APPENDIX A
NOTICE OF PREPARATION

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PUBLIC NOTICE

Notice of Preparation of an Environmental Impact Report and Notice of Public Scoping Meeting

Date:	September 9, 2020
Case No.:	**2019-020115ENV**
Project Title:	**Ocean Beach Climate Change Adaptation Project**
Location:	Ocean Beach and the Great Highway between Sloat and Skyline Boulevards, and Ocean Beach north of Lincoln Boulevard, San Francisco
Zoning:	P (Public) and RH-1D (Residential House, One Family Detached) Zoning Districts, OS (Open Space) Height and Bulk District Western Shoreline Area Plan
Block/Lot:	7281/006, 007, 009, 010 7282/008, 009
Project Sponsors:	San Francisco Public Utilities Commission Karen Frye – (415) 554-1652 KFrye@sfwater.org San Francisco Recreation and Parks Department Brian Stokle – (415) 575-5606 Brian.Stokle@sfgov.org
Lead Agency:	San Francisco Planning Department
Staff Contact:	Julie Moore – (628) 652-7566 Julie.Moore@sfgov.org

This notice of preparation (NOP) of an environmental impact report (EIR) has been prepared by the San Francisco Planning Department in connection with the project listed above. The purpose of an EIR is to provide information about potential significant physical environmental effects of a proposed project, to identify possible ways to minimize the significant effects, and to describe and analyze possible alternatives to the project in compliance with the California Environmental Quality Act (CEQA). The San Francisco Planning Department is issuing this NOP to inform the public, responsible agencies, and interested parties about the project and the intent to prepare an EIR, and to solicit comments regarding the scope of the environmental review. Pursuant to CEQA section 21083.9 and CEQA Guidelines section 15206, a public scoping meeting will be held to receive oral comments concerning the scope of the EIR. The meeting will be held on September 30, 2020 at 6 p.m. Due to the COVID-19 emergency, in order to protect the health of city staff and members of the public, the meeting will occur virtually through video and teleconference. Members of the public are encouraged to participate in the meeting remotely, either through internet video conference application (http://bit.ly/oceanbeachscoping), or by telephone (877-853-5247; Meeting ID: 828 5908 1146). Written comments may also be submitted by mail or email (more information on page 17). This NOP, staff scoping meeting presentation, and meeting procedures/instructions are available for public review at sfplanning.org/sfceqadocs.

Project Summary

The City and County of San Francisco (the city) is proposing a coastal adaptation and sea level rise resiliency project to improve the portion of Ocean Beach from Sloat Boulevard to Fort Funston known as "South Ocean Beach." The Ocean Beach Climate Change Adaptation Project (also referred to generally as the "project,") is needed to address shoreline erosion, severe coastal storm and wave hazards, and sea level rise, which threaten city infrastructure, coastal access and recreational facilities, and public safety. The project is a collaborative, multi-agency initiative involving the San Francisco Public Utilities Commission (SFPUC), San Francisco Recreation and Parks (Rec and Park), San Francisco Public Works (Public Works), San Francisco Municipal Transportation Agency (SFMTA), the Federal Highway Administration (FHWA), and the National Park Service (NPS).[1] Major project components include: (1) permanently closing the Great Highway between Sloat and Skyline boulevards, and reconfiguring affected intersections and San Francisco Zoo parking access; (2) removing pavement, rock and sandbag revetments[2], rubble and debris, recontouring the bluff, and planting dune vegetation; (3) improving public access, maintaining coastal parking and continuing to provide restroom facilities; (4) installing a buried wall to protect existing sewer infrastructure from shoreline erosion; and (5) long-term *beach nourishment*.[3]

Project location

The project area generally encompasses the portion of San Francisco's Ocean Beach extending south from Sloat Boulevard to the northern edge of the Fort Funston bluffs, and the Great Highway from Sloat Boulevard to Skyline Boulevard, along with a portion of Ocean Beach north of Lincoln Boulevard where sand is harvested for placement south of Sloat Boulevard. Figure 1 shows the project location. The majority of the project area is along the Great Highway, which is under Rec and Park jurisdiction. Public Works performs sand removal along the roadway. The NPS owns and manages lands to the west of Great Highway (i.e., parking lots, bluffs, and beach) as part of the Golden Gate National Recreation Area. Various agencies own or manage the properties to the east, such as those occupied by the San Francisco Zoo, the California Army National Guard, the Oceanside Water Pollution Control Plant, the Westside Pump Station, and the Pomeroy Recreation and Rehabilitation Center.

The project is situated within the city's westside watershed, amidst various city-owned and -operated wastewater collection, storage, conveyance and treatment facilities. The Oceanside Water Pollution Control Plant (Oceanside Treatment Plant) treats 20 percent of the city's combined wastewater and stormwater and is located east of the Great Highway and north of Fort Funston. The Westside Pump Station, which pumps

[1] The FHWA and NPS will be lead agencies for a separate federal environmental review process, including preparation of National Environmental Policy Act (NEPA) compliance documentation.
[2] In coastal engineering, revetments are sloping structures placed on the shoreline to protect the shoreline from erosion or other modification by waves.
[3] Beach nourishment is the practice of adding large quantities of sand or sediment to beaches to slow erosion, increase beach width, and provide for continued public beach access and recreation opportunities.

SOURCE: ESA, 2019; Google Earth, 2019

Ocean Beach Climate Change Adaptation Project

Figure 1
Project Location and Existing Roadway Configuration

ESA

combined wastewater and stormwater from surrounding subterranean conveyance and storage infrastructure to the Oceanside Treatment Plant, is located east of the Great Highway and south of the Great Highway/Sloat Boulevard intersection. The Lake Merced Tunnel, which serves as a conveyance and storage facility for large combined sewer flows, is buried beneath the Great Highway along South Ocean Beach and drains to the Westside Pump Station.

Project Background

Ocean Beach comprises a 4½-mile stretch of sandy beach that forms the western boundary of San Francisco. It is influenced by complex coastal processes, including an intense wave climate, strong tidal currents, and irregular offshore features. Currently, chronic erosion of the beach and bluffs by episodic coastal storms occurs at South Ocean Beach. The beach varies in width by season and location. For example, monitoring performed between June 1, 2018 and May 31, 2019 found the beach width in fall to be about 96 feet on average, and spring to be about 42 feet on average. Notably, portions of the beach with revetments were found to have the smallest beach width, including some such segments with no measurable beach.[4]

Shoreline erosion has undermined and damaged beach parking lots, stormwater drainage facilities and the Great Highway, threatens existing underground wastewater system infrastructure, and has constrained public shoreline access and recreational opportunities.

