

San Francisco Bay Conservation and Development Commission

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TO: Engineering Criteria Review Board (ECRB) Members

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SUBJECT: San Francisco International Airport (SFO) Shoreline Protection Program, San Mateo County (BCDC Pre-Application)
(For Board consideration on September 27, 2023)

Project Name

SFO Shoreline Protection Program (BCDC Pre- Application)

Project Representatives

Applicant Representative

David Kim, PhD, Senior Environmental Planner, SFO

Project Design Team

ESA - Coastal Engineering

Terra Engineers Inc. - Geotechnical Consultants

COWI- Structural Consultants

COWI/Terra Engineers, Inc. Joint Venture - Project Designers

Project Components Under Review

The following components of the SFO Shoreline Protection Program (project) are under review:

1. Steel sheet pile sea wall with outboard rock armoring of Class 4 riprap in Reaches 2-14.
2. One area of sheet pile wall in an area of new Bay fill has geotechnical treatments including temporary earth surcharging, dredging soft Bay mud to reach depth of approximately 20 feet below MSL, and new wick drains (Reaches 7 and 8).
3. Poured in place reinforced concrete sea wall with outboard rock armoring of Class 4 riprap will be in Reaches 1 and 15 that do not border San Francisco Bay.
4. 7 Openings in the walls for roads with gates that would automatically rise up (or in one case be manually deployed) when flooding is predicted.
5. Modifications to storm drain outfalls including rerouting of some storm drain pump station outfalls up and over the new sea walls with associated rock energy dissipators. Some storm drain outfalls will go through the new walls.
6. Approximately 26 acres of fill in open Bay waters.

Purpose of this Meeting

The purpose of the meeting is to request the review and advice of the ECRB about the safety aspects of the sea wall design that could affect the public through impacts to the San Francisco Airport, a critical public facility. BCDC requests the assessment of the adequacy of the engineering criteria of the new sea wall (the project) that is the main focus of this review.

The authority to review and revise engineering criteria and any safety provisions is bestowed on the ECRB through the McAteer-Petris Act government section code 66605(e), which requires that all fill must be constructed "in accordance with sound safety standards which will afford reasonable protection to persons and property against the hazards of unstable geologic or soil conditions or of flood or storm waters." Additionally, the Bay Plan policies, especially policies Nos. 1 and 2 on the Safety of Fills, provide additional authority.

Project Description

SFO has submitted pre-application materials prior to submitting a permit application to the San Francisco Bay Conservation and Development Commission (BCDC) for their Shoreline Protection Program. In this project, SFO is proposing to install a new shoreline protection system around the Airport that would comply with current Federal Emergency Management Administration (FEMA) requirements for flood protection against a 100-year flood and would incorporate protection from future sea-level rise, to eliminate the probability of substantial inundation at the Airport through 2085. The shoreline protection system has been divided into 15 reaches, as shown in Figure 1 below.

