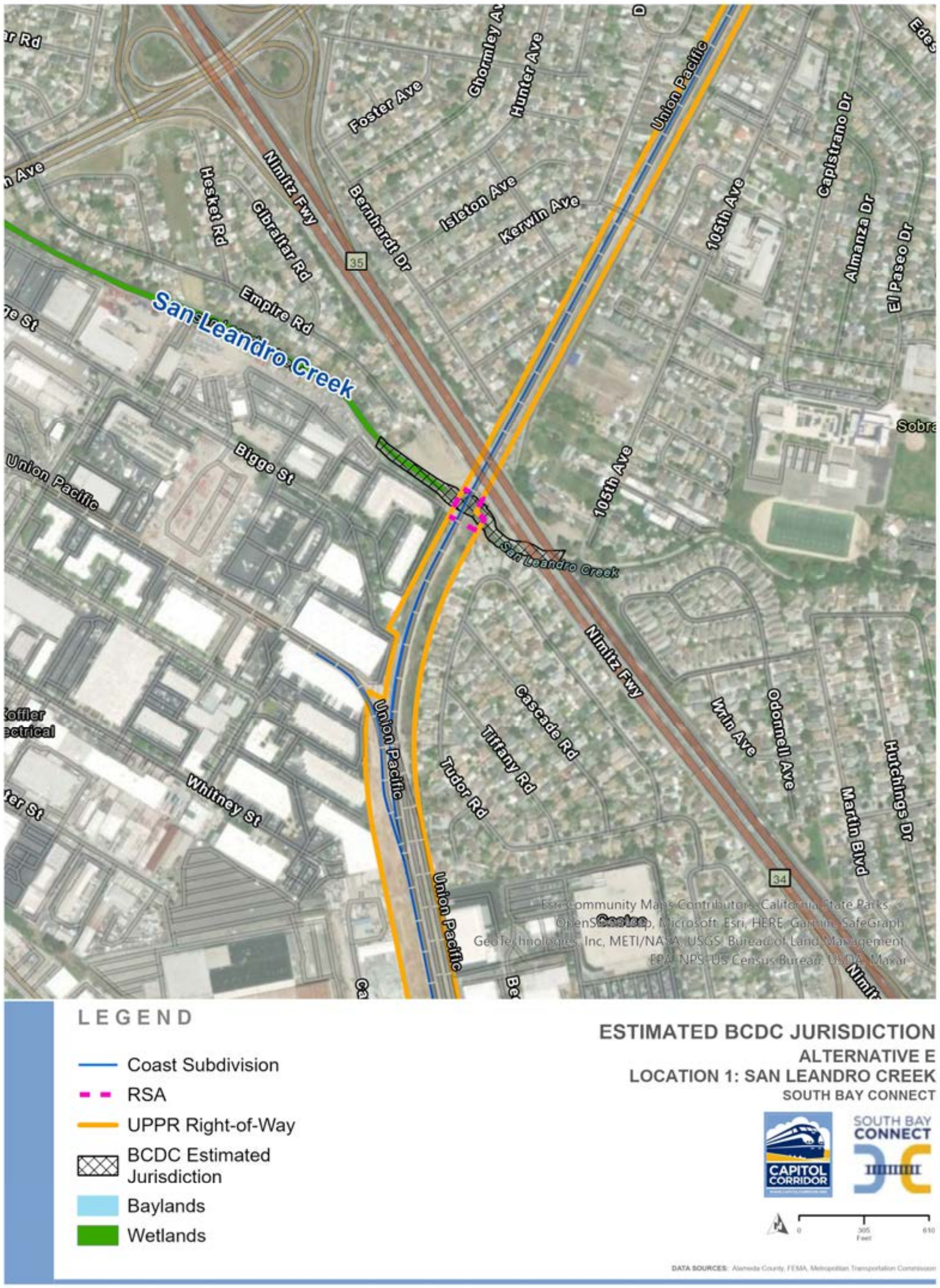


Figure 2: RSA Location 2

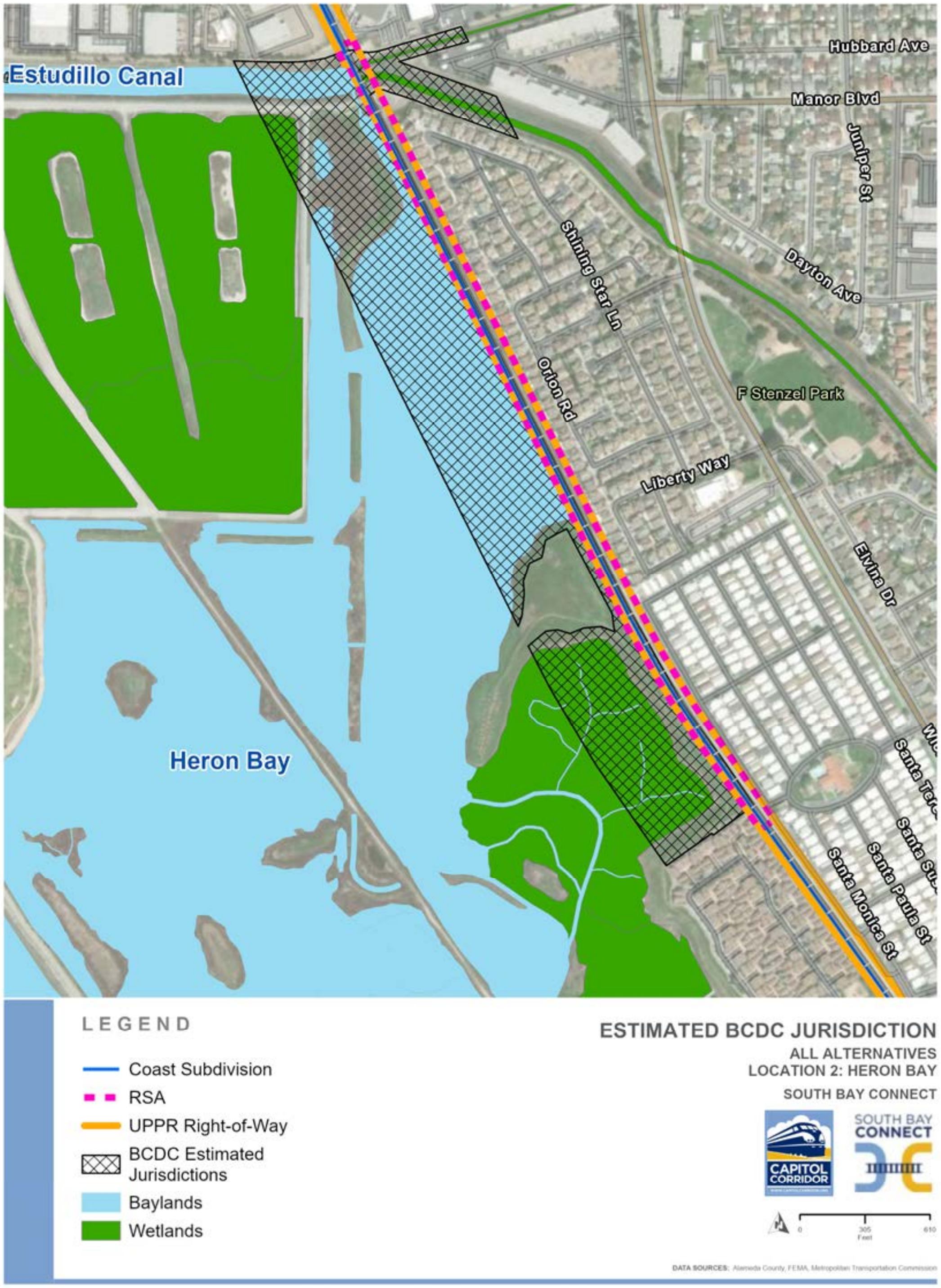


Figure 3: RSA Location 3

Figure 4. RSA Location 4

Figure 5. RSA Location 5

Figure 6. RSA Location 6

Figure 7. RSA Location 7

5.2.2 DATA SOURCES

This section describes the data sources, reports, and guidance used for evaluating the effects of SLR on the Project. Table 1 lists references and associated geographic information system (GIS) data used to describe the SLR affected environment.

Table 1. Summary of Data Sources

Data Source	Name/Description of Source(s)
Adapting to Rising Tides (ART)	San Francisco Bay Tidal Datums and Extreme Tides Study
ART	Bay Shoreline Flood Explorer Map
CCJPA	CCJPA Sea Level Rise Vulnerability Assessment
CNRA & OPC	State of California SLR Guidance 2018 Update
Federal Emergency Management Agency (FEMA)	Alameda County Flood Insurance Rate Map (FIRM) Number 06001C0266H
Google Earth	Elevations
HDR	Project Information (Mapbooks, Cumulative Project Map)
San Francisco Bay Conservation and Development Commission (BCDC)	Email correspondence
BCDC	San Francisco Bay Plan Climate Change Policy Guidance July 2021
United States Geological Survey (USGS)	CoSMoS (Coastal Storm Modeling System)

The Project team coordinated with BCDC during the development of Alternatives B, C, and D to determine their jurisdiction over areas within the Project. Potential areas of jurisdiction have been sent to BCDC as part of the evaluation for Alternative E. Final determination of jurisdictional areas and additional coordination for Alternative E and the alternative Project limits along the Coast Subdivision will be made during the permitting process. A record of this communication is shown in Table 2.

Table 2. BCDC Record of Communication

Date and Type of Communication	Content
June 25, 2021, Email	SBC Team (Maria Levario) requested BCDC delineation of 100-foot shoreline boundary.
July 1, 2021, Email	BCDC (Todd Hallenbeck) requested that SBC team provide a KMZ of the Coast Subdivision Project limits. KMZ was sent to BCDC.
July 22, 2021, Email	BCDC (Rowan Yelton) provided an initial assessment of areas that may be within BCDC jurisdiction. Four potential areas were identified.
August 10, 2021, Webex Meeting	Meeting Attendees: BCDC (Anniken Lydon and Rowan Yelton), HDR (Maria Levario), and HNTB (Pierre-Abi-hanna). An overview of the Project was provided, and the four potential areas identified by BCDC staff were discussed and reviewed. BCDC stated they would continue to review the potential locations and would advise the SBC team.
September 1, 2021, Email	BCDC (Rowan Yelton) indicated that only one of the four locations is likely within the 100-foot-shoreline band jurisdiction and possibly within Bay jurisdiction.
September 13, 2021, Email	SBC Team (Maria Levario) confirmed BCDC assessment that only one location is likely within BCDC jurisdiction, pending survey of that location by the design team.
December 7, 2021, Email	SBC Team (Maria Levario) advised BCDC that a Draft Sea Level Rise Assessment has been prepared to include the one potential BCDC jurisdiction location. Survey work was still pending. SBC Team requested to meet with BCDC staff (Rowan Yelton and Anniken Lydon) to review the draft assessment.
December 7, 2021, Email	BCDC (Rowan Yelton) agreed to meet to discuss the results of the Draft Sea Level Rise Assessment. BCDC requested to review the assessment prior to meeting with the SBC Team.
December 21, 2021, Email	SBC Team (Maria Levario) advised BCDC that Capitol Corridor Staff will need to review the Draft Sea Level Rise Assessment before it can be sent to BCDC.
December 23, 2021, Email	BCDC (Rowan Yelton) acknowledged and requested that the meeting be scheduled once they receive the draft assessment for their internal review.
April 29, 2022, Webex Meeting	BCDC CCJPA Meeting
May 23, 2022, Email	BCDC provides comments on Sea Level Rise Memo
June 17, 2023, Email	HDR provides response to BCDC Comments
August 8, 2023, Webex Meeting	SBC Team met with BCDC to discuss potential jurisdictional areas as part of Alternative E and past comments.
September 13, 2023	HDR provides updated potential BCDC jurisdictional areas for the Project, all Alternatives
September 29, 2023	Team issued response to BCDC comments on the previous memo submitted. No further response from BCDC has been received to date.

5.2.3 STEPS FOR SLR PROJECTIONS AND VULNERABILITY ASSESSMENT

The following steps were performed to evaluate SLR impacts on the Project within the SLR RSA and to identify potential adaptation measures.

1. Determined the service life of the Project.
2. Calculated SLR projections based on the service life of the Project, local active tidal information at the Project site, and probabilistic projections directly tied to a range of emissions scenarios.
3. Generated a depiction of CoSMoS model and the ART Bay Shoreline Flood Explorer Map (ART Map).
4. Considered potentially feasible adaptation measures.

5.3 Affected Environment

5.3.1 REGIONAL SETTING

The SLR RSAs are located in the western part of Alameda County in the City of Oakland, City of San Leandro, census-designated place San Lorenzo, the City of Hayward, Union City, City of Fremont, and City of Newark. The surrounding topography generally slopes moderately to the west. All SLR RSAs discussed in this memo are located within the Coast Subdivision, which lies on flat terrain by the San Francisco Bay.

RSA Location 1 spans the San Leandro Creek crossing. San Leandro Creek crosses the trackway flowing northwest into the San Leandro Bay, ultimately draining to the San Francisco Bay to the west. San Leandro Creek separates the City of Oakland from the City of San Leandro.

RSA Location 2 is located east of Heron Bay and south of the Estudillo Canal. Heron Bay consists of low-lying wetland and baylands sloping gradually to the west. The Estudillo Canal crossing flows east to west. Both waterbodies drain to the San Francisco Bay.

RSA Location 3 spans the San Lorenzo Creek crossing. San Lorenzo Creek crosses the trackway flowing east to west until reaching the San Francisco Bay. San Lorenzo Creek separates the City of San Leandro from San Lorenzo.

RSA Location 4 is between two waterbodies that flow east to west into the San Francisco Bay, Bockman Canal to the north and Sulphur Creek to the south. The cities of Hayward and San Lorenzo are separated by a housing development to the north and a golf course to the south. Oro Loma Marsh spans the entirety of RSA Location 4 and is located to the west.

RSA Location 5 is located east of Eden Landing, a wetland area located within the City of Hayward. It is south of SR-92 and west of Industrial Boulevard. A channel runs adjacent the RSA to the east, crossing underneath the trackway approximately 380 feet north of the Eden Shores Boulevard overcrossing. The channel flows adjacent to the trackway until it reaches Old Alameda Creek. RSA Location 5 also spans the Old Alameda Creek crossing. The railway alignment separates the City of Hayward to the west and Union City to the east of the RSA. A park is located on the northeastern shore of the crossing and is adjacent the RSA.

RSA Location 6 spans the Alameda Creek crossing and an unlined channel to the south. Alameda Creek crosses the trackway flowing southwest towards the San Francisco Bay. Alameda Creek separates Union City to the north from the City of Fremont to the south of the creek boundaries. The unlined channel joins with Alameda Creek just west of the RSA crossing. The trackway at this RSA separates Union City at the northwest portion of the crossing from the City of Fremont to the east.

RSA Location 7 covers the unnamed channel and Newark Slough crossings. Both the unnamed channel and Newark Slough flow southwest when crossing the trackway. Newark Slough and the unnamed channel join downstream to form an unrestricted waterbody flowing towards the San Francisco Bay.

5.3.2 LOCAL TOPOGRAPHY

Due to the nature of the proposed work, the existing elevations would not change significantly as a result of the Project. Therefore, identification of tidally influenced areas is based on the existing topography within the limits of the Project. The datum used for analysis was North American Vertical Datum of 1988. Google Earth was used to provide elevations for the evaluated Project areas.

RSA Location 1, spans San Leandro Creek. Trackway elevation at SLR RSA Location 1 is approximately 21 feet. Elevations within the creek crossing range from approximately 4 feet at the creek crossing and 17 feet along the creek bank.

RSA Location 2 spans Estudillo Canal. Trackway elevation at the Estudillo Canal crossing is approximately 10 feet. Elevations within the creek crossing range from approximately 2 feet at the creek crossing and 8 feet along the creek bank. The elevation is approximately 5 to 10 feet adjacent to and east of Heron Bay, a tidal marsh area. The channel next to the railroad is the lowest elevation while the top of the railroad embankment is the highest.

RSA Location 3 spans San Lorenzo Creek. Trackway elevation at the RSA is approximately 16 feet. Elevations within the creek crossing range from approximately 1 foot at the creek crossing and 16 feet along the creek bank.

At RSA Location 4, the elevation of the trackway is consistently within an approximate range of 10 to 11 feet. The trackway is adjacent to and east of the Oro Loma Marsh. Elevations within the channel west of the trackway and east of the marsh are approximately within 3 feet to 6 feet with the lowest elevations being those at the channel crossing.

RSA Location 5 is east of Eden Landing, a tidal marsh area, with the elevation of the trackway consistently within the range of approximately 10 to 11 feet. Elevations within the channel range from approximately 1 to 3 feet with the lowest elevations being at the southern end of the channel. Trackway elevations at the Old Alameda Creek crossing are approximately 10 to 11 feet. Elevations within the creek crossing and RSA range from approximately 0 to 5 feet.

At RSA Location 6, the trackway crosses Alameda Creek and has an elevation of 38 to 40 feet throughout. Elevations within the creek crossing range from approximately 6 feet at the creek crossing and 25 feet along the creek bank. The trackway crossing above the unlined channel has an elevation of 28 feet. The creek at the crossing is at an approximate elevation of 10 feet.

RSA Location 7 the elevation of the trackway is consistently within 19 to 20 feet. The trackway is located within a residential area and spans the unnamed channel and Newark Slough crossings. Elevations at both waterway crossings are at approximately 8 feet.

5.3.3 TIDAL

Tidal data for the RSAs was obtained from the San Francisco Bay Tidal Datums and Extreme Tides Study (ART, 2016). The study performed extreme tide analysis for more than 900 locations in the San Francisco Bay based on the current National Tidal Datum Epoch (NTDE), and the gauge locations (612, 625, 629, 631, 646, 655, 675) nearest to the RSA Locations 1 through 7, respectively, were selected for use in this analysis. The North American Vertical Datum of 88 (NAVD 88) is used to discuss elevations for this Project. The extreme tide elevations recorded at the selected gauge are shown in Table 3 below.