Since the 1990s, the city has responded to the erosion through implementation of a series of both hard shoreline armoring (e.g., construction of rock and rubble revetments) and soft shoreline protection measures (e.g., beach nourishment and sandbag revetments). In the intervening period, the city has also undertaken planning initiatives aimed at developing a long-term strategy for managing the South Ocean Beach shoreline. Notably, the city partially funded and participated in the preparation of the 2012 Ocean Beach Master Plan (master plan). Led by the San Francisco Bay Area Planning and Urban Research Association (SPUR), the master planning process brought together community members, agency representatives, and other stakeholders to develop a sustainable long-term vision for Ocean Beach, addressing public access, recreational use, environmental protection, and infrastructure needs in the context of erosion and climate-related sea level rise. The terms of a 2014 legal settlement agreement[5] and a 2015 California Coastal Commission permit[6] both establish timelines for developing and implementing a long-term solution to shoreline management at South Ocean Beach.

In 2018, the city amended its local coastal program, the Western Shoreline Area Plan,[7] to adopt policies that advance the Ocean Beach Master Plan's vision for South Ocean Beach. The local coastal program policies concerning managed retreat, beach nourishment, and shoreline armoring strategies aim to preserve and enhance public access, coastal recreation, and scenic resources at South Ocean Beach, while protecting critical wastewater system infrastructure from damage due to coastal hazards. The proposed project design represents the city's long-term strategy for addressing current and future erosion challenges at South Ocean Beach, drawing upon

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[4] ESA, Ocean Beach Short-term Erosion Protection Measures Project – 2018-2019 Monitoring Report. Prepared for San Francisco Public Utilities Commission. July 2019. This document, and all other documents referenced in this NOP unless otherwise noted, is available for review at https://tinyurl.com/Ocean-Beach-EIR.
[5] California Coastal Protection Network and City and County of San Francisco, 2014. Settlement Agreement and Mutual Release in the case *California Coastal Protection Network v. City & County of San Francisco*, Case No. CGC-11-513176.
[6] California Coastal Commission, Coastal Development Permit 2-15-1537, Issued November 9, 2015.
[7] The Western Shoreline Area Plan is the land use plan component of the city's local coastal program. The city obtained California Coastal Commission certification of the amendment in May 2018.

ideas and information obtained through many years of community engagement, technical investigation, and interim management efforts.

There are also several other separate projects that may occur in the vicinity of South Ocean Beach. The city and the California Department of Transportation (Caltrans) have proposed separate projects to improve the operations and safety of Skyline Boulevard (State Route 35) at its Great Highway and at Sloat Boulevard intersections. NPS is planning a trail to link the proposed multi-use trail to Fort Funston's existing trail network. The city and the U.S. Army Corps of Engineers (Army Corps) are currently planning and designing a project to place sand dredged from San Francisco's main shipping channel along South Ocean Beach in 2021. The San Francisco County Transportation Authority is leading the District 4 Mobility Study and will be exploring the feasibility of modifying the Great Highway between Lincoln Way and Sloat Boulevard, which is currently temporarily closed due to COVID-19.[8] In addition, Rec and Park, with support from SFMTA and Public Works, is considering temporary closure of the southbound lanes of the Great Highway between Sloat and Skyline boulevards. Each of these separate projects would be subject to separate environmental review.

Project Components

Through the project, the city would implement its certified local coastal program coastal hazards policies, which are based in part on the recommendations of the Ocean Beach Master Plan. The major components of the project fall into five categories: (1) permanently closing the Great Highway south of Sloat Boulevard and modifying affected intersections and zoo parking access; (2) removing pavement, rock and sandbag revetments, rubble and debris, recontouring the bluff, and planting dune vegetation; (3) improving public access, maintaining coastal parking and continuing to provide restroom facilities; (4) installing a buried wall to protect existing sewer system infrastructure; and (5) long-term beach nourishment. Figure 2 shows the project components, each of which is described in more detail below.

Roadway and Intersection Modifications

The city would permanently close the Great Highway between Sloat and Skyline boulevards. A portion of the Great Highway's northbound travel lanes would be retained or reconstructed as a service road, as described further below. To accommodate the road closure, the city would modify intersections at Sloat Boulevard/Great Highway and Skyline Boulevard/Great Highway, and reconfigure access to the Oceanside Treatment Plant, Westside Pump Station, and the San Francisco Zoo, each of which is currently accessible via the northbound lane of Great Highway (see Figure 1). Following the Great Highway closure, the city would remove the road's southbound travel lanes and the parking lot and restrooms near the Sloat Boulevard/Great Highway intersection. The Great Highway's existing eastern northbound travel lane would be retained in place (or reconstructed east of the current road alignment to allow for more open space) to provide continued, restricted vehicle access to the Oceanside Treatment Plant and Westside Pump Station for SFPUC operations (service road). The remaining portion of the Great Highway's existing northbound travel lane would be removed and replaced with a multi-use trail to the west of the service road. A *sculptural barrier*[9] or sand berms and landscaping would be installed between the service road and the multi-use trail to avoid conflicts among the respective user groups. With the closure of the Great Highway to through traffic, access to the zoo would be maintained through modifications to the Sloat Avenue entrance (as an entrance and

[8] This study is underway and anticipated at the end of the year.

[9] A sculptural barrier is a physical barrier designed to meet safety requirements that also provides visual or aesthetic interest.

exit), creating a new public entrance/exit from Herbst Road, and/or allowing zoo access on the service road along the Great Highway.

Debris and Revetment Removal, Bluff Recontouring and Revegetation

In addition to removing the Great Highway's southbound lanes, the city would remove the existing shoreline protection structures and debris from the beach and bluff, including rock and sandbag revetments and rubble, and recontour and stabilize the bluff to provide a more gradual slope towards the beach. The city would place sand over the stabilized slope and implement wind-erosion control measures to help keep the placed sand on the beach and bluff. These measures may include sand fencing[10] and placing a layer of coarse sand over the finer beach sand.

Public Access, Parking, and Restroom Improvements

The project would improve public access and recreation at South Ocean Beach through the construction of a multi-use trail, beach access stairways, parking, and restrooms. The multi-use trail would extend from Sloat Boulevard to Skyline Boulevard and include two beach accessways and several waysides, or turnouts. The service road may also be used as a bikeway. Figure 3 illustrates conceptual beach access improvements.

As a project awarded to Rec and Park, the FHWA's Federal Lands Access Program would deliver some components of the multi-use trail and a coastal parking lot once the SFPUC has completed the buried wall (described below) and recontoured the bluff. The coastal parking lot would be located within the approximate limits of the closed Great Highway southbound lanes and median, near their intersection with Skyline Boulevard. In addition, the project may expand parking capacity within the zoo.