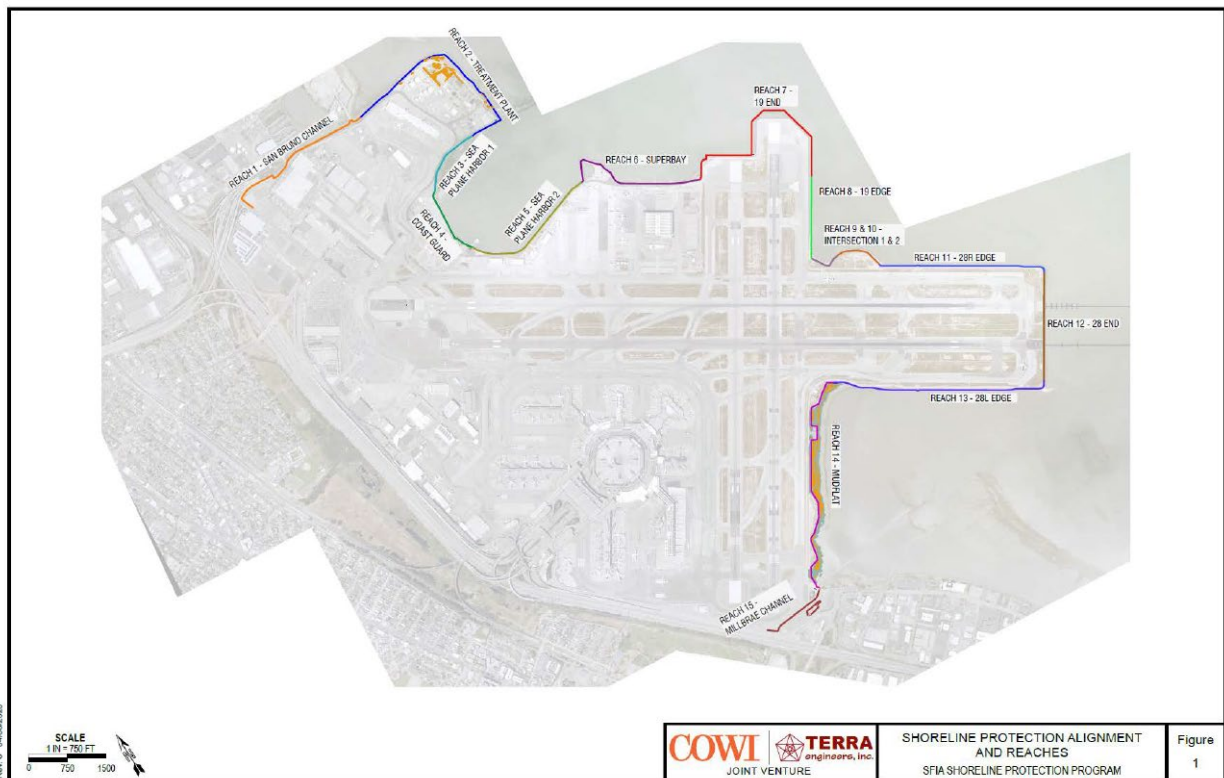


Figure 1. Map of the SFO Shoreline protection System showing Reaches 1-15 (Terra Engineers 2020)

The proposed project would remove the existing shoreline protection features and construct a new shoreline protection system comprising a combination of reinforced concrete and steel sheet pile walls. The design of these sea walls varies from reach to reach, depending on the existing site characteristics, and range in height from approximately 3.9 to 13.5 feet above the existing or newly graded ground surface, given that the elevation and slope of the ground varies for each reach. The tops of proposed wall elevations range from 16 – 20.2 feet NAVD88. The total length of the shoreline protection system is approximately 40,335 feet (7.6 miles) long. The steel sheet piles would be driven to a maximum depth of approximately 79 feet. Armor rock revetments are being used in tandem with the walls to dissipate wave energy and prevent sediment scour.

In order to form a continuous, closed flood protection system, one more segment of flood protection is required along the western perimeter of the airport boundary just east of Highway 101. This could be addressed as part of a future South San Francisco and Millbrae shoreline protection project, or by the Airport as an additional Reach 16. While the Airport has prepared a conceptual design, these segments are not included in this project.

SFO is working with the regulatory agencies to identify appropriate compensatory mitigation for the proposed project.

Project Design Considerations

SFO is currently mapped as being in the FEMA 100-year floodplain. An application is being prepared for a Conditional Letter of Map Revision (CLOMR) to remove the airport from the coastal floodplain as a result of this project. In addition to flooding directly from the Bay, flooding can also come from the San Bruno Channel north of the airport and the Millbrae Channel south of the airport. The project is designed to provide protection for 3.5 feet of sea level rise, plus freeboard, in compliance with FEMA standards. It may be possible to modify the proposed design in the future for additional sea level rise by installing a new taller reinforced concrete cap beam.