Table 3. Current Extreme Tide Elevations

Tidal Datum / Extreme Tide	Elevation (Feet NAVD 88)						
	Location 1	Location 2	Locations 3	Location 4	Location 5	Location 6	Location 7
MHHW	6.26	6.91	6.94	6.96	7.05	7.15	7.31
1-YR	8.30	8.30	8.30	8.32	8.36	8.44	8.60
10-YR	9.15	9.17	9.19	9.21	9.31	9.42	9.60
100-YR	10.11	10.19	10.24	10.26	10.50	10.68	10.93

Source: ART San Francisco Bay Tidal Datums and Extreme Tides Study (2016)

5.3.4 EXISTING FEMA FLOODPLAINS

FEMA develops FIRMs that delineate communities into zones of relative flood risk severity, independent of SLR. Table 4 lists the FIRMs covering the RSAs and the locations included within each.

Table 4. FEMA FIRMs and Corresponding RSA Locations

FEMA FIRM	RSA Location
06001C0256G	1
06001C0266H	2
06001C0267H	3 & 4
06001C426G	5
06001C427G	5
06001C0433G	6
06001C0441G	7

Source: FEMA, 2018

RSA Location 1 is within a Zone AE floodplain with a base flood elevation (BFE) of 19 feet throughout the entirety of the RSA. Zone AE floodplains are defined as areas subject to inundation by the 1-percent-annual-chance flood event determined by detailed methods, where BFEs, the elevations of surface water from this same likelihood flood, are shown. As shown in Figure 8, Zone X floodplains are located to the west and south of the RSA. San Leandro Creek is designated as a regulatory floodway at the trackway crossing. A regulatory floodway is defined as the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

At RSA Location 2 there are currently Zone AE floodplains with BFEs ranging from 10 to 12 feet, shown in Figure 9. The tidal marsh west of RSA Location 1 has a BFE of 11 feet, while directly on the track where improvements are proposed the BFE is 10 feet. However, this floodplain is not connected to the tidal marsh floodplain to west, as there is a berm separating the two. The floodplain at the railroad receives flow from a Zone AE floodplain (BFE 12) from the north through a channel directly west of and parallel to the track.

At RSA Location 3, the San Lorenzo Creek crossing is located within a Zone A floodplain. Zone A floodplains are defined as areas subject to inundation by the 1-percent-annual-chance flood event where no BFE has been determined. As shown in Figure 10, a Zone AO floodplain with a BFE of 1 foot is located on the northern edge of the RSA. Zone AO floodplains are defined as areas with a 1% or greater chance of shallow flooding each year, usually in the form of sheet flow, with an average depth ranging from 1 to 3 feet.

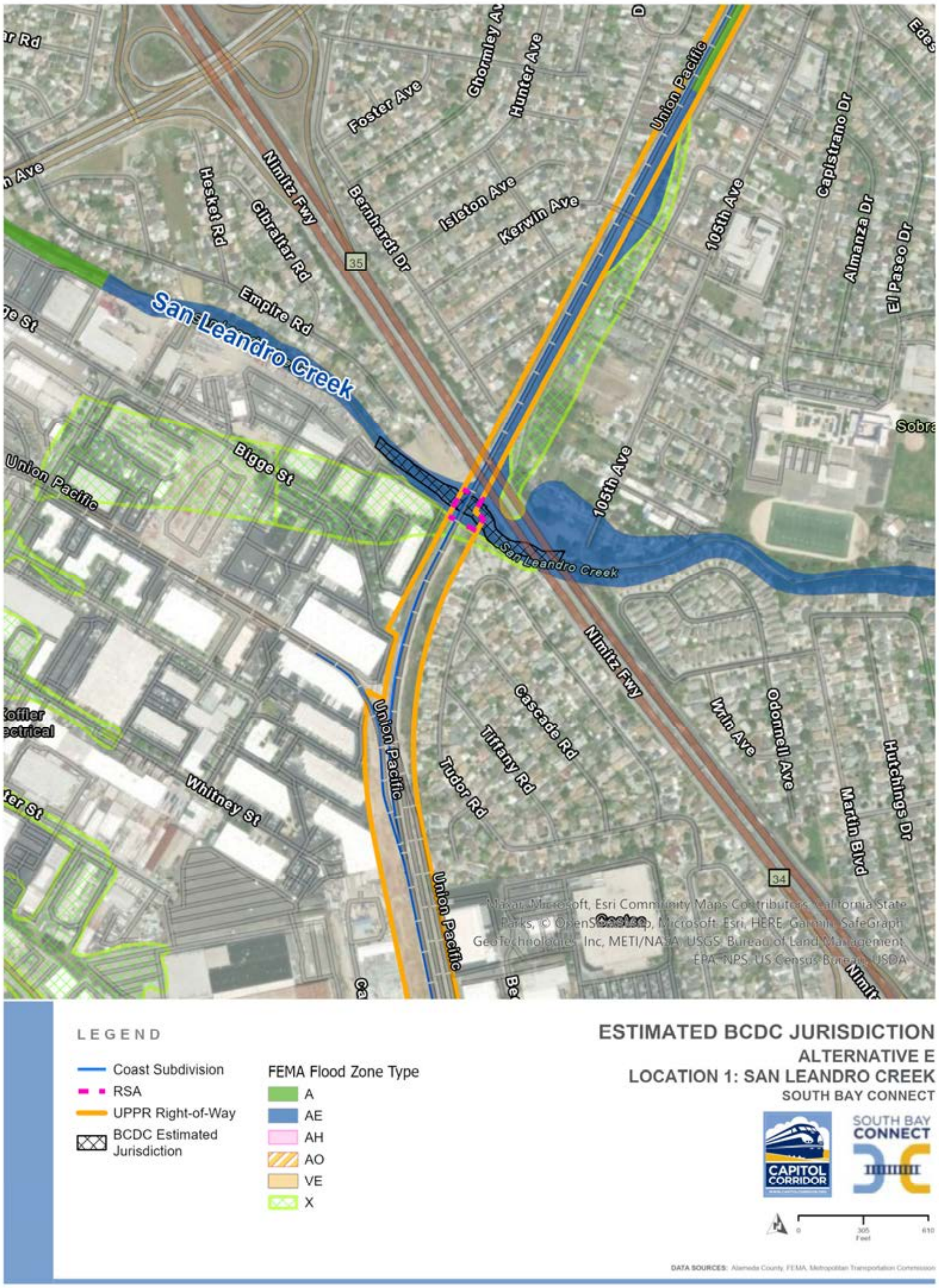
RSA Location 4 is within a Zone AE floodplain with a BFE ranging from 10 feet throughout the majority of the RSA to 16 feet at the southern tip. A Zone AO floodplain with a BFE of 1 foot is located on the northern edge of the RSA as shown in Figure 11. A Zone X floodplain with a 0.2% annual chance flood hazard and 1% annual chance flood with average depth less than 1 foot and a Zone X floodplain with reduced flood risk due to levee are adjacent the RSA on the eastern edge.

RSA Location 5 is located within a Zone AE floodplain with BFEs ranging from 10 to 12 feet. As shown in Figure 12, Zone AH and Zone X floodplains area adjacent to and east of the RSA. Zone AH floodplains are defined as areas with a 1% annual chance of shallow flooding, usually in the form of a pond, with an average depth ranging from 1 to 3 feet. Also shown in Figure 12 is RSA Location 5, which is located within a Zone AE floodplain with BFEs ranging from 11 to 12 feet. A Zone AH floodplain is adjacent to RSA Location 4 just east of the Old Alameda Creek crossing.

At RSA Location 6, the Alameda Creek crossing is within a Zone A floodplain. As shown in Figure 13, a Zone AE floodplain is located just south of the Alameda Creek crossing on either side of the trackway. The BFE at the areas to the south of the RSA is 17 feet.

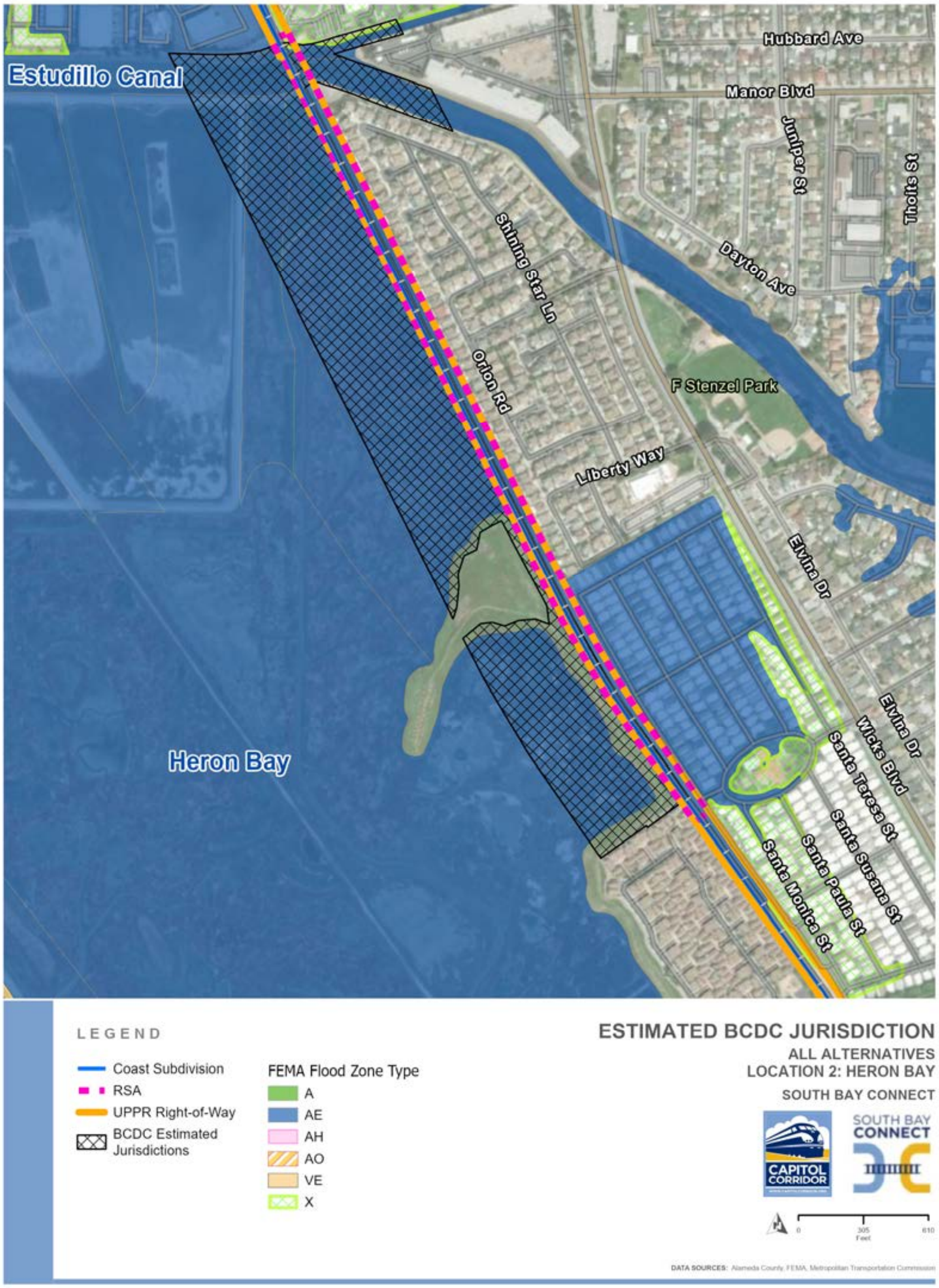
As shown in Figure 14, RSA Location 7 is located within a Zone AE floodplain with BFEs ranging from 18 to 14 feet at the unnamed channel crossing. A Zone X floodplain is located to the east of the trackway. The Newark Slough crossing is located within a Zone X floodplain.

Figure 8. RSA Location 1 – FEMA Floodplain Map



Source: FEMA FIRM 06001C0256G (2009)

Figure 9. RSA Location 2 – FEMA Floodplain Map

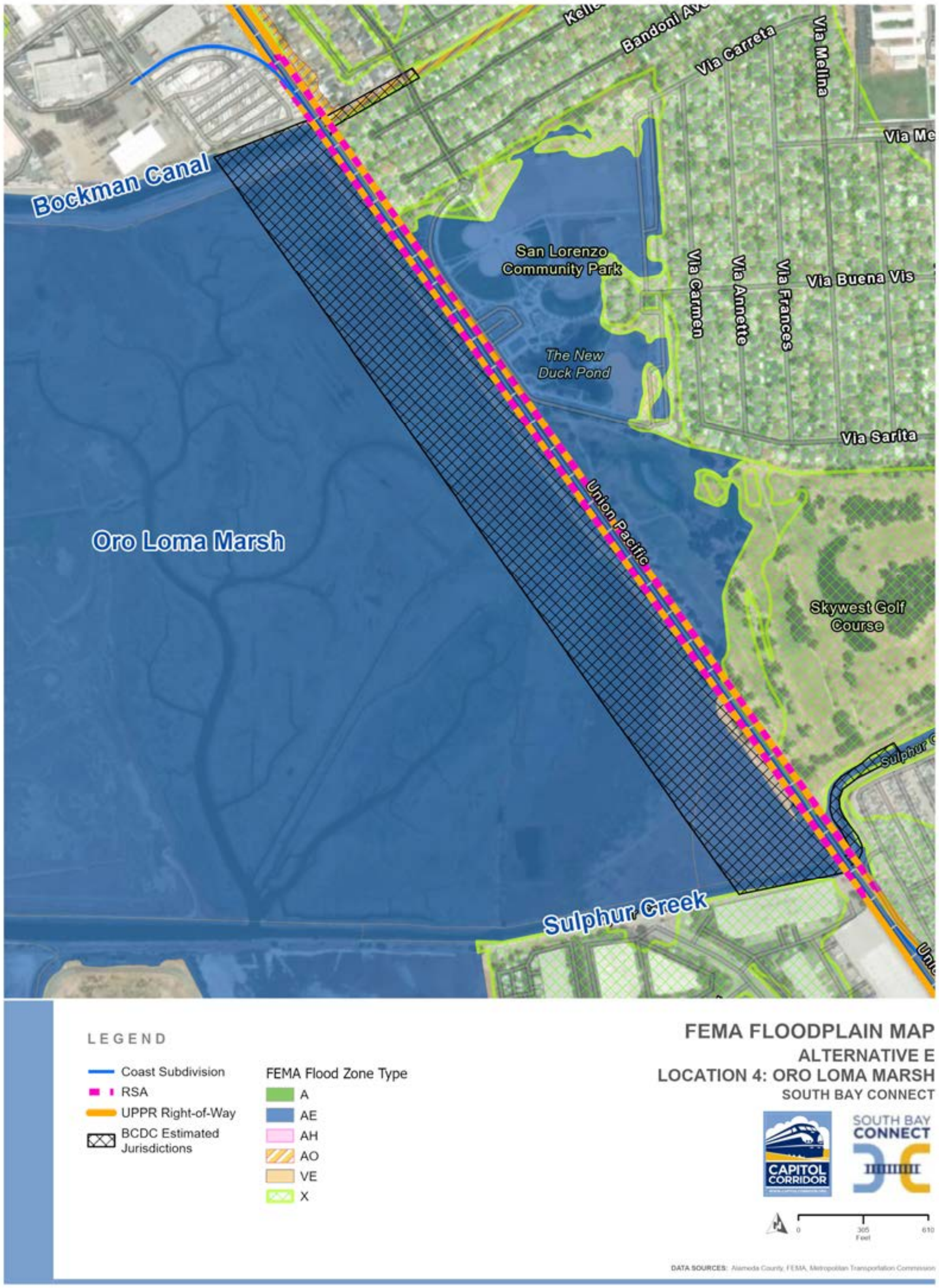


Source: FEMA FIRM 06001C0266H (2018)

Figure 10. RSA Location 3 – FEMA Floodplain Map

Source: FEMA FIRM 06001C0267H (2018)

Figure 11. RSA Location 4 – FEMA Floodplain Map



Source: FEMA FIRM 06001C0267H (2018)

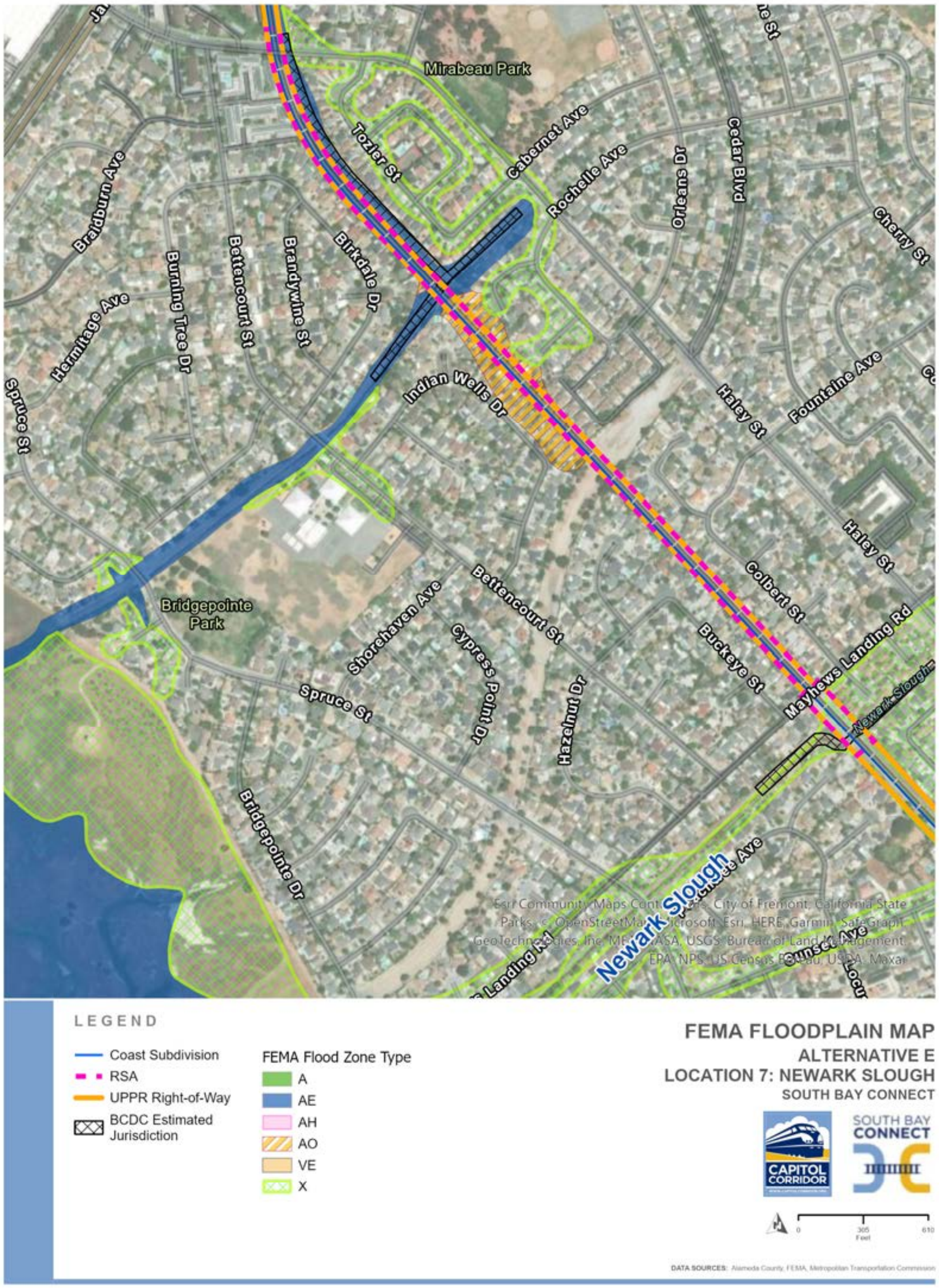
Figure 12. RSA Location 5 – FEMA Floodplain Map

Source: FEMA FIRM 06001C427G (2009)

Figure 13. RSA Location 6 – FEMA Floodplain Map

Source: FEMA FIRM 06001C0433G (2009)

Figure 14. RSA Location 7 – FEMA Floodplain Map



Source: FEMA FIRM 06001C0441G (2009)

5.3.5 SLR PROJECTIONS

Service Life

The service life of the Project improvements within the SLR RSAs is anticipated by the design team to range from 10 to 100 years. Proposed work at all RSA locations will include a track realignment with upgrades to rail and ties. Alternatives B, C, and D include trackway improvements at RSA Location 2, therefore, the SLR evaluation for these alternatives would be based on the standard service life of the rail components, which are 10-20 years. Alternative E includes: 1) an additional trackway, which may be constructed from the Elmhurst to Newark connections spanning all seven RSA locations; 2) new culverts proposed at RSA Location 7, which span the Newark Slough and unlined channel and have a standard service life of 50 years; and 3) new bridge structures proposed at RSA locations 1 through 6. Bridge structures have the longest standard service life of any improvements for Alternative E, at 100 years, therefore the service life considered for Alternative E will be 100 years. Based on preliminary Project schedule, construction may be completed in 2029, so the Years 2040, 2050, and 2130 were selected as the years when SLR would be evaluated.