New restrooms would be constructed near the Sloat Boulevard/Great Highway intersection in one of two locations. The first potential restroom location is approximately 50 feet east (inland) of the existing Sloat Boulevard restrooms, and east of the proposed buried wall. The second potential restroom location would be approximately 225 feet northeast of the existing restrooms, in the undeveloped area along the north side of Sloat Boulevard, between Lower and Upper Great Highway (see Figure 2).

The turnaround route and layover space for Muni Line 23 would change in response to the Sloat Boulevard/Great Highway intersection reconfiguration. Muni Line 23 would continue service to the existing last bus stop on the north side of Sloat Boulevard between Lower Great Highway and 47th Avenue. This stop would then serve as the layover space instead of the current layover location at the western terminus of Sloat Boulevard. The city would modify Muni Line 23's turnaround route to follow a clockwise loop along Lower Great Highway, Wawona Street, and 47th Avenue. The bus would then turn east onto Sloat Boulevard at the signalized 47th Avenue/Sloat Boulevard intersection before reaching its first return stop at the existing bus stop located just east of the zoo's main pedestrian entrance at 45th Avenue.

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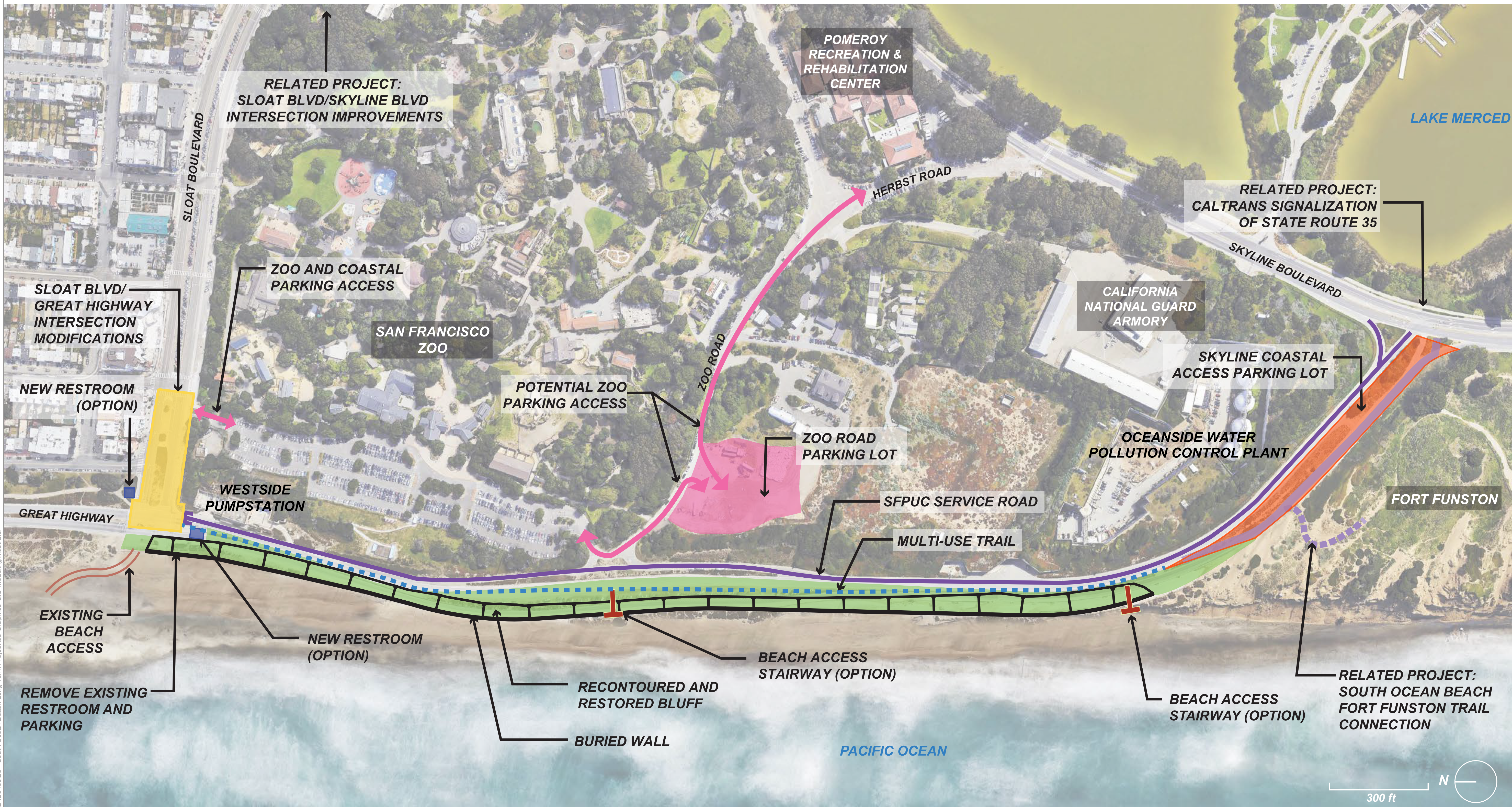
[10] Sand fencing consists of wooden slats, plastic, or fabric attached to fence posts and is designed to reduce local wind speed and trap sand. Sand fencing on a beach or berm can assist in building additional berms, and helps prevent sand from blowing onto roads and paths.



Note: Long-term beach nourishment not shown.

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SOURCE: MN+AGS JV, Conceptual Engineering Report, Ocean Beach Long-term Improvements Project, September 2019