Federal Aviation Administration requirements limit the maximum wall crest in certain reaches. In Reach 7, at the end of Runway 19, this restriction has resulted in the alignment of the new sea wall out in the Bay, 215 feet from the existing shoreline.

Aircraft bird strikes are a serious safety concern and therefore the project was designed to minimize wildlife attractants. Nature-based solutions were therefore not an option.

The project includes a relocation and widening of the vehicle service road (VSR) in places around the perimeter of the airport to improve emergency access.

SFO currently has a stormwater control system with 91 miles of piping and 19 pump stations. Some stormwater discharges to the bay while other stormwater is pumped to an onsite combined sewer/stormwater treatment system with treated water discharged to the Bay, in compliance with the SFO NPDES permit from the RWQCB. Besides collecting rainwater, the storm drain system may also be collecting and treating shallow groundwater as well, where it

infiltrates into leaky pipes. Groundwater at the airport is currently around 1 to 4 ft NAVD88 and ground surface elevations are around 7 to 8 ft NAVD88 in some areas. Emergent groundwater is anticipated to be an issue, as groundwater levels rise in direct proportion to sea level rise in the Bay. The existing stormwater system will continue to mitigate surface water flooding and intercept and pump out groundwater. The deep sheet pile walls may mute tidal effects on groundwater levels with the project, although it will also contain rainwater within it. A groundwater collection and pumping system, possibly integrated with the existing or upgraded stormwater system, is anticipated as a future adaptation measure in response to sea-level rise.

The geotechnical report describes the local geology, seismic design criteria, liquefaction and design details. Stability modeling indicates the sheet piles (in the reaches except where dredging is required) should be installed deep into the layer below the young bay mud, leading to depths of approximately 79 feet. In Reaches 7 and 8, at the end of Runway 19, where the new sea wall is located out in the Bay 215 feet from the existing shoreline, special geotechnical treatments are recommended. This will require dredging prior to construction of a perimeter rock dike in the bay, filling the area between the rock dike and the current shoreline, preloading the filled area with a temporary earth cover and installing wick drains to expedite consolidation of the young bay mud, and deep vibratory compaction of the fill. It is recommended to install the sheet piles a minimum of 10 feet into the young bay mud in these areas.

The Board will review the following reports submitted by SFO:

1. COWI, Basis of Design – Final, SFO Shoreline Protection Program, dated 8/4/2023;
2. COWI, SFO Coastal Flood Hazard Study, dated August 2023;
3. COWI- Terra Engineers Inc. Joint Venture, SFO Shoreline Protection Program Conceptual Design Development Plans and Sections (27 pages), dated 7/19/2023;
4. Terra Engineers Inc. SFO Shoreline Protection Program Preliminary Geotechnical Report dated August 2, 2023 and Appendices A, B, C and D;
5. COWI, Structural Report – Final, SFO Shoreline Protection Program, dated 8/4/2023; and
6. ESA, San Francisco International Airport Shoreline Protection Program – Flooding Hazards, dated August 2023.

Staff Questions to the Board

BCDC staff requests that the Board review the content provided and advise on the following:

1. Are the scenarios and design criteria in the geotechnical stability analyses appropriate for the site hazards and conditions and site criticality?
2. Are current and future flooding concerns (i.e. from groundwater, coastal and riverine flooding and sea level rise) addressed adequately based on the references and the nature of the project?
3. Has the applicant demonstrated that adverse impacts to adjacent properties from the project have been minimized in the design?

4. Is there any data monitoring you recommend BCDC require of the applicant to enhance the future safety of the project in light of its projected 60-year estimated lifespan?
5. Are there any other design and physical concerns that have not been addressed?