Table 5: Project Service Life and Corresponding RSA Locations

RSA Location	Project Improvement	Anticipated Service Life	Alternative
2	New trackway	10-20 years	B, C, D
1-7	New trackway, Culvert, Bridge structures	100 years	E

SLR Scenarios

SLR projections are based on the latest BCDC guidance, as of July 2021, which recognizes the State of California SLR 2018 Update (CNRA & OPC, 2018) to be the best estimate of future SLR. These projections use the approach developed by Kopp et al. 2014, which represents the best available science. The methods use probabilistic modeling to develop SLR estimates based on different global greenhouse gas emission scenarios during this century and beyond, ranging between “business-as-usual” and significant reduction.

SLR projections for the San Francisco tide gauge were applied to this Project. A summary of the values used in the Project evaluation are included in Table 6, and the projections are with respect to a baseline of the year 2000. The source for Table 6 is shown in Table 7 which is from the State of California SLR 2018 Update. With the first Project improvement’s service life ending in 2040 and 2050, only values for the high emissions scenario are available for consideration. This is due to differences in SLR projections being minor under high and low emissions scenarios prior to 2050, as the 2050 projections are strongly linked to emissions that have already occurred. The projected SLR of the Project in the 2050 medium-high (1-in-200 chance) risk aversion scenario is 1.9 feet, and the projected SLR in the 2050 extreme (H++) risk aversion scenario is 2.7 feet. Analysis of the SLR in the 2050 scenario was completed to assess the SLR impacts to the Project RSAs at the end of the service life for the proposed trackway improvements. This analysis is applicable to all Alternatives B, C, D, and E. The projected SLR of the Project in the 2130 medium-high risk scenario is 10 feet. This SLR scenario was evaluated to assess the SLR at the end of the service life for the proposed bridge structures at RSA Locations 1 through 7. This analysis is applicable to Alternative E. The medium-high risk aversion scenario was selected for this Project due to the Project's lack of adaptability and high consequences for underestimating SLR. The H++ scenario does not represent a probability of occurring, rather it serves as the "maximum physically plausible" projection of SLR. As such, the H++ scenario will not be evaluated further.

Table 6: Projected SLR for Medium-High Risk and H++ Scenarios

Year	High Emissions / Medium-High Risk Aversion: 1-in-200 Chance Occurrence Scenario (SLR in feet)	Extreme Risk Aversion: H++ Scenario (SLR in feet)
2030	0.8	1.0
2040	1.3	1.8
2050	1.9	2.7
2090*	5.6	8.3
2100*	6.9	10.2
2130	10	16.6

*Years correlated to closest available ART and CoSMoS visualizations for 100-year service life

Source: CNRA & OPC, 2018

Table 7: San Francisco SLR Projections

		Probabilistic Projections (in feet) (based on Kopp et al. 2014)					H++ scenario (Sweet et al. 2017) *Single scenario
		MEDIAN	LIKELY RANGE		1-IN-20 CHANCE	1-IN-200 CHANCE	
		50% probability sea-level rise meets or exceeds...	66% probability sea-level rise is between...		5% probability sea-level rise meets or exceeds...	0.5% probability sea-level rise meets or exceeds...	
				Low Risk Aversion		Medium - High Risk Aversion	Extreme Risk Aversion
High emissions	2030	0.4	0.3 -	0.5	0.6	0.8	1.0
	2040	0.6	0.5 -	0.8	1.0	1.3	1.8
	2050	0.9	0.6 -	1.1	1.4	1.9	2.7
Low emissions	2060	1.0	0.6 -	1.3	1.6	2.4	
High emissions	2060	1.1	0.8 -	1.5	1.8	2.6	3.9
Low emissions	2070	1.1	0.8 -	1.5	1.9	3.1	
High emissions	2070	1.4	1.0 -	1.9	2.4	3.5	5.2
Low emissions	2080	1.3	0.9 -	1.8	2.3	3.9	
High emissions	2080	1.7	1.2 -	2.4	3.0	4.5	6.6
Low emissions	2090	1.4	1.0 -	2.1	2.8	4.7	
High emissions	2090	2.1	1.4 -	2.9	3.6	5.6	8.3
Low emissions	2100	1.6	1.0 -	2.4	3.2	5.7	
High emissions	2100	2.5	1.6 -	3.4	4.4	6.9	10.2
Low emissions	2110*	1.7	1.2 -	2.5	3.4	6.3	
High emissions	2110*	2.6	1.9 -	3.5	4.5	7.3	11.9
Low emissions	2120	1.9	1.2 -	2.8	3.9	7.4	
High emissions	2120	3	2.2 -	4.1	5.2	8.6	14.2
Low emissions	2130	2.1	1.3 -	3.1	4.4	8.5	
High emissions	2130	3.3	2.4 -	4.6	6.0	10.0	16.6
Low emissions	2140	2.2	1.3 -	3.4	4.9	9.7	
High emissions	2140	3.7	2.6 -	5.2	6.8	11.4	19.1
Low emissions	2150	2.4	1.3 -	3.8	5.5	11.0	
High emissions	2150	4.1	2.8 -	5.8	5.7	13.0	21.9

Source: CNRA & OPC, 2018

Potential SLR Inundations at Project Site

Two mapping tools were employed to evaluate inundations at all RSAs using the SLR values from Table 6. The SLR projection years of 2040 and 2050 were evaluated at all locations. For Alternative E with RSA locations 1 through 7 where the projected service life of improvements is year 2130, SLR projections for an elevation of 10 feet were unavailable for both mapping tools. The highest available SLR projection scenario was used for the purpose of presenting a visual aid. This included the projection year 2100 for the CoSMoS model and 2090 for the ART model.

The end of construction is anticipated to be the Year 2029, and the service life of the components in the RSA is anticipated to be 10 to 20 years for all railway improvements, 50 years for all proposed culverts, and 100 years for all bridge improvements. The CoSMoS model developed by the USGS incorporates long-term coastal processes and flooding to make predictions, and it was used to visualize the total water level (TWL) under the 100-year storm events. The TWL is the total elevation of the water surface including tides, storm surge, and wave runup. The ART Map was also reviewed for comparison since it includes more detailed local topography. However, it does not include wave runup.

The projected water surface elevations (WSE) under the medium-high risk aversion SLR scenario in the 100-year tide event, along with the approximate track elevation from Google Earth, are provided for reference in Table 8. These projected WSEs are stillwater levels (SWL), which are less than the TWLs that were visually demonstrated by the mapping tools because they do not include wave runup. The track is inundated by the SWLs for all projection years, without adding the wave runup that further increases water levels.

Table 8. Projected 100-Year SLR SWLs for RSA Locations

Year	High Emissions / Medium-High Risk Aversion: 1-in-200 Chance Occurrence Scenario (SLR in feet)	Medium-High Risk Aversion 100-yr WSE (feet)						
		Location 1	Location 2	Location 3	Location 4	Location 5	Location 6	Location 7
2000	N/A	10.11	10.19	10.24	10.26	10.50	10.68	10.93
2030	0.8	10.91	10.99	11.04	11.06	11.30	11.48	11.73
2040	1.3	11.41	11.49	11.54	11.56	11.80	11.98	12.23
2050	1.9	12.01	12.09	12.14	12.16	12.40	12.58	12.83
2090*	5.6	15.71	15.79	15.84	15.86	16.10	16.28	16.53
2100*	6.9	17.01	17.09	17.14	17.16	17.40	17.58	17.83
2130	10.0	20.11	20.19	20.24	20.26	20.50	20.68	20.93

*Years correlated to closest available ART and CoSMoS visualizations for 100-year service life

CoSMoS was utilized to visualize areas of SLR flooding. The CoSMoS model generates visual results for every 0.8 feet of SLR, so the model is not able to generate the visual results to exactly match the SLR projections in Table 6 for 2040 and 2050. The CoSMoS visualization of 1.6 feet in SLR was selected to be analyzed, which correspond roughly to the SLR projections for the years 2040 (1.3 feet) and 2050 (1.9 feet). No visualization data was available for the SLR scenario closest to the projected 100-year service life of 10 feet. The closest available visual data was for 6.6 feet of SLR, which most closely corresponds to the projected SLR in the Year 2100, or the 70-year projected service life of the Project. The visualization of the Year 2100 SLR scenario is included in this report as a visual aid to gain a better understanding of the minimum reaches of the 100-year inundation levels. The CoSMoS model shows two layers, the flood extent and flood-prone low-lying areas. For the Years 2040 and 2050, flood extent area is shown in bright red and flood-prone low-lying areas are shown in dark red. For the Year 2100, the flood extent area is shown in blue and flood-prone low-lying areas are shown in green. The flood extent includes areas projected to be under water for at least one minute under a given SLR scenario. Flood-prone low-lying areas are those areas with no direct surface water connection to the ocean, however they lie below the projected TWL.

The most accurate corresponding CoSMoS visualization for both the 2040 and 2050 SLR scenarios is a 100-year storm event and 1.6 feet of SLR. Figure 15 shows that there would be no impacts to RSA Location 1 or surrounding area during this event. In the case of 6.6 feet of SLR during a 100-year storm, which most closely matches the SLR projection for the Year 2100, Figure 15 shows still no impacts to the RSA.

At RSA Location 2, the most accurate corresponding CoSMoS visualization for the Years 2040 and 2050, a 100-year storm event and 1.6 feet of SLR, shows that there would be a flood-prone low-lying area north of the Estudillo Canal crossing on either side of the RSA. Figure 16 shows an additional section of RSA Location 2 to the south as a flood-prone low-lying area. SLR would inundate areas west of RSA Location 2. The channel next to the berm is not rendered in the CoSMoS model likely due to the scale of topographic data used in its calculations. CoSMoS visualization for 6.6 feet of SLR during a 100-year storm shows inundation covering the entire RSA.

At RSA Location 3, inundation impacts at 1.6 feet of SLR during a 100-year storm are contained within San Lorenzo Creek as shown in Figure 17. The CoSMoS visualization for 6.6 feet of SLR during a 100-year storm event shows inundation impacts extending on either side of the trackway and encroaching within UPRR ROW.

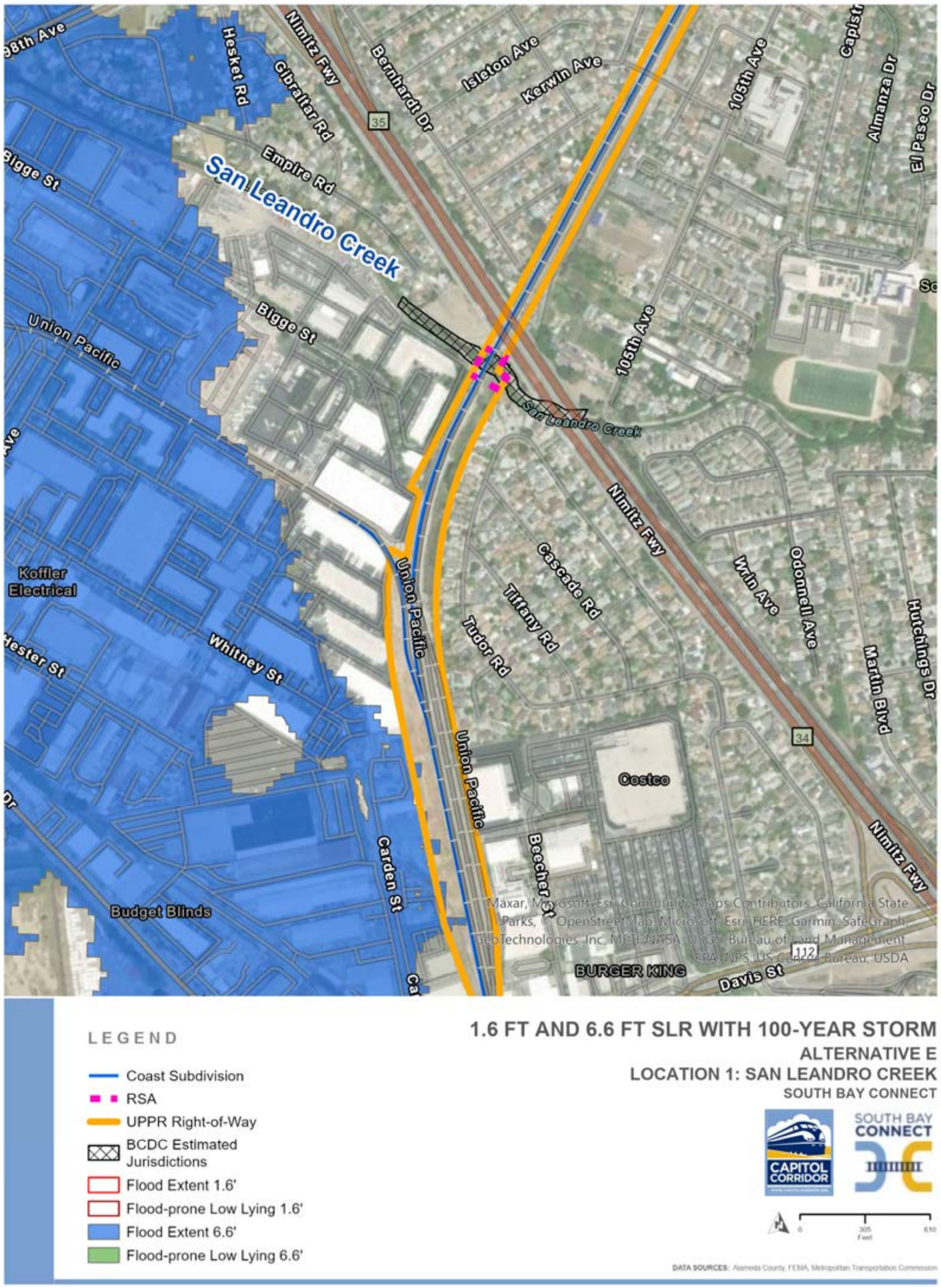
Figure 18 shows that at RSA Location 4, inundation impacts for a 100-year storm event and SLR of 1.6 feet at the northern and southernmost ends of the RSA are contained within Bockman Canal and Sulphur Creek. The CoSMoS visualization shows inundation areas adjacent Oro Loma Marsh extend along the trackway crossing the UPRR ROW and extending deeper into the park east of the trackway. CoSMoS visualization for 6.6 feet of SLR during a 100-year storm shows inundation covering the entire RSA.

The corresponding CoSMoS visualization for the year of 2040 and 2050, a 100-year storm event with 1.6 feet of SLR, shows extensive inundation throughout the northern end of RSA Location 5. Inundation extends from Old Alameda Creek until Hesperian Boulevard and via the channel east of and adjacent to RSA Location 3, extends into the developed area to the east. Inundation impacts spread south from the Old Alameda Creek into the undeveloped area between the Kaiser Permanente parking lot and the creek itself. CoSMoS visualization for 6.6 feet of SLR during a 100-year storm shows inundation covering the entire RSA. Both inundation scenarios are shown in Figure 18.

At RSA Location 6, there are no inundation impacts 1.6 feet of SLR during a 100-year storm event as shown in Figure 20. During the 100-year storm event at 6.6 feet of SLR there are low-lying areas within Alameda Creek near the crossing. Flooding extents during this SLR scenario are limited to the residential areas west of the trackway and Alameda Creek itself.