Ocean Beach Climate Change Adaptation Project

Figure 2
Project Components

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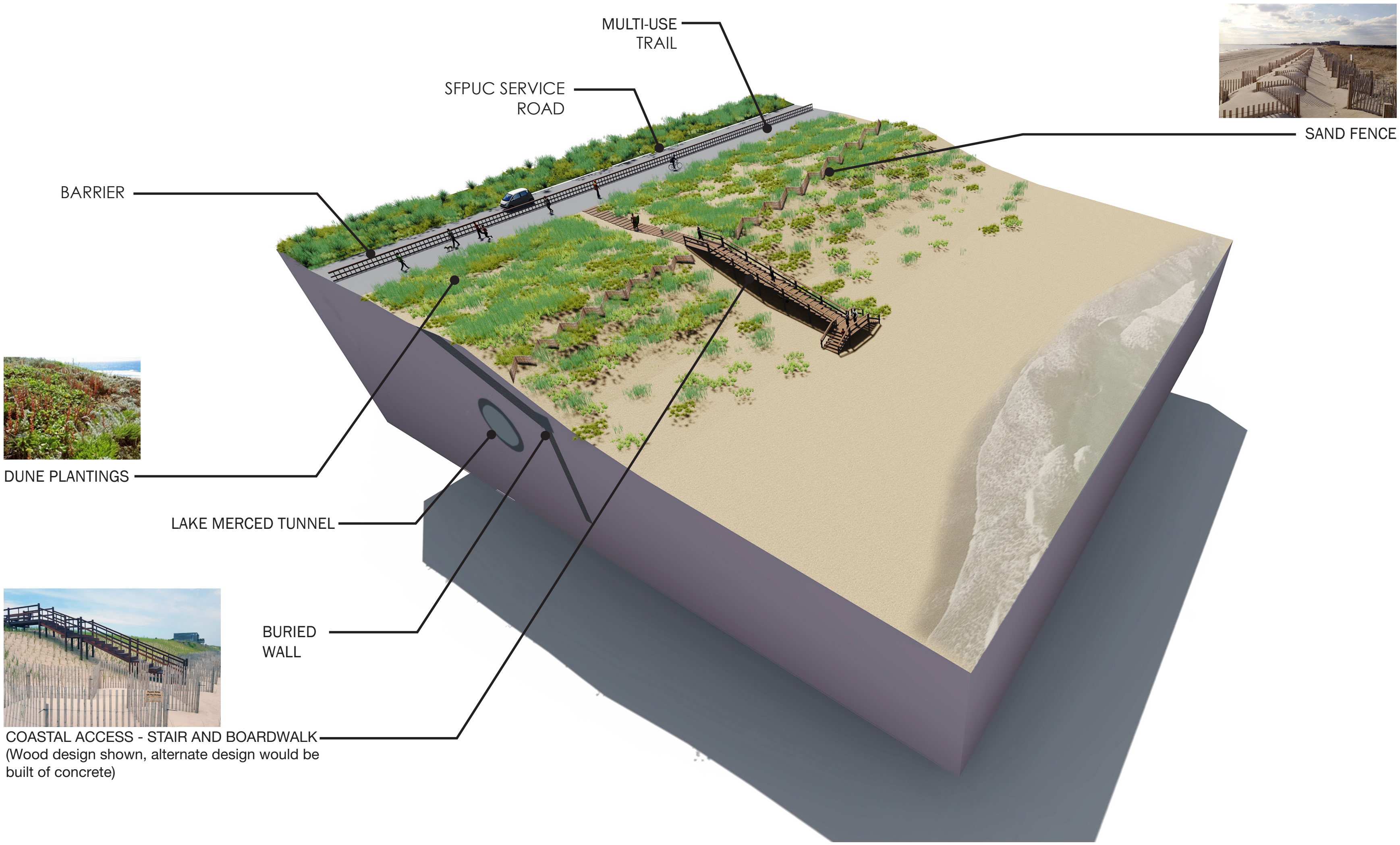

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SOURCE: SFPUC, 5/21/2019

Ocean Beach Climate Change Adaptation Project

Figure 3
Beach Access Conceptual Block Diagram

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Buried Wall

To protect the Lake Merced Tunnel from exposure to coastal hazards, the city would install a below-grade wall adjacent to and seaward of the Lake Merced Tunnel. The proposed wall would consist of a *secant pile* wall system with *tiebacks* and would extend from Sloat Boulevard to approximately 3,000 feet to the south.[11] The wall would be approximately 3 feet thick, set back as far from the shoreline as feasible, and buried under sand. To stabilize the recontoured bluff inland of the wall, the city would install a 4-foot thick, gently sloping (3:1 horizontal to vertical slope) layer of cementitious material, comprised of a *soil-cement mix*[12] or *controlled low strength material*[13] (slope stabilization). The slope stabilization would minimize erosion of the material overlying the tunnel to protect against scour behind the wall from waves and high surf conditions and prevent buoyancy of the Lake Merced Tunnel.

Beach Nourishment

By removing the existing shoreline revetments at South Ocean Beach, the project would allow erosion and retreat of the remaining bluff face seaward of the buried wall. With bluff retreat and erosion of sand placed over the slope stabilization, portions of the wall would occasionally be exposed, and the beach would narrow. To address these issues, the city proposes to implement a shoreline monitoring program and place sand as deemed needed per the results of annual monitoring.

The city has identified two primary sand sources and placement methods. The first is the San Francisco Harbor – Main Ship Channel, which is regularly dredged by the U.S. Army Corps of Engineers (Army Corps) as part of that agency's ongoing federal navigation channels maintenance program.[14] Under the first option – referred to generally as the "large placement" option – an Army Corps dredge would pump approximately 300,000 cubic yards of sand in a *slurry*[15] form onto the beach, rather than disposing of it offshore. The second primary source is North Ocean Beach (i.e., north of Lincoln Boulevard). Under this option – referred to generally as the "small placement" option – the city would continue its practice of excavating and trucking excess sand from North Ocean Beach to South Ocean Beach and placing coarse sand from other sources as a top layer (referred to as *sand backpass*).[16] The small placement option would involve trucks dumping up to 85,000 cubic yards of sand onto the beach and bluff. In the event that sand from the Army Corps and North Ocean Beach is unavailable in a given year, the city would obtain a smaller volume of sand (~25,000 cubic yards) from a commercial vendor and truck the sand to South Ocean Beach. Also, in conjunction with yearly sand maintenance along the Great Highway at the intersections between Sloat and Lincoln boulevards, the city, in coordination with NPS, would relocate sand from NPS land west of the Great Highway and the roadway to South Ocean Beach areas needing supplemental

[11] The secant pile wall would consist of overlapping cast-in-place concrete piles (called "primary" and "secondary" piles, respectively), connected with a continuous concrete pile cap along the length of the wall. The primary unreinforced piles are drilled first and filled with concrete, followed by the secondary reinforced piles drilled between and partially cutting into the primary unreinforced piles. Tieback anchors consist of high-strength steel tendons that would be grouted into drill holes connecting to the pile cap.
[12] A weak form of concrete formed by mixing in place the existing soils with a cementitious grout.
[13] A weak mixture of cement, aggregate, and water that flows easily.
[14] To provide deep-draft marine vessel access between the Pacific Ocean and San Francisco Bay, the Army Corps regularly dredges a sandbar located approximately 2 miles offshore of the Golden Gate. Commonly known as the main ship channel, the passage measures approximately 2,000 feet wide, 26,000 feet long, and is maintained at a depth of approximately 55 feet mean lower low water.
[15] A mix of sand and ocean water that can be transported via pipeline from an offshore dredge to the beach.
[16] Sand backpassing has been performed at Ocean Beach since 2013 and occurred most recently in 2019.

sand. The activity would prevent windblown sand from impacting the Great Highway and clogging the storm drain system.

The type and frequency of sand placements would depend upon sand availability (i.e., Army Corps and North Ocean Beach) and shoreline conditions (e.g., sea-level rise and related erosion rates). Sand placements would occur about once every two to eight years, generally in the late summer or early fall.[17] The city would obtain permits from the appropriate resource agencies with jurisdiction (e.g., NPS and California Coastal Commission) to ensure compliance with relevant plans, policies, and guidelines. Due to its reliance on Army Corps dredging operations, the large placement option would require additional federal, state, and local agency reviews and approvals, including supplemental environmental review under National Environmental Policy Act (NEPA).