Bay Plan Policies

The project raises issues related to Bay Plan policies on topics including Safety of Fills, Shoreline Protection and Climate Change. The following policies are relevant for the Board's review:

Safety of Fills

The policies on the Safety of Fills seek to reduce risk of life and damage to property for projects that require construction on fill in San Francisco Bay. The following policies apply:

1. **Policy No. 1.** The Commission has appointed and empowered the ECRB to:
 - a. Establish and revise safety criteria for Bay fills and structures thereon,
 - b. Review projects for the adequacy of their specific safety provisions and make recommendations concerning these provisions, and
 - c. Prescribe an inspection system to assure placement and maintenance of fill according to approved designs.
2. **Policy No. 2.** Even if fill may be permissible, no fill or building should be constructed if hazards cannot be overcome adequately for the intended use in accordance with the criteria prescribed by the ECRB.
3. **Policy No. 3** requires the installation of strong-motion seismographs on all future major landfills with the guidance of and recommendations by the California Geological Survey, for purposes of data comparison and evaluation.
4. **Policy No. 4.** Adequate measures should be provided to prevent damage from sea level rise and storm activity that may occur on fill or near the shoreline over the expected life of a project. The Commission may approve fill that is needed to provide flood protection for existing projects and uses. New projects on fill or near the shoreline should either:
 - a. Be set back from the edge of the shore so that the project will not be subject to dynamic wave energy,
 - b. Be built so the bottom floor level of structures will be above a 100-year flood elevation that takes future sea level rise into account for the expected life of the project,
 - c. Be specifically designed to tolerate periodic flooding, *or*
 - d. Employ other effective means of addressing the impacts of future sea level rise and storm activity.

Rights-of-way for levees or other structures protecting inland areas from tidal flooding should be sufficiently wide on the upland side to allow for future levee widening to support additional levee height so that no fill for levee widening is placed in the Bay.

Shoreline Protection Policies

The following policies of Shoreline Protection apply:

1. **Policy No. 1.** New shoreline protection projects and the maintenance or reconstruction of existing projects and uses should be authorized if:
 - (a) the project is necessary to provide flood or erosion protection for
 - (i) existing development, use or infrastructure, or
 - (ii) proposed development, use or infrastructure that is consistent with other Bay Plan policies;
 - (b) the type of the protective structure is appropriate for the project site, the uses to be protected, and the causes and conditions of erosion and flooding at the site;
 - (c) the project is properly engineered to provide erosion control and flood protection for the expected life of the project based on a 100-year flood event that takes future sea level rise into account;
 - (d) the project is properly designed and constructed to prevent significant impediments to physical and visual public access;
 - (e) the protection is integrated with current or planned adjacent shoreline protection measures; and
 - (f) adverse impacts to adjacent or nearby areas, such as increased flooding or accelerated erosion, are avoided or minimized.
2. **Policy No. 4.** Authorized protective projects should be regularly maintained according to a long-term maintenance program to assure that the shoreline will be protected from tidal erosion and flooding and that the effects of the shoreline protection project on natural resources during the life of the project will be the minimum necessary.

Dredging Policies

The Bay Plan Dredging policies apply to this project, but are not related to project design safety and so are not repeated here.

Climate Change Policies

The Bay Plan Climate Change policies apply to the proposed project:

2. **Policy No. 2.** 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 sea level rise 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 sea level rise 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.

3. **Policy No. 3.** 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 within existing urbanized areas—should be designed to be resilient to a mid-century sea level rise 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 sea level rise at the end of the century.

Subtidal Areas Policies

The Bay Plan includes the following Subtidal Area policies relevant to the proposed project:

1. **Policy No. 1.** Any proposed filling or dredging project in the subtidal area should be thoroughly evaluated to determine the local and Bay-wide effects of the project on: (b) tidal hydrology and sediment movement; ... and (e) the Bay's bathymetry. Projects in the subtidal areas should be designed to minimize and, if feasible, avoid harmful effects.

Airports Policies

The Bay Plan Airports policies apply to the proposed project:

1. **Policy No. 2b.** Airports for general aviation can and should be at inland sites whenever possible. Expansion of existing general aviation airports should be permitted on Bay fill only if no feasible alternative is available.