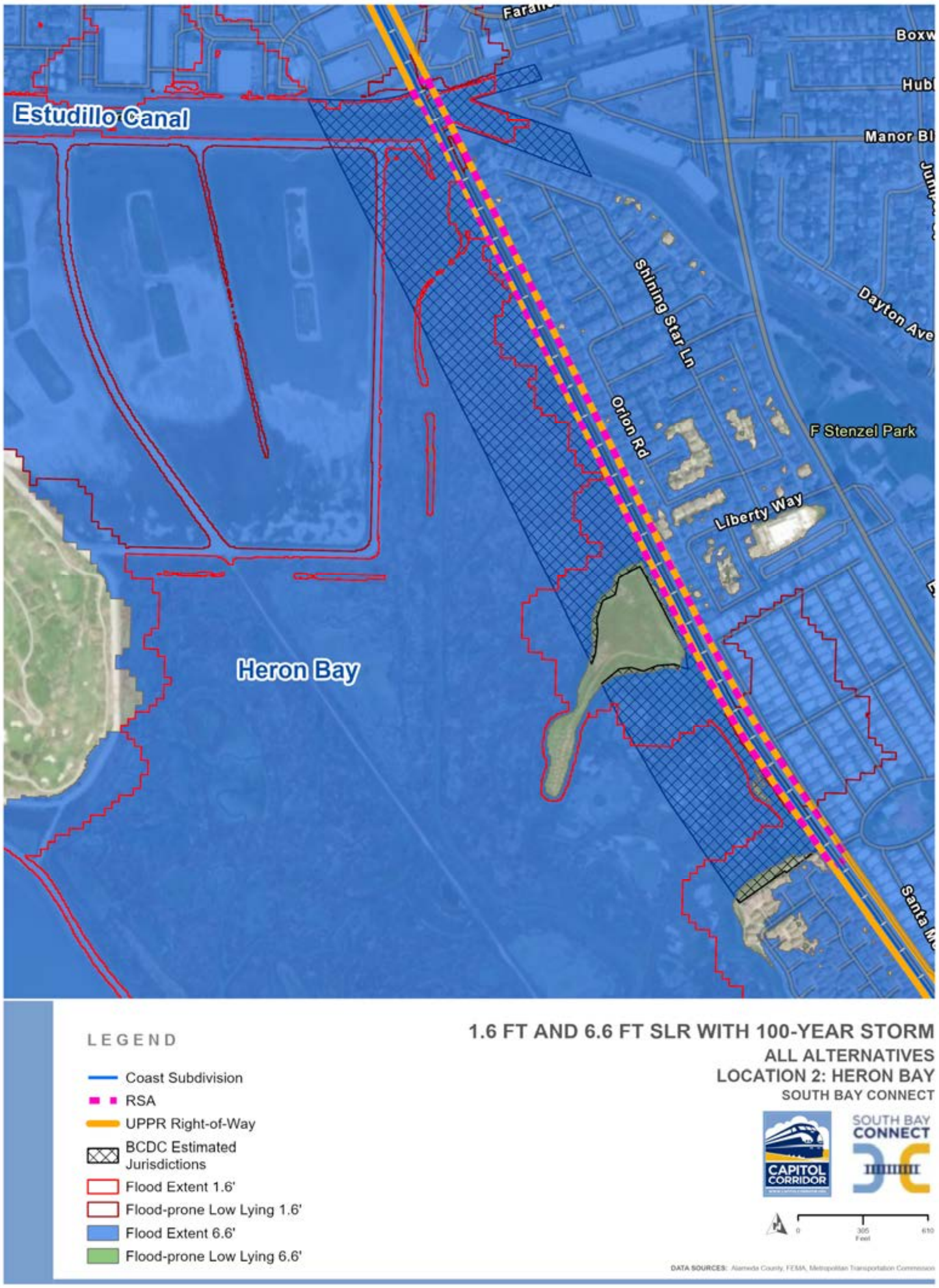
For RSA Location 7, the most accurate corresponding CoSMoS visualization for both SLR scenarios is a 100-year storm event and 6.6 feet of SLR. Figure 21 shows that there would be limited impacts to RSA Location 7 or surrounding area with the flooding extents reaching just the edges of the railway ballast but still within the RSA. Flooding extents in the surrounding area extend to the residential zones east of the RSA. There are no inundation impacts to the RSA during the 1.6-feet SLR scenario.

Figure 15. 1.6-Foot and 6.6-Foot Sea Level Rise Inundation with Baseline MHW and 100-Year Storm Event at Location 1



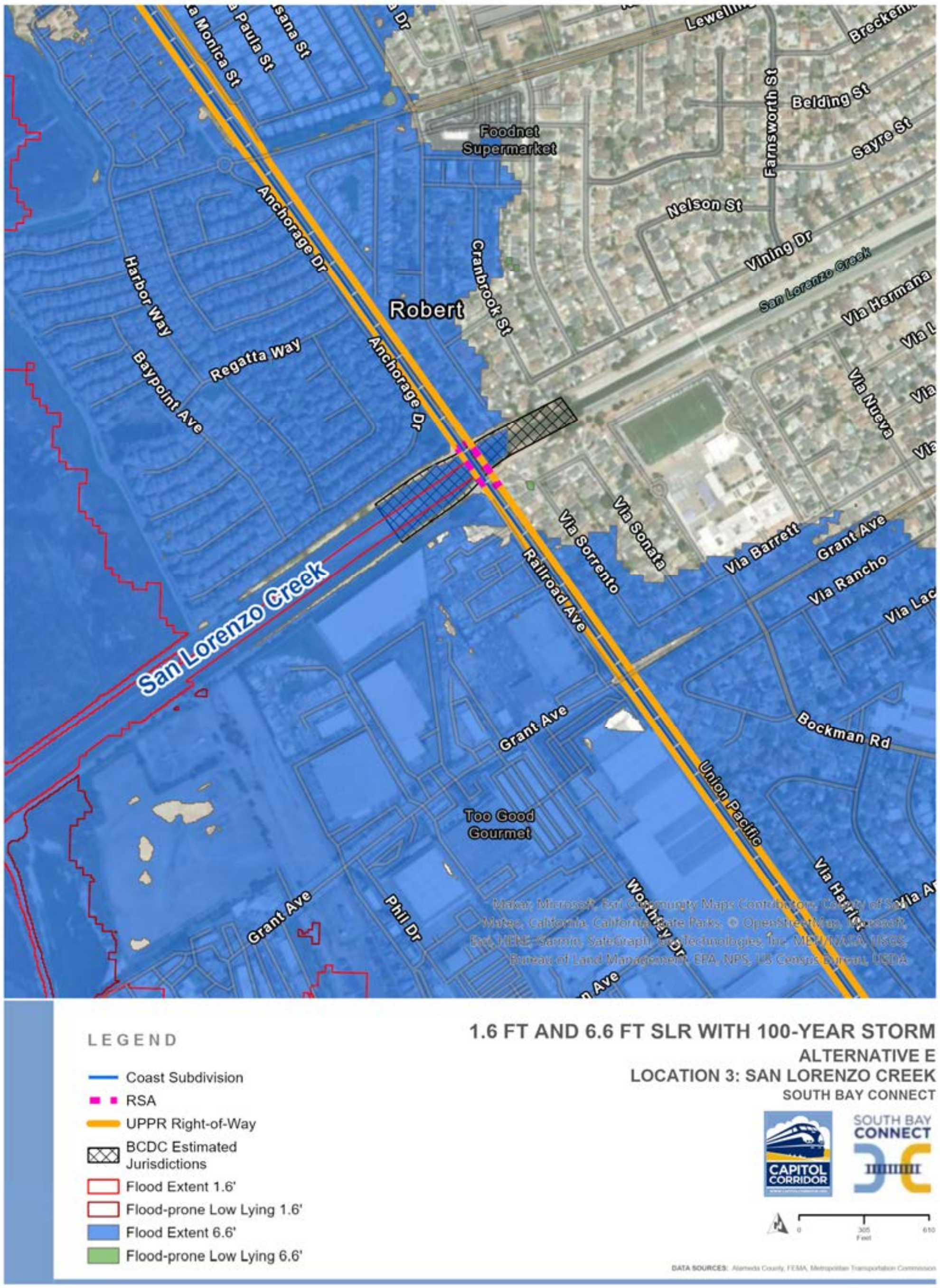
Source: CoSMoS (2022)

Figure 16. 1.6-Foot and 6.6-Foot Sea Level Rise Inundation with Baseline MHW and 100-Year Storm Event at Location 2



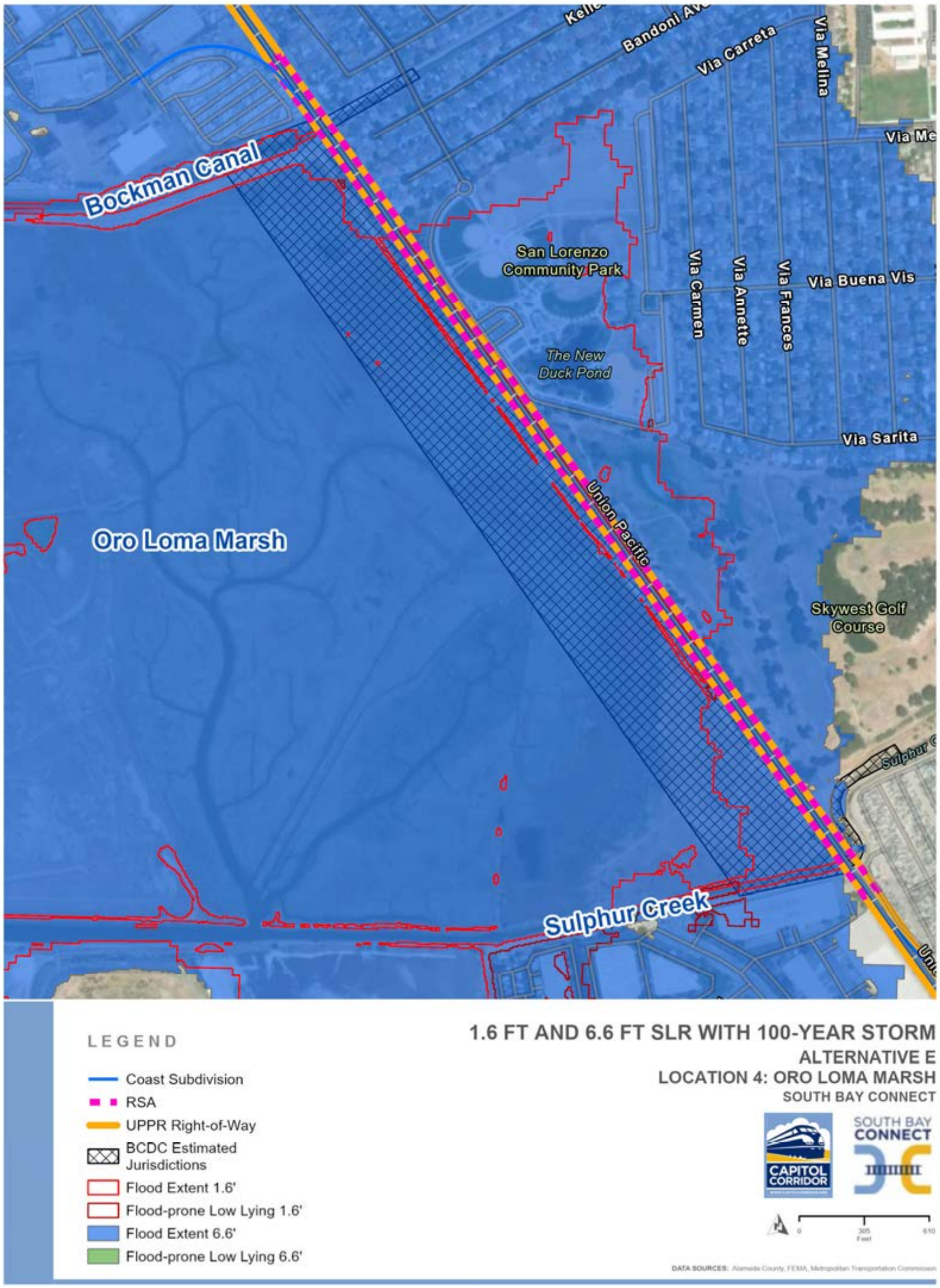
Source: CoSMoS (2022)

Figure 17. 1.6-Foot and 6.6-Foot Sea Level Rise Inundation with Baseline MHW and 100-Year Storm Event at Location 3



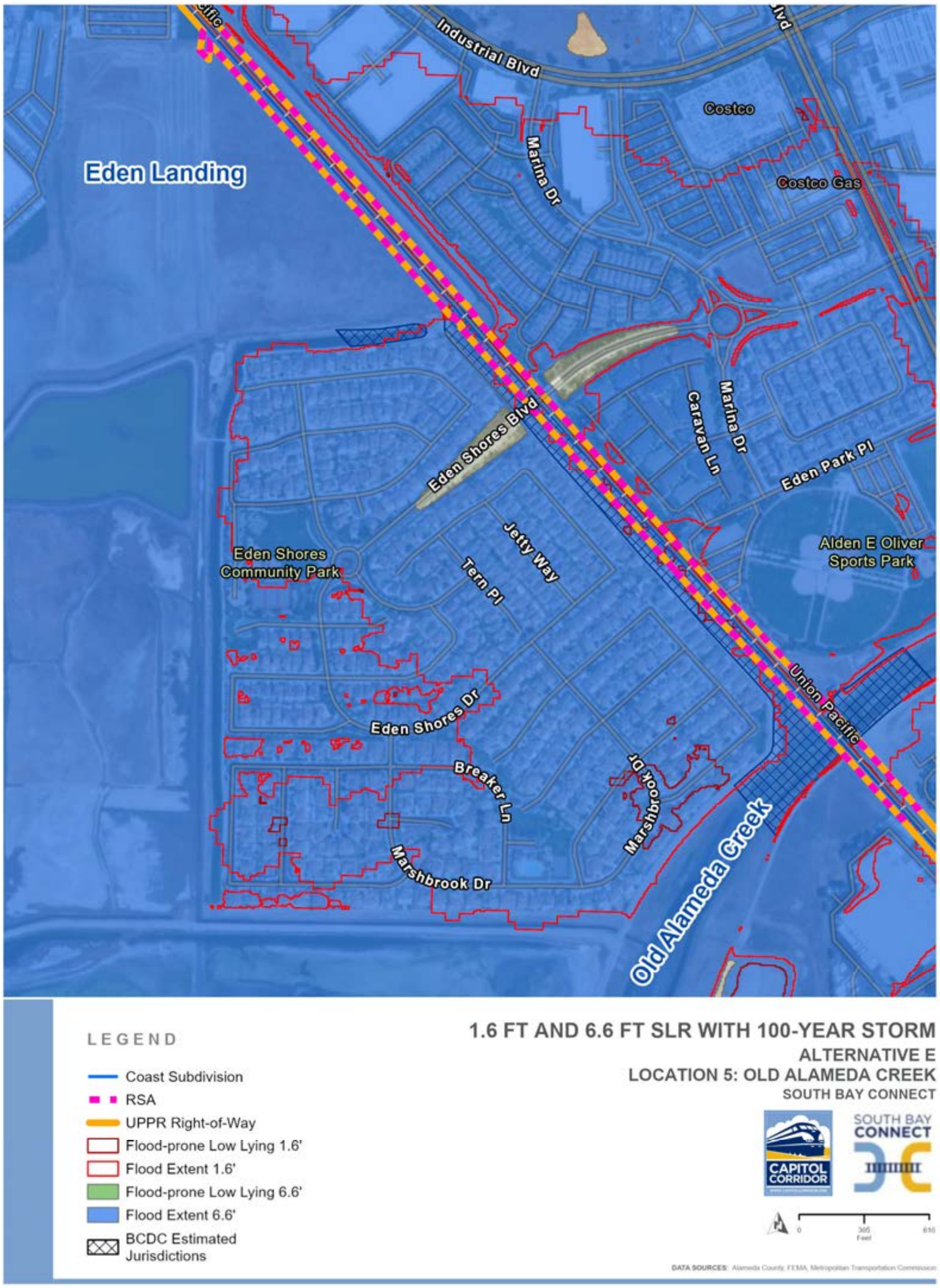
Source: CoSMoS (2022)

Figure 18. 1.6-Foot and 6.6-Foot Sea Level Rise Inundation with Baseline MHW and 100-Year Storm Event at Location 4



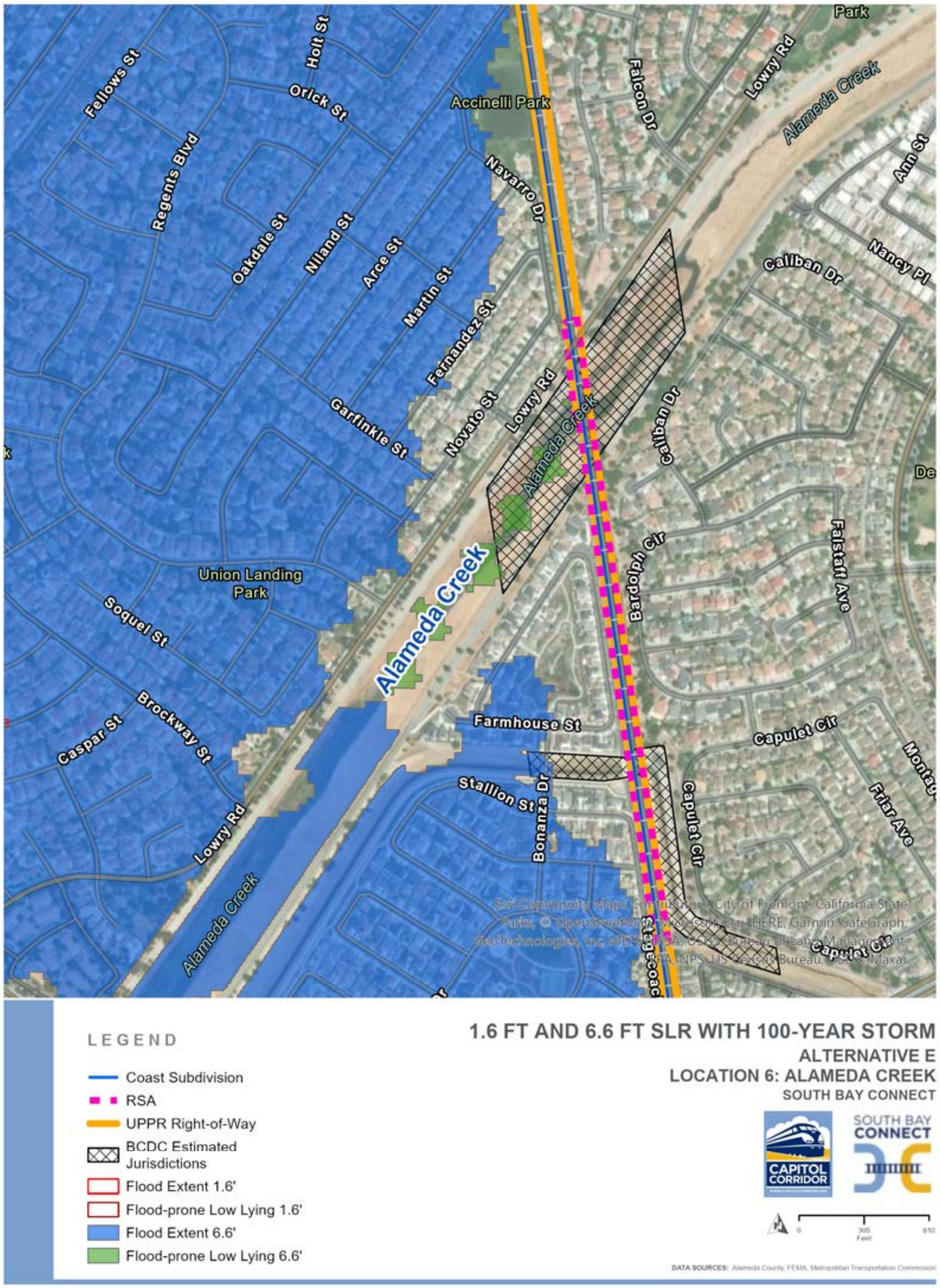
Source: CoSMoS (2022)