Construction Activities, Schedule and Access

Construction Activities and Phasing

Construction activities would proceed in five general phases. The city would first modify the affected intersections and zoo parking access, close the Great Highway south of Sloat Boulevard, and remove the existing restroom at the Sloat Boulevard terminus. Construction would then proceed with buried wall installation, followed by removal of existing revetments and rubble from the beach. The city would reuse clean, debris-free sand excavated from the buried wall installation to recontour the bluffs. Following shore stabilization and associated earthwork, the project focus would shift to recreational facilities and amenities, such as coastal access parking, the multi-use trail, restrooms, beach stairways, and landscaping. Upon construction completion, the city would remove all construction debris and waste, and restore remaining disturbed areas to their approximate pre-construction conditions.

Construction Schedule

The city would construct the project over approximately four years with an estimated construction period spanning 2023 through 2027. Project construction would proceed up to seven days per week, except holidays, between 7 a.m. and 8 p.m. consistent with the city's noise ordinance. Some nighttime construction is also proposed.

Construction Access and Staging

Construction vehicles would use the closed portion of the Great Highway to access the project site. The project would use local and regional roadways to haul construction materials. The Great Highway, Sloat Boulevard, and Skyline Boulevard would be the primary vehicle access routes for construction haul trucks and deliveries.

The project would use various construction equipment and vehicles, such as cranes, small bulldozers, excavators, backhoes, dozers, drill rigs, slurry mix plants, asphalt paving machines, compactors, generators, water trucks, concrete trucks, pickup trucks, dump trucks, 4x4 utility vehicles, and other assorted small equipment, such as compressors, jackhammers, pumps, trailers, compactors, and chippers.

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[17] Moffatt & Nichol Engineers, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020. Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements. Prepared for San Francisco Public Utilities Commission. July 2020.

The city may use the following areas for project construction staging:

- The Great Highway's closed northbound and southbound lanes. SFPUC operations and maintenance staff would also use the Great Highway's northbound lanes for Westside Pump Station and Oceanside Treatment Plant access during construction.
- The existing NPS parking lot at the western terminus of Sloat Boulevard.
- The designated site of the future Zoo Road parking lot, which is presently being used as a staging area for other city projects (also generally referred to as the zoo staging area).
- The closed area of Ocean Beach during removal of the revetments and rubble, and during sand placement and bluff recontouring.
- Available space within the Oceanside Treatment Plant, Westside Pump Station, and Zoo Pump Station.

Operations and Maintenance

Agencies and entities with jurisdiction and/or oversight responsibility would operate and maintain project facilities, as is done under existing conditions and generally in a similar fashion. Operations and maintenance would be required for public access features (such as the restrooms, trash enclosures, trails, signs and lighting), the service road and parking lot, and the beach and dunes. Periodic removal of sand on the trail and the service road would be necessary. SFPUC vehicles, employees, vendors and visitors would use the service road on a daily basis to access the Oceanside Treatment Plant and Westside Pump Station. The city would undertake ongoing beach nourishment activities as described above for "Beach Nourishment". The beach nourishment volume and frequency would be informed by site conditions and the findings of annual monitoring, but would likely occur once every two to eight years, with individual placement events lasting approximately 2 to 9 weeks depending upon sand source. No changes to city agency or NPS staffing levels are anticipated.

Anticipated Permits and Approvals

As a project partner and owner and manager of lands within the project area, NPS's project involvement would include a project approval action, such as issuing a special use permit, as well as potential funding and management assistance for project elements. The Federal Highway Administration Federal Lands Access Program would approve the project components funded through its grant program. Accordingly, the FHWA and NPS will be lead agencies for a separate federal environmental review process under the NEPA. The following is a preliminary list of potential approvals needed for project construction and operation.

- National Park Service – Golden Gate National Recreation Area:
  - NEPA compliance for work within NPS land
  - Special use permit and/or other authorization for work within NPS land
- Federal Highway Administration Federal Lands Access Program:
  - NEPA compliance for the multi-use trail and the coastal parking lot
  - Project approval for components funded through FHWA grant program
- U.S. Army Corps of Engineers:

  - NEPA compliance for revetment removal and sand placement
  - Clean Water Act section 404 authorization for revetment removal and sand placement
- National Oceanic and Atmospheric Administration National Marine Fisheries Service consultations:
  - Federal Endangered Species Act, section 7 for potential effects on chinook and coho salmon, green sturgeon, and steelhead, and designated critical habitat for green sturgeon and leatherback sea turtle
  - Marine Mammal Protection Act for potential impacts on managed fish species and essential fish habitat, including those managed under the Pacific coast groundfish fisheries management plan (FMP), Pacific salmon FMP, and coastal pelagic FMP
- U.S. Fish and Wildlife Service: Federal Endangered Species Act, section 7 consultation for potential effects on western snowy plover
- California Coastal Commission: Coastal Development Permit for development within the coastal zone
- California Department of Transportation: encroachment permit for work within State Route 35 (Skyline Boulevard) right-of-way
- California Office of Historic Preservation: National Historic Preservation Act, section 106 consultation for potential effects on historic resources
- California Department of Fish and Wildlife: Fish and Game Code, section 2081 permit for potential effects on bank swallow
- California State Lands Commission Lease: may be needed for beach access stairways, and beach nourishment
- State Water Resources Control Board: Stormwater General Construction Permit and Stormwater Pollution Prevention Plan for potential construction effects on water quality18
- San Francisco Regional Water Quality Control Board: Clean Water Act section 401 Water Quality Certification and/or a Porter-Cologne Water Quality Control Act Report of Waste Discharge for potential discharges to waters of the United States and waters of the state
- San Francisco Planning Commission: Certification of the Final EIR
- San Francisco Public Utilities Commission:
  - Adoption of CEQA Findings and Mitigation Monitoring and Reporting Program
  - Approval of SFPUC project components including the buried wall, service road and construction contract for Rec and Park components
- San Francisco Recreation and Parks Commission:
  - Adoption of CEQA Findings and Mitigation Monitoring and Reporting Program
  - Approval of Rec and Park project components including new Skyline Coastal Access Parking Lot, multi-use trail, and zoo improvements including new gravel parking lot as well as easements to SFPUC for construction and operation of SFPUC components
- San Francisco Public Works (SFPW): Approval of Sidewalk Changes and Street Improvement Permit

[18] Applicable to areas that do not drain to the city's combined sewer system.