Figure 19. 1.6-Foot and 6.6-Foot Sea Level Rise Inundation with Baseline MHW and 100-Year Storm Event at Location 5



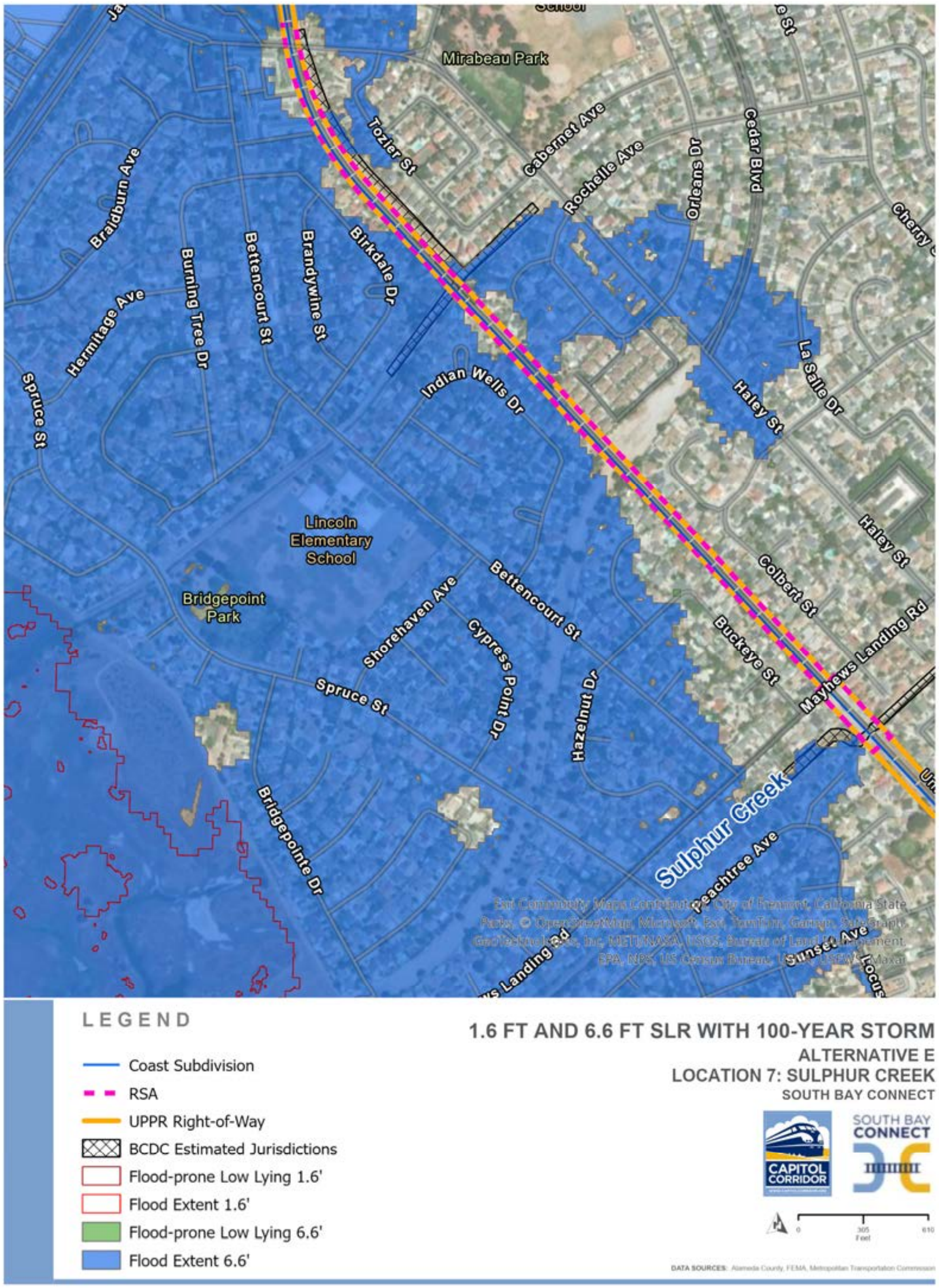
Source: CoSMoS (2022)

Figure 20. 1.6-Foot and 6.6-Foot Sea Level Rise Inundation with Baseline MHW and 100-Year Storm Event at Location 6



Source: CoSMoS (2022)

Figure 21. 1.6-Foot and 6.6-Foot Sea Level Rise Inundation with Baseline MHW and 100-Year Storm Event at Location 7



Source: CoSMoS (2022)

The ART Bay Shoreline Flood Explorer Map was also used to visualize inundation at the RSAs. The ART Map does not include wave action within their storm surges like CoSMoS but incorporates useful data about berms and levees from local stakeholders. The ART Map also cannot generate results to exactly match each SLR projection, so 1 foot and 2 feet of SLR were used as they were closest to the SLR projections in Table 7. These SLR depths respectively correspond to the projections for the Years 2040 (1.3 feet) and 2050 (1.9 feet). There is no visualization data available on the ART Map for any SLR scenario greater than 5.5 feet. According to the data listed in Table 5, a SLR scenario of 5.5 feet best matches the projected SLR in the Year 2090. Year 2090 represents a 60-year projected life span of the Project. Visualizations for the projected 5.5 feet of SLR are included to serve as visual aids when considering the 100-year projected SLR. The ART Map visualizes depths of flooding in 2 feet intervals.

RSA Location 1 ART Maps for the 100-year tide event and 1-, 2-, and 5.5 feet of SLR are shown in Figure 22, Figure 23, and Figure 24, respectively. The figures show that the 1- and 2-foot SLR are contained within San Leandro Creek. The 5.5 feet of SLR inundation would extend to 0-2 feet along the creek banks adjacent to the trackway.

RSA Location 2 and the impacts of the 100-year tide event and 1-, 2-, and 5.5 feet of SLR, are shown in Figure 25, Figure 26, and Figure 27, respectively. Figure 25 shows that SLR would inundate the entire RSA Location 2, overtopping the railroad structure from the west by approximately 1 foot. Depths would range from 0 to 6 feet, with water deepest on the west side of the railroad in the existing channel. Unlike the CoSMoS model, water would flow from north to south through the existing channel and overtop the berm in a small segment in this scenario. This better matches the existing flow patterns and topography visible on Google Earth, which shows the channel currently inundated. The 2 feet of SLR inundation shown Figure 26, indicates that SLR would flood the entire RSA Location 2 similarly to the 2040 scenario, but to a deeper depth of up to 6 feet. The railroad and a slightly larger segment of the berm to the west is overtopped. RSA Location 2 also receives flow from the northeast from Estudillo Canal, which overtops its banks. Inundation impacts from 5.5 feet of SLR during a 100-year storm event extend throughout RSA Location 2 with inundation depths reaching up to 8 feet along the trackway.

RSA Location 3 ART Maps for the 100-year tide event and 1-, 2-, and 5.5-feet of SLR are shown Figure 28 Figure 29, and Figure 30, respectively. One (1) foot of SLR impacts would be contained within San Lorenzo Creek. Inundation depths within the creek would reach approximately 6 to 8 feet. At 2 feet of SLR, the inundation within RSA Location 3 is still contained within the creek reaching inundation depths of approximately 8-10 feet. Impacts due to 5.5 feet of SLR extend throughout the RSA with inundation levels ranging from 0 to 2 feet at the areas adjacent the RSA and along the creek banks.

RSA Location 4 ART Maps for the 100-year tide event and 1-, 2-, and 5.5 feet of SLR are shown Figure 31, Figure 32, and Figure 33, respectively. The ART flood layer for the 1-foot SLR scenario shows inundation crossing the RSA and spilling into the park areas to the east. Inundation by the trackway reaches a potential depth of 2 feet with the adjacent park areas reaching potential depths of 4 feet. In the 2-foot SLR inundation scenario flooding expands past the park and into the residential areas further east. These residential areas experience potential flooding depths of up to 2 feet. Inundation by the trackway reaches potential depths of up to 6 feet under this scenario. In the 5.5-SLR visualization, inundation impacts extend past the trackway into the park and residential community to the east. Inundation depths along the trackway and within UPRR ROW range from 4 to 6 feet.

RSA Location 5 ART Maps for the 100-year tide event and 1-, 2-, and 5.5 feet of SLR are shown Figure 34, Figure 35, and Figure 36, respectively. During the 1-foot SLR scenario, there is extensive flooding throughout the RSA. Flooding impacts from the Eden Landing marsh areas as well as the channel to the east of the trackway extend throughout the length of the RSA. Inundation depths by the trackway at Eden Landing reach a potential depth of 6 feet. Flooding extends beyond the Old Alameda Creek crossing with inundation by this segment of the trackway reaching potential depths of up to 4 feet. In the 2-foot SLR scenario, inundation extends past the channel adjacent the RSA into the developed areas to the east. This developed area experiences inundation impacts from the overtopping of the adjacent channel as well as Old Alameda Creek east of the crossing. Inundation by the trackway along RSA Location 5 reaches a potential depth of 8 feet under this scenario. The greatest levels of inundation at this location occur within the channel adjacent the railway. In the same scenario, inundation by the trackway remains at a potential depth of 4 feet. Inundation extents in this scenario go beyond Hesperian Boulevard and extend to the east. A majority of the inundation impacts adjacent the RSA reach potential depths of up to 4 feet. Inundation in the 5.5-foot SLR scenario extends throughout the RSA and the surrounding area. Inundation in the areas directly adjacent the trackway reach depths of 10 to 12 feet.

RSA Location 6 ART Maps for the 100-year tide event and 1-, 2-, and 5.5 feet of SLR are shown Figure 37, Figure 38, and Figure 39, respectively. The ART flood layer for the 1- and 2-foot SLR scenario shows inundation at the crossing contained within Alameda Creek and southern unlined channel crossings. Inundation during the 5.5-feet SLR scenario is contained within Alameda Creek at the trackway crossing. Inundation at the southern unlined channel crossing extends just outside the trackway at depths of 0 to 2 feet with the majority of the inundation impacts contained within the channel. Areas north and west adjacent to the trackway are impacted by inundation 0 to 4 feet in depth but is outside of the UPRR ROW.

RSA Location 7 ART Maps for the 100-year tide event and 1-, 2-, and 5.5 feet of SLR are shown Figure 40, Figure 41, and Figure 42, respectively. There are no impacts to the RSA from SLR in either the 1-foot or 2-foot SLR scenario. Inundation during the 5.5-feet SLR scenario spreads throughout the RSA at depths of 0 to 2 feet.

The ART Map shows greater inundation than CoSMoS in the 2040 and 2050 scenarios. The ART Map even shows greater inundation than CoSMoS when comparing the 2090 projected SLR impacts shown by ART to the 2100 projected SLR impacts shown in the CoSMoS maps, despite the ART Map not including wave runup which would increase the TWL. Table 9 summarizes the susceptibility of each RSA to SLR at each service life horizon.

Table 9. SLR Susceptibility by ART and CoSMoS Visualizations at Each Service Life Horizon

RSA Location	2040		2050		2090/2100	
	ART	CoSMoS	ART	CoSMoS	ART	CoSMoS
1	No	No	No	No	No	No
2	Yes	Yes	Yes	Yes	Yes	Yes
3	No	No	Yes	No	Yes	Yes
4	Yes	Yes	Yes	Yes	Yes	Yes
5	Yes	Yes	Yes	Yes	Yes	Yes
6	No	No	No	No	No	No
7	No	No	No	No	Yes	Yes

Figure 22. 1-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 1

Source: ART Flood Explorer Map (2022)

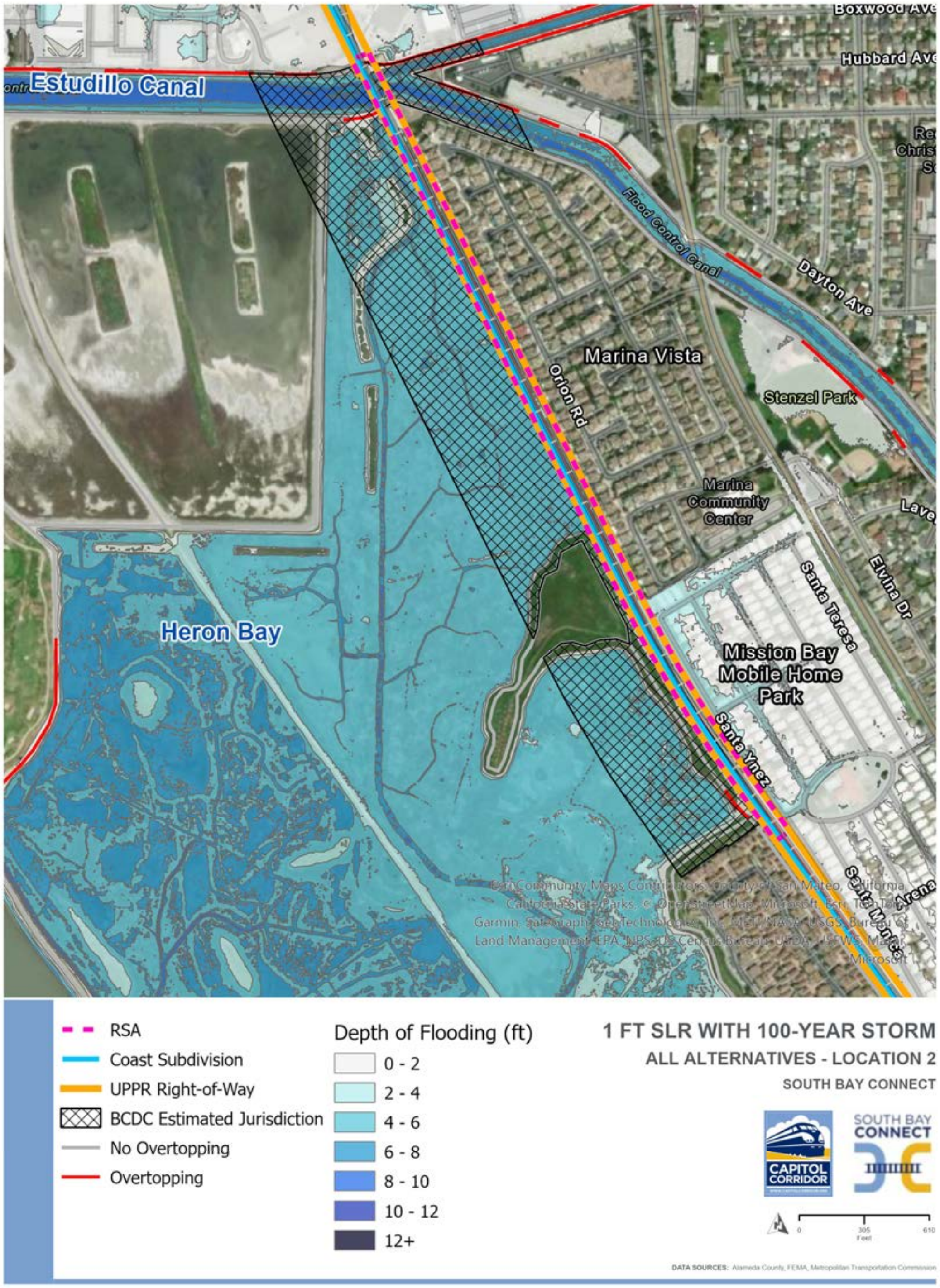
Figure 23. 2-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 1

Source: ART Flood Explorer Map (2022)