- San Francisco Municipal Transportation Agency: Approval of certain parking and traffic measures in accordance with the San Francisco Transportation Code; approval of bus route and stop changes; and approval of closure of the Great Highway (if needed)
- San Francisco Board of Supervisors: Approval of Sidewalk Legislation and closure of the Great Highway
- Consultation and coordination with city departments, including without limitation Public Works, Department of Building Inspection, Department of Public Health, and the Municipal Transportation Agency, to ensure that soil disturbance and site mitigation, street vacation, street and sidewalk improvements, on-street parking modifications, and building construction complies with substantive requirements of the law

Summary of Potential Environmental Issues

The proposed project could result in potentially significant environmental effects. Therefore, the San Francisco Planning Department will prepare an initial study and EIR in accordance with CEQA, the CEQA Guidelines, and Chapter 31 of the San Francisco Administrative Code, and will address project-specific construction and operational impacts. The EIR will examine those topics for which there is potential for a significant physical environmental effect, identify mitigation measures, and analyze whether the mitigation measures would reduce the environmental effects to a less-than-significant level. The initial study will be published as an appendix to the draft EIR and will be considered part of the EIR. The document will consider both project-specific and cumulative impacts for all topics in the San Francisco Planning Department's initial study checklist. Key environmental topics to be addressed in the EIR (including initial study) are described briefly below.

Aesthetics

The project is designed to enhance and improve the visual and scenic quality of South Ocean Beach by removing portions of the Great Highway, revetments, and debris from the shoreline and reconfiguring the beach and bluff. Project construction would involve numerous pieces of heavy equipment operating near and along the coastline, extensive earthwork, construction materials and debris stockpiling, vegetation removal, and nighttime lighting, which would temporarily affect project area aesthetics. The EIR's aesthetics analysis will consider potential project effects on scenic vistas, scenic resources, and the site's visual quality, as well as impacts related to new substantial light or glare.

Tribal and Other Cultural Resources

Project construction would involve ground disturbance and building demolition/modifications. A number of archeological and historical resources have been documented in the vicinity of the project area. The EIR will assess the potential for the project to result in significant impacts to archeological and historical resources, including tribal cultural resources. The analysis will consider historic and prehistoric archeological deposits and historic buildings or structures ("historical resources"). The EIR will describe the historical resources and potential historical resources on the project site, assess the potential for subsurface archeological resources to be present, and identify potential impacts of the project on these resources.

Transportation and Circulation

With permanent closure of the Great Highway between Sloat and Skyline boulevards, vehicle traffic would be routed inland and access to the zoo would be modified. The intersection at Sloat Boulevard and Great Highway would be modified and the Skyline and Great Highway intersection restriped to accommodate this closure. Construction activities would generate additional vehicle traffic, including construction vehicles traveling to and from work sites, and transporting supplies and equipment. Once operational, the project would provide new pedestrian and bicycle access on the multi-use trail between Sloat and Skyline boulevards as well as access from the zoo parking lot to the multi-use trail. The project would also include zoo access and parking modifications. The transportation and circulation analysis will evaluate specific transportation impacts and mitigation measures associated with the project's construction and operations. The EIR will evaluate effects of the project with regard for changes in potentially hazardous conditions for people walking, bicycling, and driving, accessibility and emergency access, public transit delay, vehicle miles traveled, and whether loading or parking demand in the vicinity of the proposed project could result in secondary effects that would create potentially hazardous conditions.

Noise

Project construction would include the use of heavy equipment, which would temporarily increase noise and vibration levels in the project area. In addition, with permanent modifications in traffic patterns, long-term vehicle traffic-related noise levels could also change. The EIR will include analysis of noise compatibility standards for residential and other land uses and discuss the long-term impacts of noise that could result from the proposed project. Short-term construction-related noise and vibration impacts also will be described, and the analysis will evaluate the potential for noise from the project to adversely affect nearby sensitive land uses.

Air Quality

The project would require the use of heavy construction equipment and would involve permanent rerouting of vehicle traffic in the vicinity of the Sloat Boulevard/Great Highway and the Skyline Boulevard/Great Highway intersections. The EIR will describe the existing conditions at the project site and at surrounding sensitive land uses, and evaluate project consistency with applicable air quality plans and standards, the potential for its emissions of criteria air pollutants and toxic air contaminants at levels that could affect sensitive populations, and the potential to emit odors that could affect substantial numbers of people. The air quality analysis will include quantification of both construction- and operations-related air pollutant emissions and will evaluate potential health risk effects from emissions of toxic air contaminants, including effects on residents near the project site.

Greenhouse Gas Emissions

The EIR's greenhouse gas emissions analysis will focus on the project's consistency with the city's Greenhouse Gas Reduction Strategy and the degree to which the proposed project's construction-phase and operations-phase greenhouse gas emissions could result in a significant effect on the environment.

Recreation

The project would involve construction and operation of new recreational facilities at South Ocean Beach. During construction, large areas of South Ocean Beach would be closed to the public. The EIR's recreational impacts analysis will evaluate whether the project would require new or expanded recreational facilities, the construction of which could have significant effects on the environment. In addition, the analysis will consider whether project area closure during construction would result in increased use of other regional recreational facilities such that substantial physical deterioration would result.

Biological Resources

Project construction would involve vegetation removal, increased noise, potential nighttime noise and lighting, and extensive ground disturbance along South Ocean Beach. Project operations would involve reduced vehicle noise along the beach, but potentially greater cyclist and pedestrian access and presence and periodic disturbance from long-term beach nourishment. While the project area's ecology has been substantially modified over the years, it continues to provide habitat for biological resources, including special-status plants and animals. The EIR will analyze potential direct and indirect effects of project construction and operation on special-status plants and animals and their habitats; sensitive natural communities; movement of any native resident or migratory fish or wildlife species; and potential conflicts with the substantive requirements of the relevant, applicable local policies, codes and ordinances, including the city's urban forestry ordinance.

Hydrology and Water Quality

The project area's beach and bluffs are highly susceptible to coastal erosion, including that associated with surface drainage of stormwater, longshore currents, and wave action. The project would involve changes in impervious surface area, drainage modifications, and development in close proximity to buried wastewater infrastructure needed to maintain compliance with water quality standards. The EIR's hydrology and water quality analysis will assess the project's potential to violate water quality standards or otherwise degrade water quality; substantially alter drainage patterns or surface runoff; cause substantial erosion; substantially increase surface runoff in a manner which would result in flooding; and increase risk of pollution due to flood hazard, tsunami, or seiche. The analysis will also consider project implications for groundwater supplies and potential to conflict with or obstruct implementation of a water quality control or sustainable groundwater management plan.

Other Environmental Issues and Topics

All topics listed on the city's initial study checklist will be considered in the project EIR. In addition to the key topics identified above, potential effects associated with the environmental topics listed below will also be analyzed.