Figure 24. 5.5-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 1

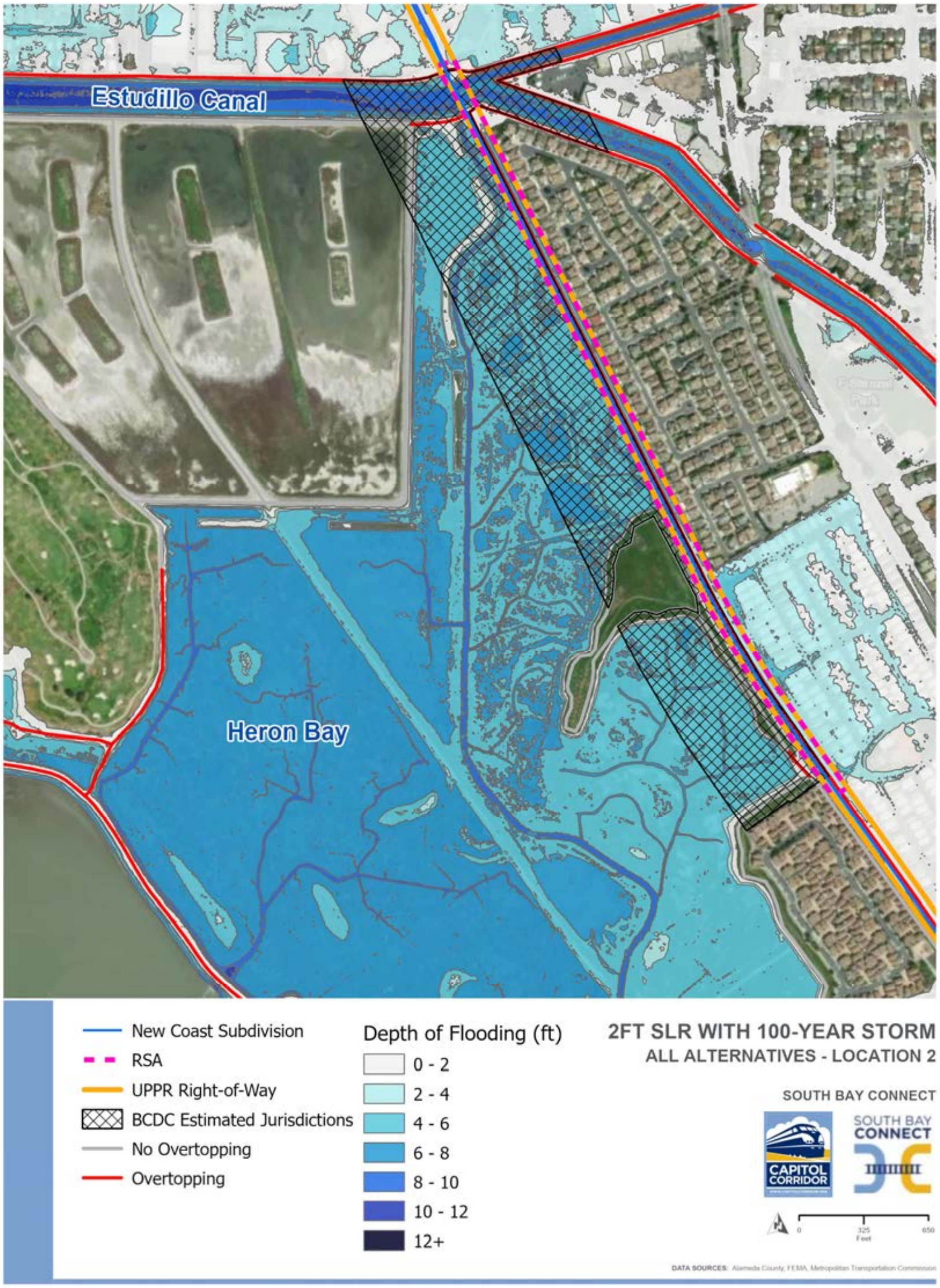
Source: ART Flood Explorer Map (2022)

Figure 25. 1-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 2



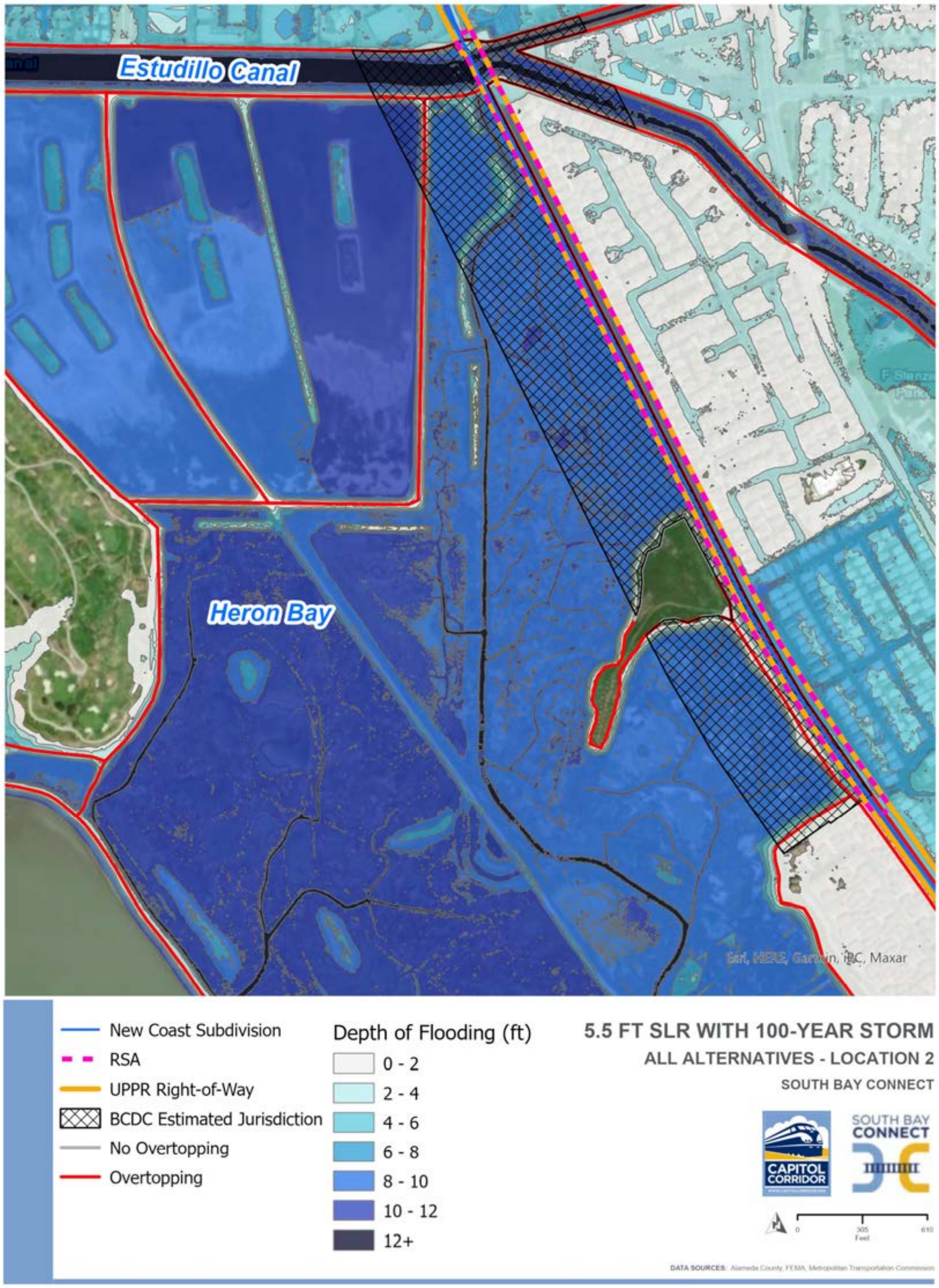
Source: ART Flood Explorer Map (2022)

Figure 26. 2-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 2



Source: ART Flood Explorer Map (2022)

Figure 27. 5.5-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 2



Source: ART Flood Explorer Map (2022)

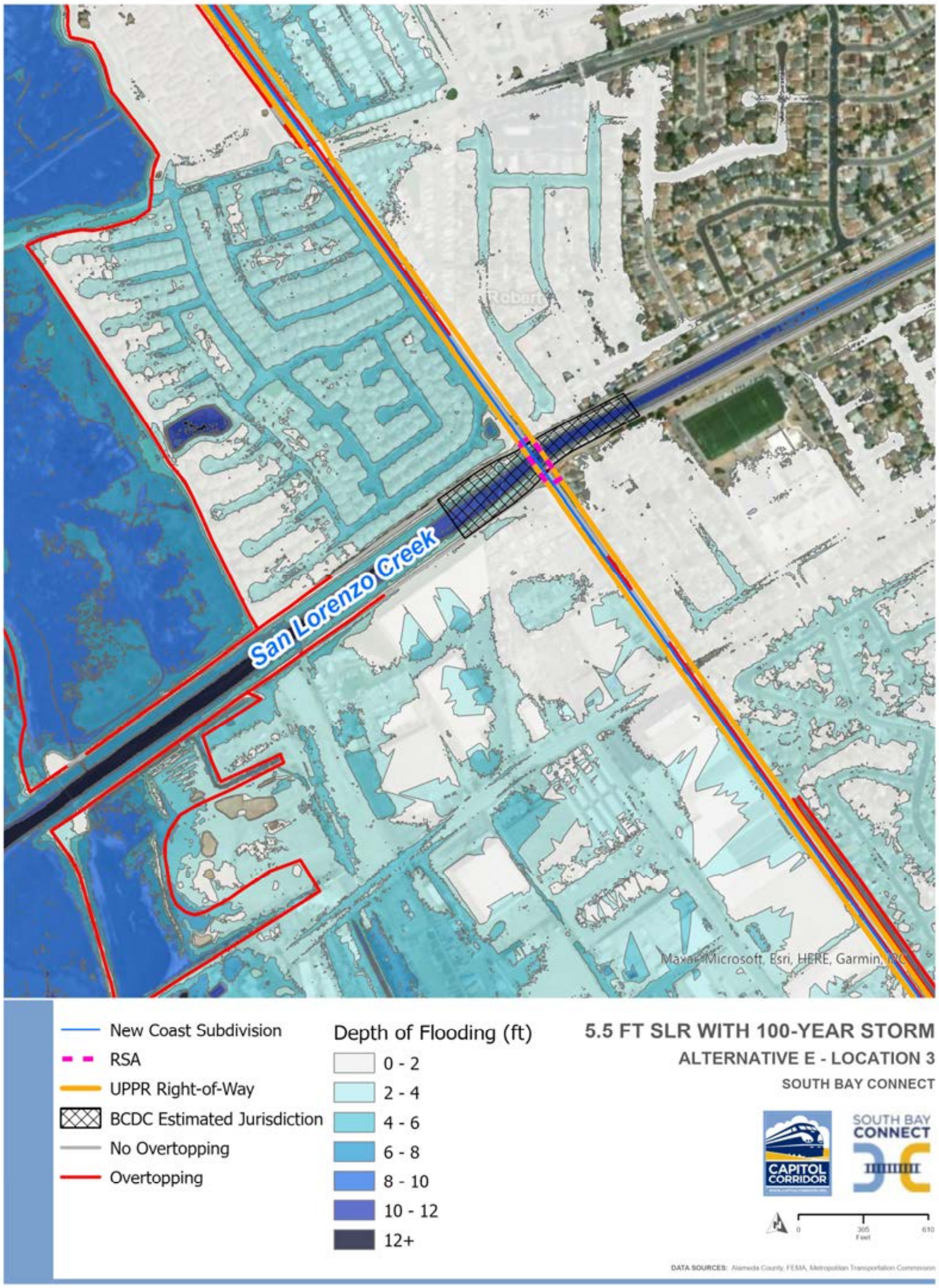
Figure 28. 1-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 3

Source: ART Flood Explorer Map (2022)

Figure 29. 2-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 3

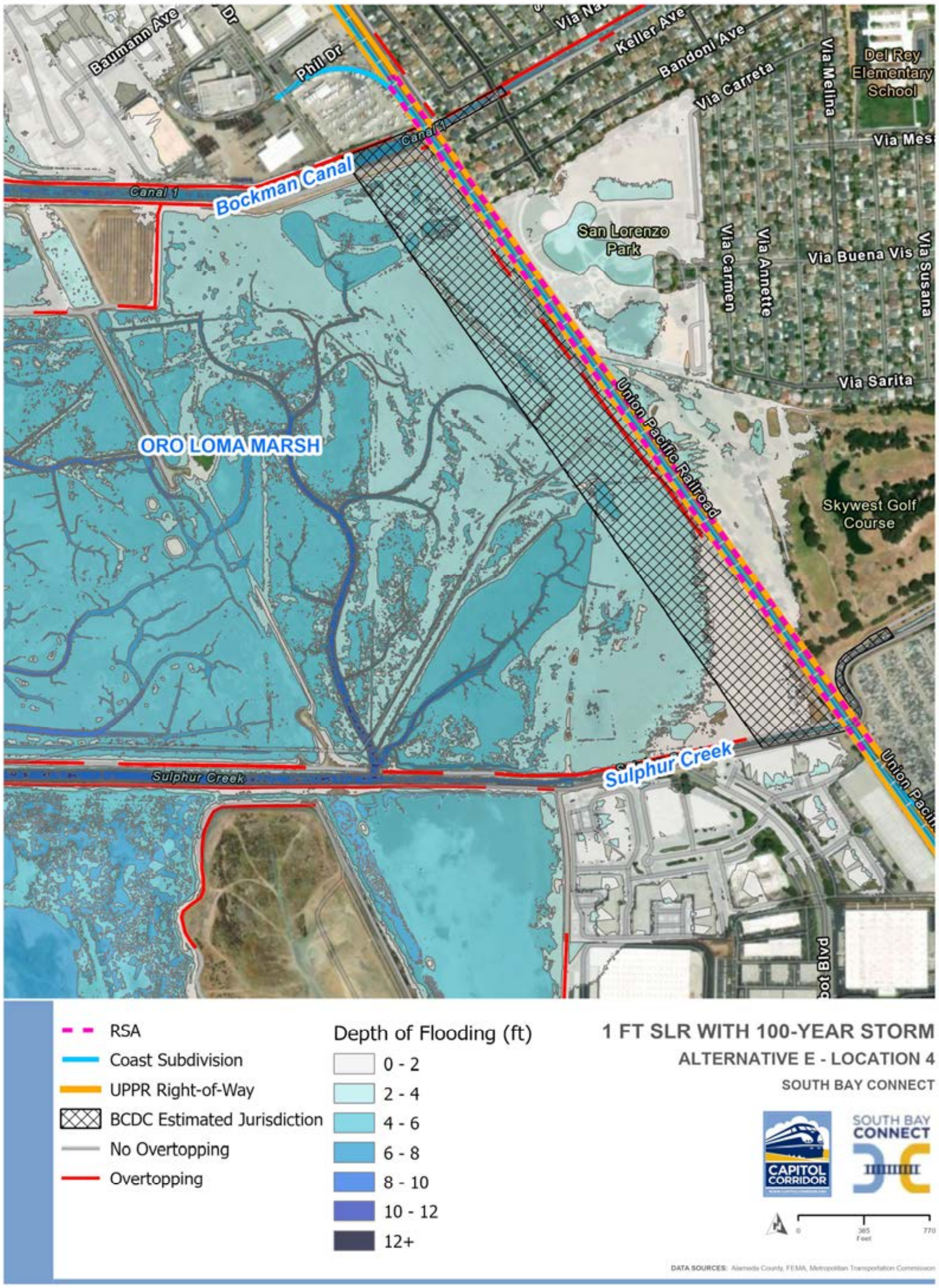
Source: ART Flood Explorer Map (2022)

Figure 30. 5.5-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 3



Source: ART Flood Explorer Map (2022)

Figure 31. 1-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 4



Source: ART Flood Explorer Map (2022)

Figure 32. 2-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 4

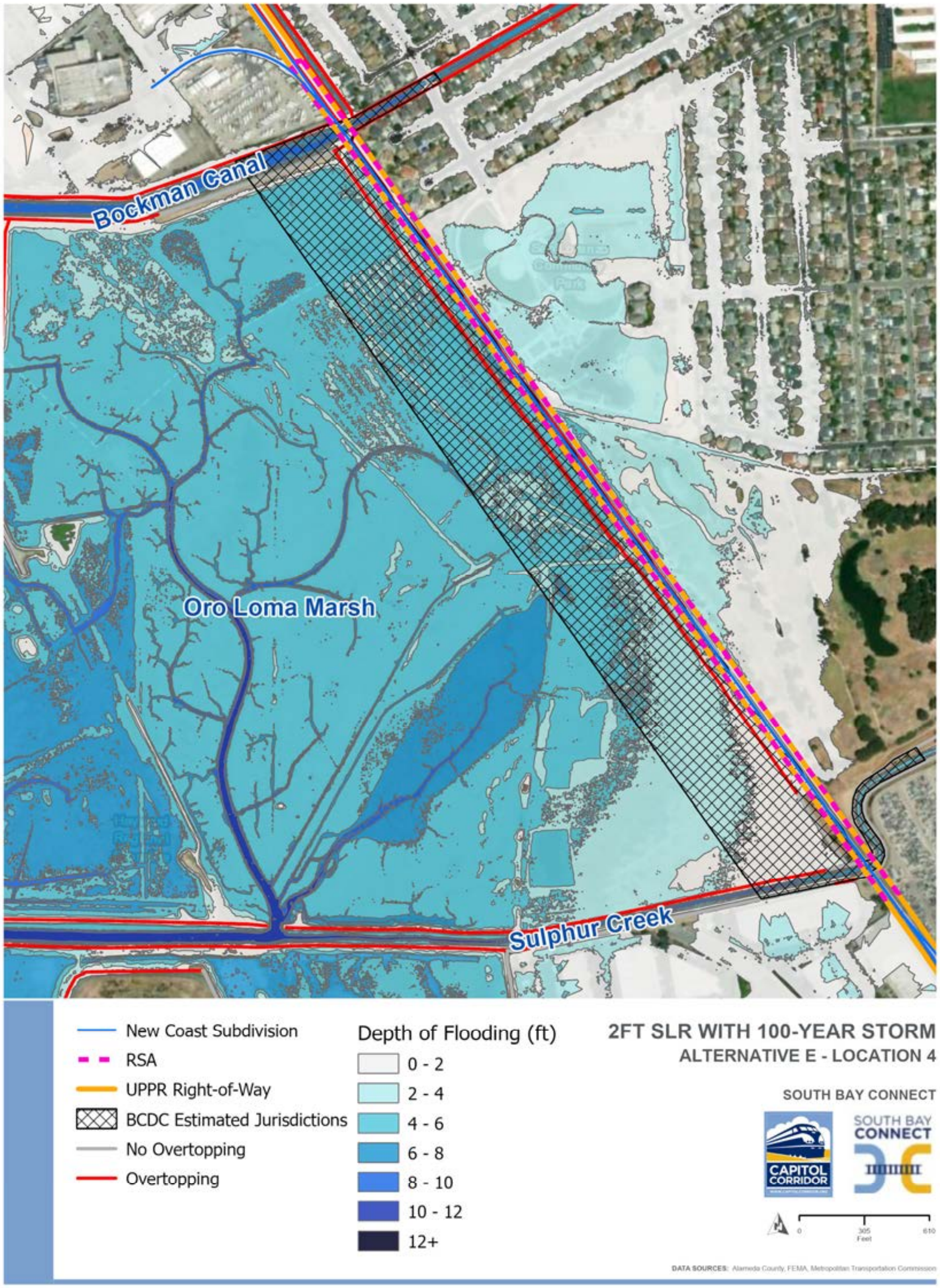


Figure 33. 5.5-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 4

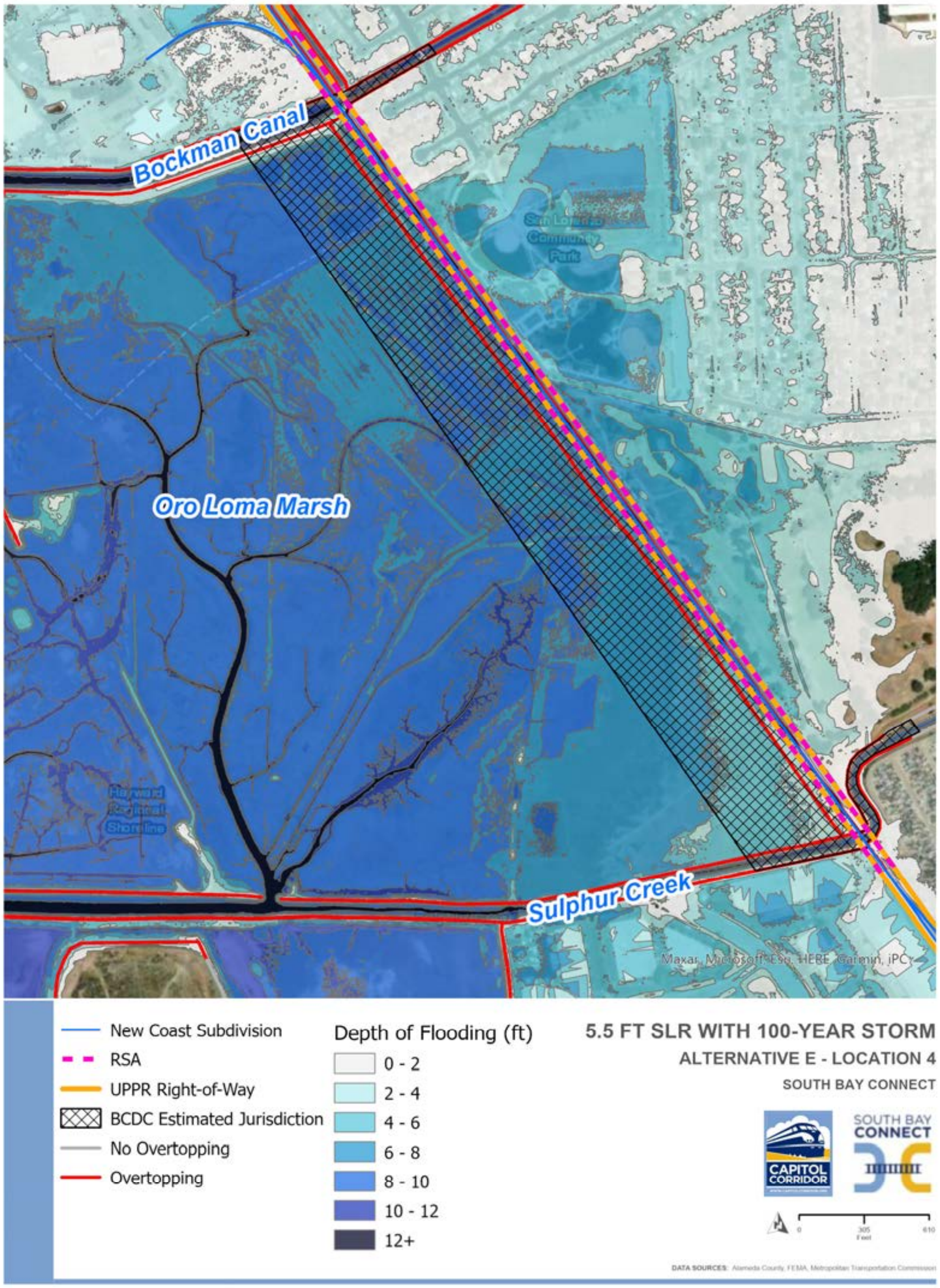


Figure 34. 1-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 5

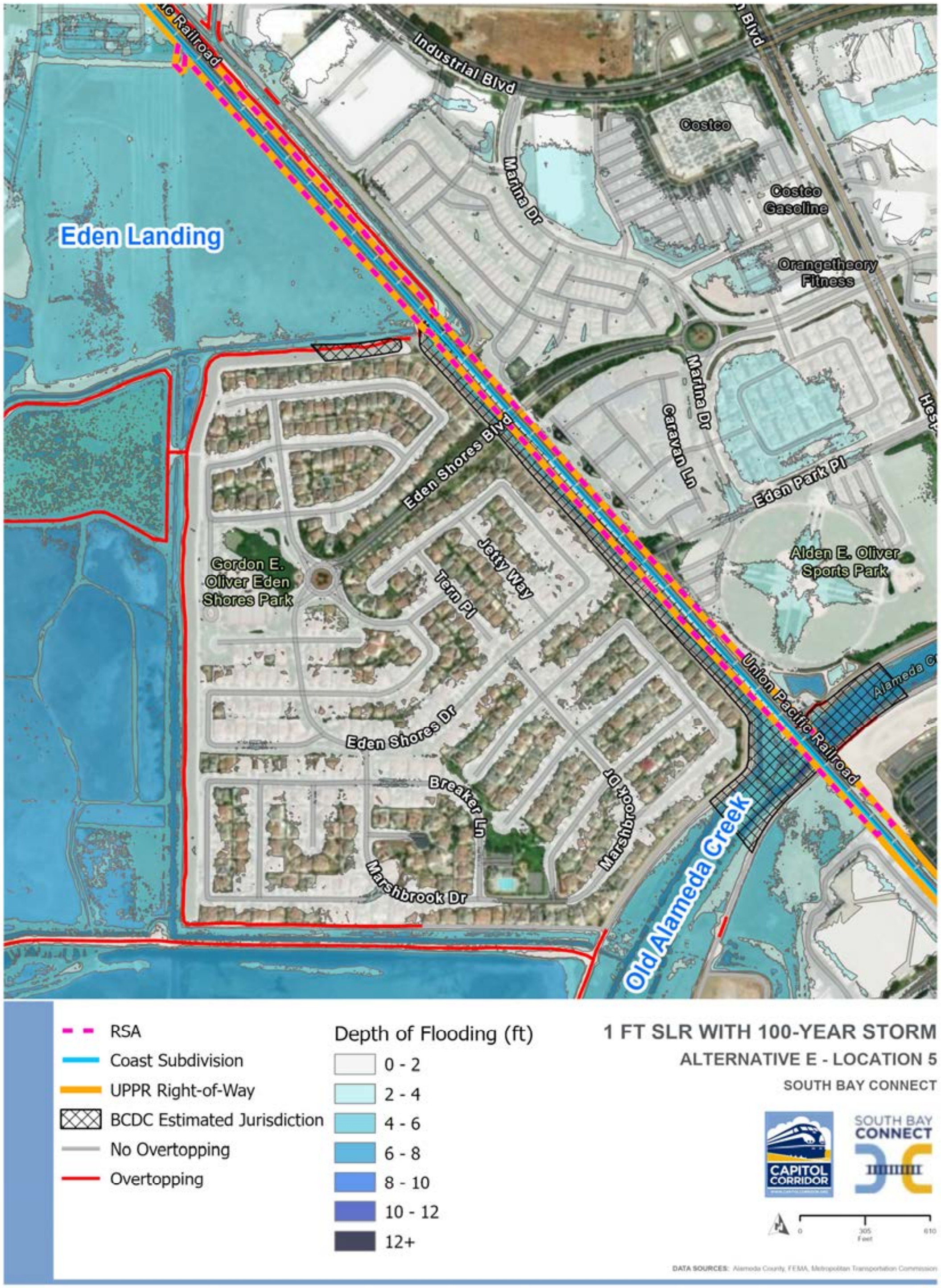


Figure 35. 2-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 5

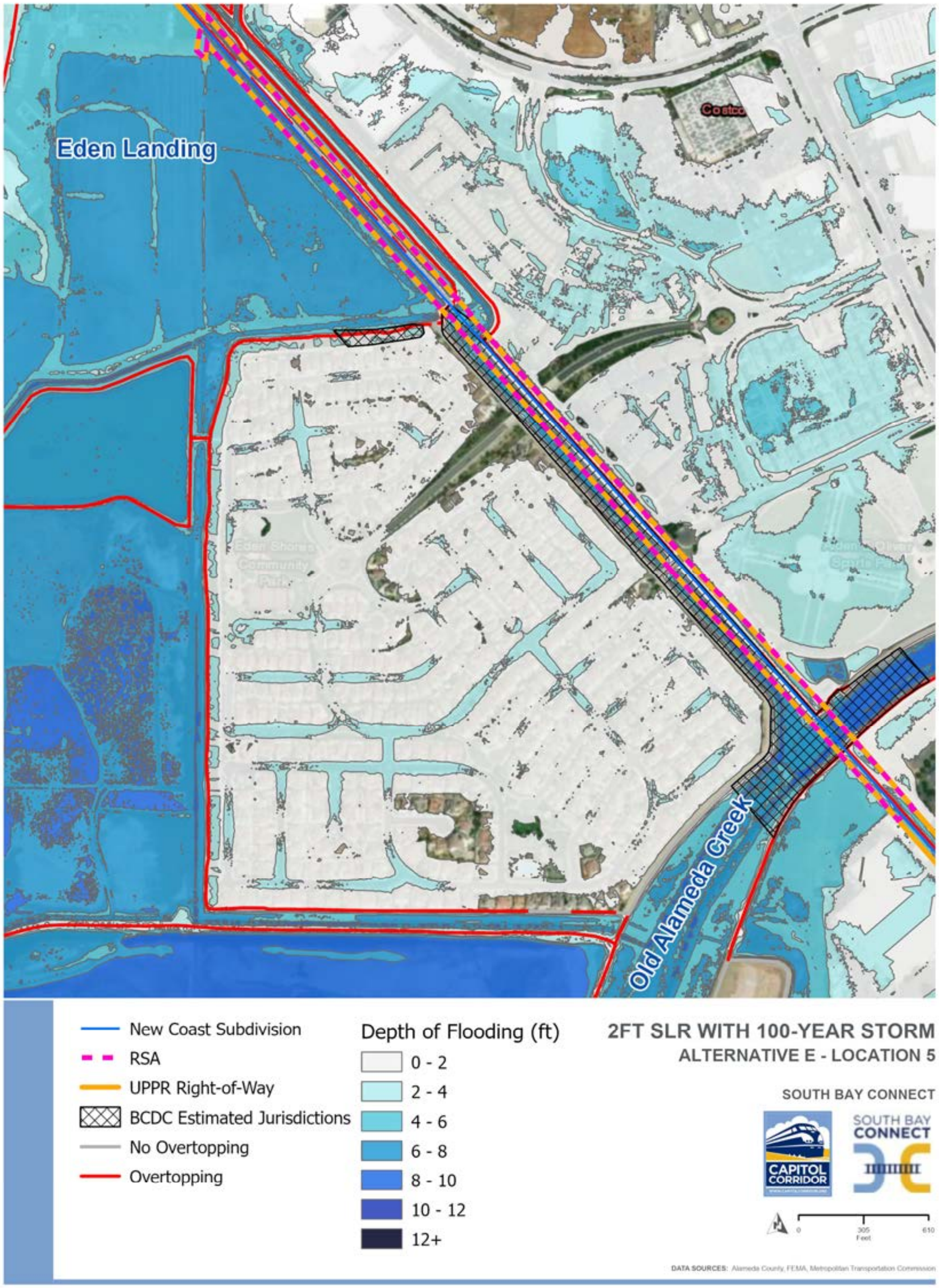


Figure 36. 5.5-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 5

Figure 37. 1-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 6

Figure 38. 2-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 6

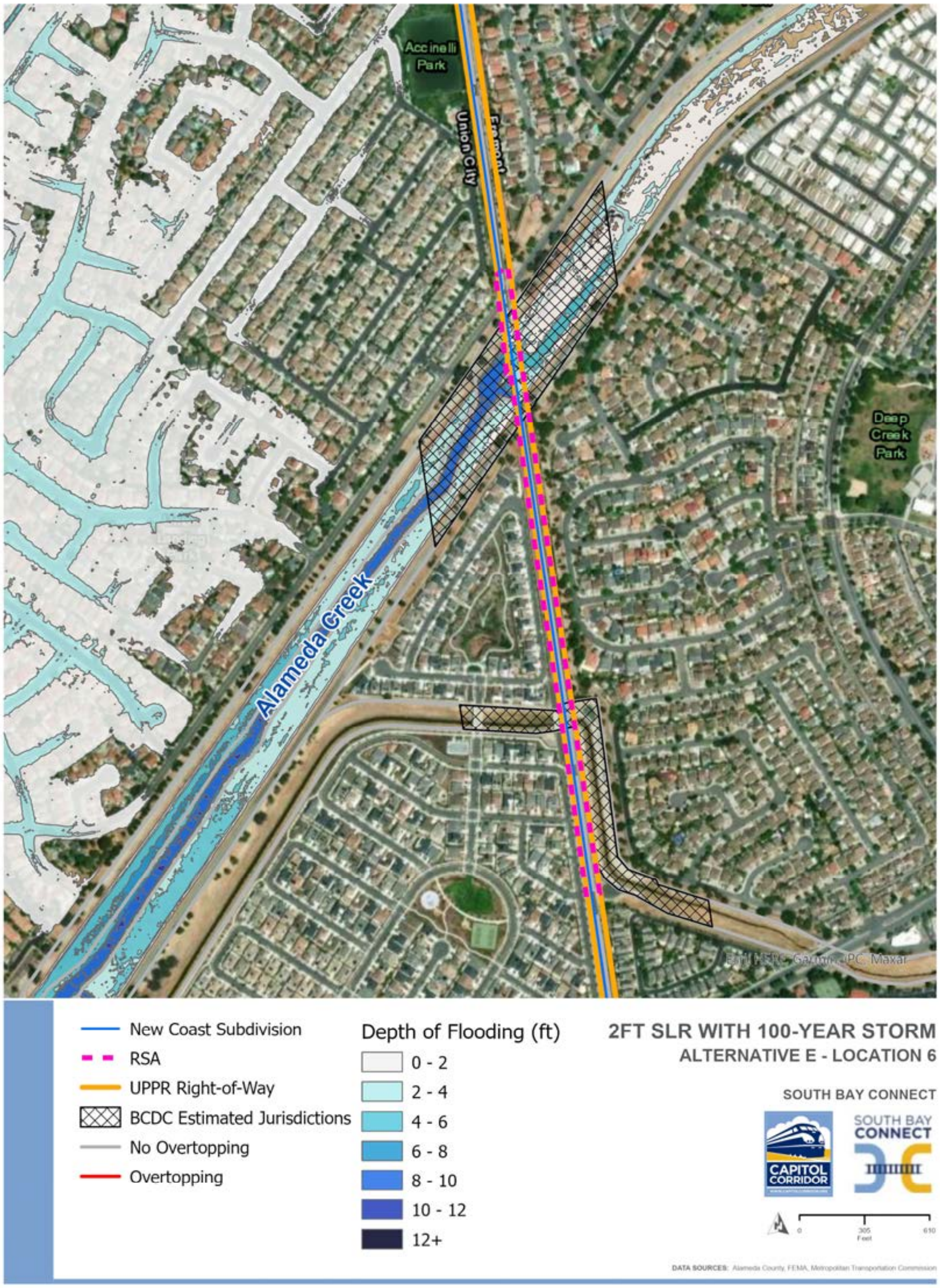


Figure 39. 5.5-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 6

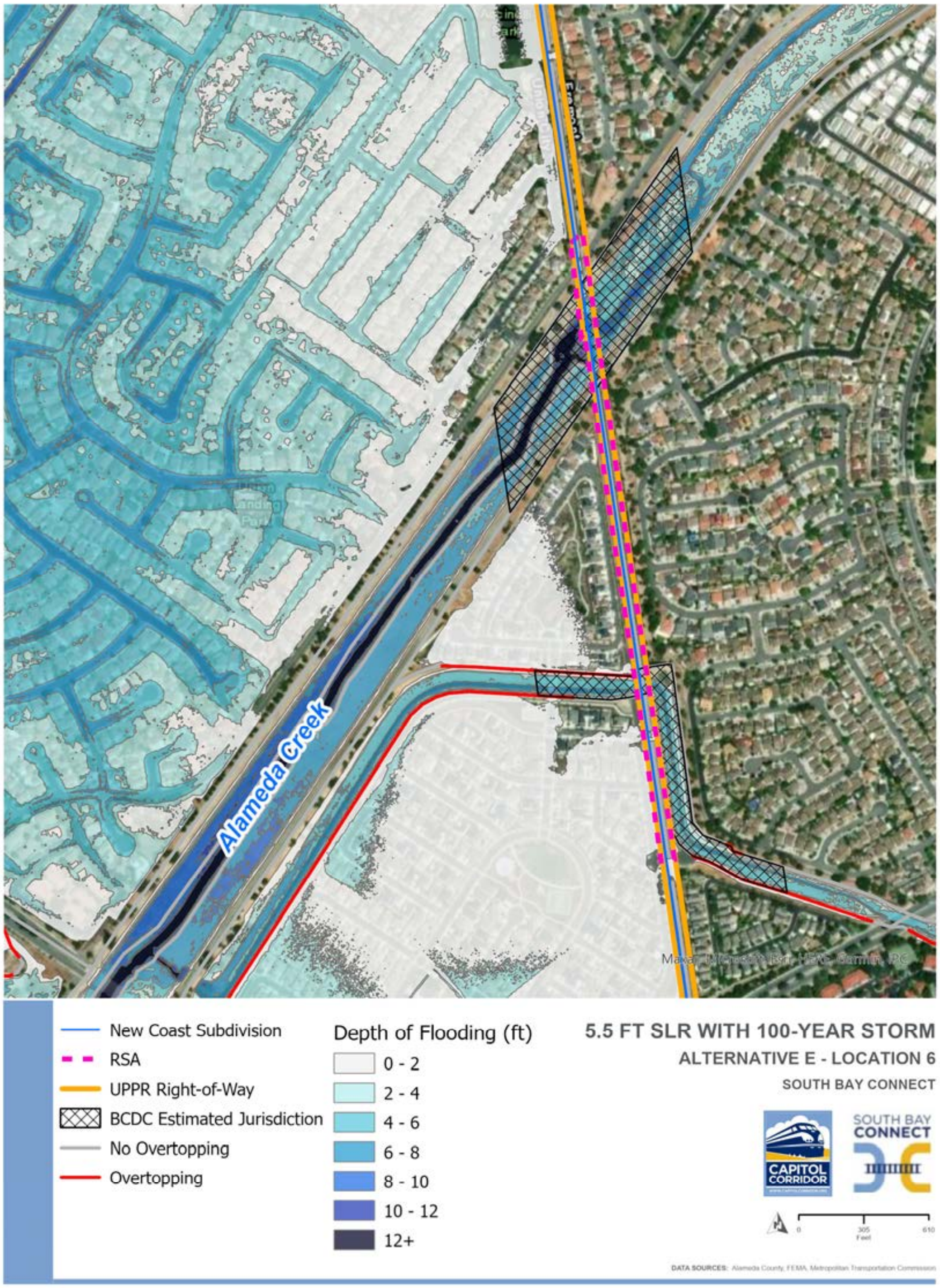
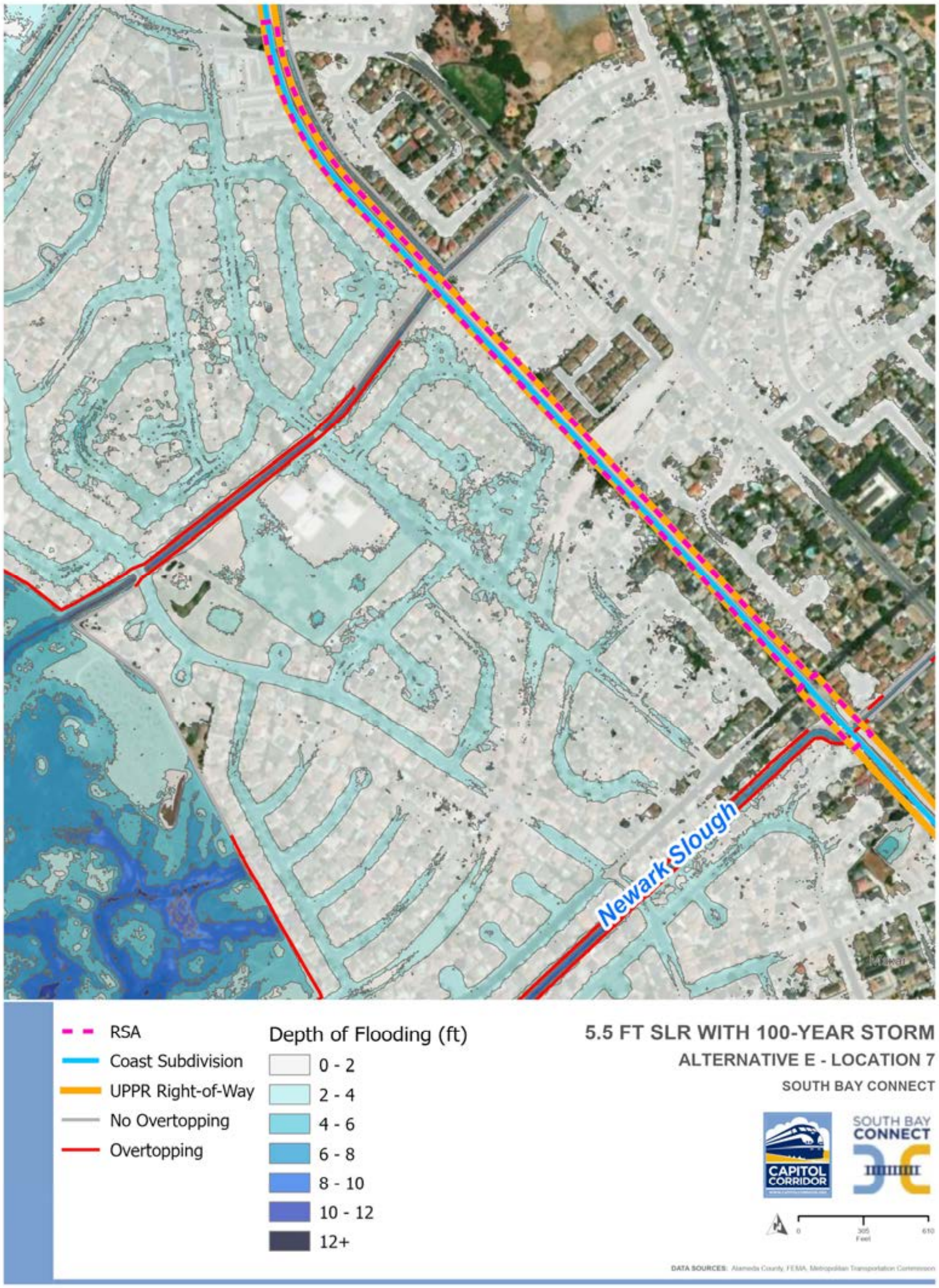


Figure 40. 1-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 7

Figure 41. 2-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 7

Figure 42. 5.5-Foot Sea Level Rise Inundation with FEMA 100-Year Baseline at Location 7



5.4 Assessment of Effects and Adaptation Measures

5.4.1 IMPACT ASSESSMENT

Based on the projected SLR elevation in 2050 under the medium to high-risk aversion scenario, RSAs 2 through 5 may be prone to potential inundation by 2050 in the 100-year tide event with 1.9 feet of SLR.

RSA Location 2 may be prone to potential inundation by 2050 as the flow of water from the north and the overtopping of berms and levees in the RSA vicinity could cause flooding. The CoSMoS mapping tool shows that a section of RSA Location 2 would be a flood-prone low-lying area. The ART Map displays deeper flooding than CoSMoS in the same scenario, showing that the railroad would be overtopped in the 100-year tide event with 1-in-200 scenario SLR.

RSA Location 3 may be prone to potential inundation by 2050 due to the impacts of flow from Heron Bay to the north of the RSA. The ART mapping tool shows flows overtopping Heron Bay and flooding the residential community adjacent to the trackway. CoSMoS does not show this area impacted by SLR in the year 2050.

RSA Location 4 may be prone to potential inundation by 2050 as the overtopping of the berm west of the RSA could cause flooding. The CoSMoS mapping tool shows that flooding would extend into the park but stop before reaching residential development. The ART Map displays deeper flooding than CoSMoS in the same scenario, showing that flooding would extend into the residential area to the east.

RSA Location 5 may be prone to potential inundation by 2050 due to its proximity to the channel adjacent the trackway and Old Alameda Creek. The CoSMoS mapping tool shows that flooding would extend from Old Alameda Creek east of the RSA and the channel east of the trackway extending into the residential area between the railway and Hesperian Boulevard. The ART Map displays deeper flooding than CoSMoS in the same scenario showing that flooding would extend past Hesperian Boulevard.

5.4.2 CONSIDERED SLR ADAPTATION MEASURES

Adaptation measures of local and regional projects; on-going SLR adaptation efforts currently proposed by the City of San Leandro; as well as the CCJPA SLR Vulnerability Assessment were researched and reviewed. BCDC recommends an adaptive management approach to SLR if a project is expected to remain in place past mid-century. The following sections provide a description of those adaptation measures and their applicability to this Project.

SLR Adaptation Measure Categories

The adaptation measures identified were grouped into the following categories: Project Improvements with the RSA, Operational Measures, and Regional Coordination Efforts.

1) Category 1 - Project Improvements within the RSA
   a) Raise the elevation of the railroad tracks
   b) Raise electrical and signal equipment to address rising sea levels
   c) Install watertight or corrosion-resistant electrical conduits, vaults, and appurtenances
   d) Build flood walls along the Project corridor
2) Category 2 - Operational Measures
   a) Update Amtrak's emergency evacuation and train operation plans in case of inundation to include the possibility of retreat as a response to SLR
   b) Coordinate with UPRR on train operation plans with adaptation response to SLR
   c) Allocate future CCJPA funding to assist in SLR adaptation projects with partner agencies
3) Category 3 - Regional Coordination Efforts
   a) Work with regional agencies and local communities as part of a larger regional adaptation planning process
   b) Work with UPRR to plan for long-term SLR adaptation along the entire Project corridor. Encourage the incorporation of waterproof and corrosion-resistant materials.
   c) Install flood control infrastructure (berms, levees, tide gates) outside the RSA
   d) Collaborate on environmental-based flood control infrastructure (horizontal levees, creek reconnection, and/or construction and designation of upland inundation areas)

Feasibility of Adaptation Measures

The feasibility analysis of incorporating SLR adaptation measures included the evaluation of the potential benefits of the proposed improvements, the potential impacts to the Project scope, and the costs of the SLR adaptation measures.

1) Category 1 - Projects Improvements within the RSA

A possible adaptation measure considered within the RSAs would be to raise the elevation the railroad tracks where inundation impacts are anticipated. Elevating the railroad more than once depending on the rate of SLR was discussed. Raising the track may require reconstructing the at-grade crossings north and south of the RSA locations, re-grading the full extent of the UPRR right-of-way between the reconstructed at-grade crossings, and reconstructing the railroad bridge over the Estudillo Canal, San Leandro, San Lorenzo, Sulphur, Alameda and Old Alameda creeks and Bockman Canal.

If necessary, within the RSAs, possible adaptation measures to minimize the effects of SLR include waterproofing of electrical equipment and conduits and elevating aboveground components to avoid damage from SLR. Additional communication with UPRR is possible concerning the incorporation of waterproof and corrosion-resistant materials as a part of the Project's SLR adaptation measures.

The possibility of building flood walls would be best coordinated with regional efforts for comprehensive flood control infrastructure. Without regional coordination, building flood walls may divert and exacerbate inundation to adjacent areas not protected by flood walls.

2) Category 2 – Operational Measures

Amtrak operates the trains on the CCJPA corridor and could update their emergency plan as a possible measure to address evacuation in case of flooding from SLR at the RSA. As part of an updated plan, CCJPA could incorporate managed retreat as part of their seasonal response to SLR impacts in the near term. In the long term, dependent on regional planning, total retreat could also be a potential response to SLR impacts along the corridor. CCJPA could also develop an operational plan on how address a service gap due to SLR at the RSA, including bus bridges, train movement, and storage. Any changes to train operation plans would be coordinated with UPRR.

Future CCJPA funding could be allocated for SLR adaptation projects with local and regional partners. Regional coordination efforts will be discussed further in the next section.

3) Category 3 - Regional Coordination Efforts

While the Project alone cannot provide a comprehensive response to SLR impacts along the proposed Project area, regional approaches can be supported to provide SLR management to the area. On a regional scale, the Project's ROW is very limited, thus limiting the options for on-site SLR management. As such, SLR impacts within or adjacent to the Project area may best addressed by collaborating with an existing regional approach and coordinating with UPRR on a future long-term adaptation response to SLR. As owner of the railroad, UPRR has more control over infrastructure improvements than CCJPA.