- Land Use and Planning
- Geology, Soils, Seismicity, and Paleontological Resources
- Population and Housing
- Wind and Shadow
- Hazards/Hazardous Materials
- Public Services
- Utilities and Service Systems
- Mineral Resources
- Energy
- Agriculture and Forestry Resources
- Wildfire

Pursuant to CEQA, the EIR will further analyze a range of alternatives that would reduce or avoid significant environmental impacts identified in the EIR, including a No Project Alternative, as described in CEQA Guidelines Section 15126.6. The EIR will also address other topics required by CEQA, including growth-inducing impacts, significant unavoidable impacts; significant irreversible impacts; known controversy associated with environmental effects; issues to be resolved by the decision-makers; and the potential for the project to contribute to significant cumulative effects.

Finding

This project may have a significant effect on the environment and an environmental impact report is required. This determination is based upon the criteria of the State of California Environmental Quality Act (CEQA) Guidelines, sections 15063 (Initial Study), 15064 (Determining Significant Effect), and 15065 (Mandatory Findings of Significance). The purpose of an EIR is to provide information about potential significant physical environmental effects of a proposed project, to identify possible ways to minimize the significant effects, and to describe and analyze possible alternatives to a proposed project. Preparation of a NOP or EIR does not indicate a decision by the city to approve or to disapprove the project. However, prior to making any such decision, the decision makers must review and consider the information contained in an EIR.

Public Scoping Process

You may participate in the public process concerning the proposed project's environmental review by submitting written or verbal comments to the planning department. Pursuant to CEQA section 21083.9 and CEQA Guidelines section 15206, the planning department will hold a public scoping meeting to receive oral comments concerning the scope of the EIR. The meeting will be held on September 30, 2020 at 6 p.m. Due to the COVID-19 emergency, in order to protect the health of city staff and members of the public, the meeting will occur virtually through video and teleconference. The meeting will consist of a staff presentation describing the project background, proposed features, and the environmental review process, followed by an opportunity for the public to provide oral comments. Members of the public are encouraged to participate in the meeting by internet video conference (http://bit.ly/oceanbeachscoping), or by telephone (877-853-5247; Meeting ID: 828 5908 1146). Staff's scoping meeting presentation, meeting procedures and instructions—including on how to provide oral comments—are available at sfplanning.org/sfceqadocs. To request a language interpreter, please contact the staff contact listed below at least 72 hours in advance of the meeting to ensure availability.

Written comments will be accepted until 5 p.m. on Friday, October 9, 2020. Written comments should be mailed to Julie Moore, EIR Coordinator, San Francisco Planning Department, 49 South Van Ness Avenue, Suite 1400, San Francisco, CA 94103, or emailed to CPC.OceanBeachEIR@sfgov.org. Your comments should focus on significant environmental issues concerning the project, information that would help the environmental analysis or factors to consider in the environmental analysis.

State Agencies: If you represent an agency that is a Responsible or a Trustee Agency, we need to know the views of your agency as to the scope and content of the environmental information that is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency may need to use the EIR when considering a permit or other approval for this project. Please include the name of a contact person in your agency. If you have questions concerning environmental review of the proposed project, please contact Julie Moore at (628) 652-7566 or Julie.Moore@sfgov.org.

Members of the public are not required to provide personal identifying information when they communicate with the commission or the department. All written or oral communications, including submitted personal contact information, may be made available to the public for inspection and copying upon request and may appear on the department's website or in other public documents.

September 9, 2020
Date

Lisa Gibson
Environmental Review Officer

APPENDIX B
INITIAL STUDY

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Figures

Tables

INITIAL STUDY

A. Project Description

The description of the Ocean Beach Climate Change Adaptation Project (the project) is provided in Chapter 2, Project Description, of the environmental impact report (EIR), to which this initial study is appended.

B. Project Setting

The project setting and existing site land use characteristics are described in Chapter 2, Project Description, of the EIR, to which this initial study is appended.

C. Compatibility with Existing Zoning and Plans

	Applicable	Not Applicable
Discuss any variances, special authorizations, or changes proposed to the Planning Code or Zoning Map, if applicable.	☐	☒
Discuss any conflicts with any adopted plans and goals of the City or Region, if applicable.	☒	☐
Discuss any approvals and/or permits from City departments other than the Planning Department or the Department of Building Inspection, or from Regional, State, or Federal Agencies.	☒	☐

See Chapter 3, Plans and Policies, of the EIR for a detailed discussion of land use plans applicable to the project and identification of the project's potential to be inconsistent with any of those plans or policies, including the existing zoning and height and bulk designations for the project area. The project does not propose changes to the Planning Code or Zoning Map or require a variance to the general plan. Chapter 3, Plans and Policies, discusses conflicts with adopted plans and goals of the city and region. Chapter 2, Project Description, discusses approvals and permits from city, regional, state, and federal agencies.

D. Summary of Environmental Effects

The project could potentially result in adverse physical effects on the environmental resources checked below. Where those impacts are significant or potentially significant, the California Environmental Quality Act (CEQA) requires identification of mitigation measures to reduce the severity of the impacts to less than significant to the extent feasible. The initial study and the EIR present a more detailed checklist and discussion of each environmental resource.

- ☐ Land Use
- ☒ Aesthetics
- ☐ Population and Housing
- ☐ Cultural Resources
- ☒ Transportation and Circulation
- ☒ Noise
- ☐ Air Quality
- ☐ Greenhouse Gas Emissions
- ☐ Wind and Shadow
- ☒ Recreation
- ☐ Utilities and Service Systems
- ☐ Public Services
- ☒ Biological Resources
- ☐ Geology and Soils
- ☐ Hydrology and Water Quality
- ☐ Hazards/Hazardous Materials
- ☐ Mineral/Energy Resources
- ☐ Agricultural and Forest Resources
- ☒ Mandatory Findings of Significance

This initial study evaluates the potential for the project to result in significant environmental impacts and identifies which environmental resource topics are appropriately analyzed in the initial study and those that warrant more detailed analysis in the EIR.

On the basis of this initial study, the resource topics for which there is a potential for project-specific effects to be significant or for which the analysis requires additional detail are analyzed in the EIR and are as follows:

- Aesthetics
- Transportation and Circulation
- Noise
- Recreation
- Biological Resources

EFFECTS FOUND NOT TO BE SIGNIFICANT

For the following resource topics, the initial study determined that potential individual and cumulative environmental effects would be either less than significant or reduced to a less-than-significant level through the required mitigation measures identified in this initial study:

- Land Use and Planning
- Population and Housing
- Cultural Resources
- Tribal Cultural Resources
- Air Quality
- Greenhouse Gas Emissions
- Wind
- Shadow
- Utilities and Service Systems
- Public Services
- Geology and Soils
- Hydrology and Water Quality
- Hazards and Hazardous Materials
- Mineral Resources
- Energy
- Agricultural and Forest Resources
- Wildfire

Impacts associated with these topics are discussed with mitigation measures, where appropriate, in Section E, Evaluation of Environmental Effects, of this initial study. These topics require no further environmental analysis in the EIR. All mitigation measures identified in this initial study are listed in Section F, Mitigation Measures. The project sponsor has agreed to implement the mitigation measures identified in this section as part of implementation of the project, if approved. For each checklist item, the evaluation considers both project-specific and cumulative impacts of the project.