As an effort to reduce the impact of SLR on the RSAs, CCJPA will support SLR management efforts beyond the footprint of the Project. This is outlined in the CCJPA SLR Vulnerability Assessment and encouraged by BCDC. BCDC's Climate Change Policy 6 recommends the development of such a regional strategy of climate change adaptation, in which existing shoreline development and critical infrastructure such as regional transportation would be protected. In accordance with the next steps outlined in the CCJPA Vulnerability Assessment, CCJPA is willing to be an active participant in organizations focused on providing regional approaches to mitigating SLR impacts. Beyond participation in the SLR mitigation strategies set by regional coordination organizations, CCJPA will consider future coordination with cities and municipalities that have initiatives potentially impacting the RSAs identified in this document. The Project has identified the following regional organizations and local agencies that CCJPA may collaborate or form potential partnerships with.

- Bay Adapt is an initiative to establish regional agreement on the actions necessary to protect people and the natural and built environment from rising sea levels. The initiative is facilitated by BCDC. Bay Adapt developed Joint Platform, a consensus-based strategy that will protect people and the natural and built environment from rising sea levels. In June 2021, Bay Adapt agreed that the actions in its Joint Platform were ready to move towards implementation. The initiative consists of members across a wide range of public agencies, interest groups, and community organizations, including Bay Area Rapid Transit (BART) and the California Department of Transportation (Caltrans).

- The San Francisco Bay Regional Coastal Hazards Adaptation Resiliency Group (CHARG) is a current organization of flood managers and scientists responsible for reducing flood risk in the San Francisco Bay Area. It is a strategic initiative of the Bay Area Flood Protection Agencies Association (BAFPAA). The group consists of members from the Alameda County Flood Control District, the county in which the SLR RSAs are located. CHARG seeks to engage local flood control districts to advance the scientific foundation needed to direct SLR adaptation at a regional scale.

- The City of San Leandro has several planned projects that would impact RSA Location 2. Per the San Leandro 2035 General Plan, Alameda County Public Works Agency and the City of San Leandro are working together to remove property in western San Leandro from FEMA's 100-year floodplain designation. As stated in the Plan, this will require the construction of sea walls in locations such as the western edge of Mission Bay Mobile Home Park, and the raising of bank heights along the Estudillo Canal below Wicks Boulevard. Both projects would impact the RSA, as the RSA lies directly west adjacent to the Mission Bay Mobile Home Park, and based on the ART mapping tool, the RSA receives flow from Estudillo Canal during 100-year storms with SLR. The 2035 General Plan also mentions rehabilitation of the Estudillo Canal tide gates as a planned flood control project. These projects have potential to reduce the impact of SLR on the RSA. Coordination with the City of San Leandro would be necessary to suggest a sea wall adjacent to the Mission Bay Mobile Home Park in a location to better protect other stakeholders. Additionally, as stated in the San Leandro Draft 2021 Climate Action Plan, the City of San Leandro plans to seek funding for the sandbank restoration of Long Beach, near Roberts Landing. This planned project would lie directly west of the RSA on the shoreline of San Francisco Bay and would help mitigate SLR at the RSA.

- The First Mile Horizontal Levee Project located in the City of Hayward and encompasses a portion of the Oro Loma Marsh. This project is part of a system of sea level rise adaptation measures identified in the Hayward Shoreline Adaptation Master Plan adopted by the Hayward Area Shoreline Planning Agency in 2021. Current partners of this project include East Bay Regional Parks District, East Bay Dischargers Authority, San Francisco Estuary Partnership, and Hayward Area Shoreline Planning Agency. The concept for this project, which has been tested through the Oro Loma Horizontal Levee Demonstration Project, is to use nature-based solutions to provide SLR resilience, water quality improvement, and habitat enhancements, in addition to the flood protection functions of a more traditional levee. The First Mile Horizontal Levee Project would provide an opportunity for UPRR to participate on a potential integration of railroad track embankment into a larger SLR embankment/levee structure that consolidates flood defense with an access corridor.

5.4.3 CUMULATIVE IMPACT ANALYSIS

Cumulative impacts are impacts to resources in the environment that result from past, present, and reasonably foreseeable future actions, combined with the potential impacts of the proposed Project. Section 15355 of the State CEQA Guidelines defines cumulative impacts as two or more individual effects that, when considered together, are considerable and may compound or increase other environmental impacts. These impacts may result from residential, commercial, industrial, and highway development that can degrade habitats, alter hydrology, and harm water quality.

This memo analyzes the impact of SLR on the Project. The memo does not investigate the inverse relationship, the impact of the Project on SLR, which is not an environmental resource. SLR is an environmental condition that will occur regardless of this Project and others in the vicinity, so the Project will have no cumulative impact on SLR.

5.5 References

Adapting to Rising Tides (ART). 2016. "San Francisco Bay Tidal Datums and Extreme Tides Study". Accessed September 30, 2023. https://www.adaptingtorisingtides.org/wp-content/uploads/2016/05/20160429.SFBay_Tidal-Datums_and_Extreme_Tides_Study.FINAL_.pdf

ART. 2021. "ART Bay Shoreline Flood Explorer." Accessed September 26, 2023.

Association of Bay Area Governments and Metropolitan Transportation Commission. 2021. "Plan Bay Area 2050". https://www.planbayarea.org/sites/default/files/documents/Plan_Bay_Area_2050_October_2021.pdf

Bay Adapt. 2021. "Bay Adapt Regional Strategy for a Rising Bay". Accessed September 26, 2023. https://www.bayadapt.org/

California Natural Resources Agency and Ocean Protection Council (CNRA & OPC). 2018 "State of California Sea-Level Rise Guidance 2018 Update". Accessed September 20, 2023.

Capitol Corridor Joint Powers Authority (CCJPA). 2014. "CCJPA Sea Level Rise Vulnerability Assessment". Accessed December 7, 2021.

CCJPA. 2022. Personal Correspondence.

City of San Leandro. 2016. "2035 General Plan". Accessed December 6, 2021.

City of San Leandro. 2021. "2021 Climate Action Plan". Accessed December 7, 2021. https://civicaadmin.sanleandro.org/civicax/filebank/blobdload.aspx?BlobID=32895

Federal Emergency Management Agency (FEMA). 2018. "Flood Insurance Rate Map, Alameda County, California and Incorporated Areas". Map Number 06001C0266H. Panel 266 of 725.

Google Earth 7.3. Accessed October 2, 2023.

Hayward Area Shoreline Planning Agency (HASPA). 2021. "Hayward Regional Shoreline Adaptation Master Plan". Accessed December 3, 2021. https://www.hayward-ca.gov/sites/default/files/210510_Hayward%20Shoreline%20Adapatation%20Master%20Plan_Document_Pages.pdf

HDR. "Coast Division Mapbook." Accessed October 7, 2021.

HDR "SBC Cumulative Project Polygon Map". Accessed October 27, 2021.

San Francisco Bay Conservation and Development Commission (BCDC). Email Correspondence. Accessed July 27, 2021.

BCDC. "San Francisco Bay Plan Climate Change Policy Guidance. 2021. Accessed September 27, 2021.

United States Geological Survey (USGS). 2021. "Hazard Map – Our Coast Our Future". Accessed September 30, 2023. https://ourcoastourfuture.org/hazard-map/