APPROACH TO CUMULATIVE IMPACT ANALYSIS

The CEQA Guidelines require that the environmental document disclose the cumulative impacts of a project. Furthermore, CEQA Guidelines section 15355 defines "cumulative impacts" as two or more individual effects that, when considered together, are considerable or which compound or increase other environmental impacts. EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, Section 4.1.5, Approach to Cumulative Impacts Analysis and Cumulative Projects, describes the overall approach used in this document to conduct the cumulative analysis. The cumulative impact analyses for topics addressed in this initial study are presented in Section E, Evaluation of Environmental Effects, and use the list-based approach, a projections approach, or a hybrid of the two as appropriate. Development and infrastructure projects that could produce related or cumulative impacts are listed in Table 4.1-3, Cumulative Projects in the Project Vicinity, of EIR Section 4.1, Overview, and mapped on Figure 4.1-1, Cumulative Projects.

E. Evaluation of Environmental Effects

E.1 LAND USE AND PLANNING

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
1. LAND USE AND PLANNING. Would the project:					
a) Physically divide an established community?	☐	☐	☒	☐	☐
b) Cause a significant physical environmental impact due to a conflict with any land use plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☒	☐	☐

Impact LU-1: The project would not physically divide an established community. (*Less than Significant*)

The project is situated between multiple unrelated land uses: recreation and open space uses along Ocean Beach, the Oceanside Water Pollution Control Plant (Oceanside Treatment Plant), the San Francisco Zoo, and residential and commercial uses. The project area includes a portion of the Great Highway, south of Sloat Boulevard, that provides a connection between communities (residents and businesses) to the north and south (e.g., San Francisco's Sunset District and Daly City's Westlake District). The project would permanently close this portion of the Great Highway to public vehicular traffic and enhance pedestrian and bicycle connectivity between surrounding land uses (such as between Ocean Beach and Lake Merced) by constructing a multi-use trail. The proposed trail would connect the Lake Merced Trail and the Great Highway multi-use trail, and would provide new pedestrian and bicycle access to Ocean Beach. Closing the Great Highway south of Sloat Boulevard would remove a vehicle travel connection between communities, but would not physically divide an established community because connectivity between these communities would remain via other existing roadways (e.g., via Sloat Boulevard and Skyline Boulevard). Therefore, the project would not physically divide an established community and the impact would be ***less than significant***.

Impact LU-2: The project would not cause a significant physical environmental impact due to a conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project adopted for the purpose of avoiding or mitigating an environmental effect. (*Less than Significant*)

Land use impacts are considered significant if the project would conflict with any plan, policy, or regulation adopted for the purpose of avoiding or mitigating an environmental effect. Environmental plans are those that directly address environmental issues and/or contain targets or standards that must be met in order to preserve or improve characteristics of San Francisco's physical environment. Conflicts with plans, policies, and regulations do not necessarily indicate a significant environmental land use impact under CEQA, unless the project substantially conflicts with a land use plan or policy that was adopted for the purpose of avoiding or mitigating an environmental effect, such that a substantial adverse physical change in the environment would result. To the extent that such substantial physical environmental impacts may result from such conflicts, this initial study and the EIR disclose and analyze the physical impacts under the relevant environmental topic sections.

Applicable land use plans, policies, and regulations that govern development within the project area include the San Francisco General Plan, including the Western Shoreline Area Plan, the San Francisco Recreation and Parks Department Strategic Plan, the California Coastal Act, and the General Management Plan for the Golden Gate National Recreation Area and Muir Woods National Monument, among others. The discussion in EIR Chapter 3, Plans and Policies, generally describes the project's potential conflicts with these plans.[1]

As described in EIR Chapter 3, Plans and Policies, the project could conflict with elements of the San Francisco General Plan, the California Coastal Act, and National Park Service (NPS) Management Policies. Conflicts relate primarily to the project's potential impacts on bank swallow habitat and potential environmentally sensitive habitat areas (discussed in greater detail in EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, Section 4.6.2.2 Project Setting). Project consistency with applicable plans, policies, and regulations of agencies with jurisdiction would continue to be analyzed and considered as part of the respective agencies' permit application review and approval process required for the project, independent of CEQA review. Any such potential conflicts would also be considered by decision-makers during their deliberations on the merits of the project and as part of their actions to approve, modify, or disapprove the project. Therefore, the project would have a ***less-than-significant*** impact with regard to conflicts with existing plans, policies, and regulations.

Impact C-LU-1: The project, in combination with the cumulative projects, would not result in significant cumulative impacts related to land use. (*Less than Significant*)

A cumulative land use impact would occur if the project in combination with the cumulative projects were to result in the physical division of an established community or conflict with applicable land use plans, policies, or regulations adopted for the purpose of avoiding or mitigating an environmental effect. The geographic scope for potential cumulative land use impacts encompasses project sites within approximately 0.25 mile of the project area, as identified in Table 4.1-3 and shown on EIR Figure 4.1-1.

The project would not physically divide an established community, and therefore would have no potential to combine with cumulative projects to result in a significant physical environmental impact related to dividing an established community. The cumulative projects would maintain existing land uses in the project vicinity and, like the project, would be required to comply with applicable regulations. It is therefore expected that, in general, implementation of the cumulative projects in combination with the project would be consistent with relevant plans and policies adopted for the purpose of avoiding or mitigating and environmental impact. The cumulative effects of the project, in combination with cumulative projects, would be ***less than significant***.

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[1] Other regional plans, such as the 2017 Clean Air Plan, address specific environmental resources and are discussed in the relevant sections of this initial study or the EIR.

E.2 AESTHETICS

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
2. AESTHETICS. Except as provided in Public Resources Code section 21099, would the project:					
a) Have a substantial adverse effect on a scenic vista?	☒	☐	☐	☐	☐
b) Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☒	☐	☐	☐	☐
c) In non-urbanized areas, substantially degrade the existing visual character or quality of public views of the site and its surroundings? (Public views are those that are experienced from publicly accessible vantage points.) If the project is in an urbanized area, would the project conflict with applicable zoning and other regulations governing scenic quality?	☒	☐	☐	☐	☐
d) Create a new source of substantial light or glare which would adversely affect daytime or nighttime views in the area?	☒	☐	☐	☐	☐

The project has the potential to result in significant impacts related to aesthetics. All aesthetics topics (i.e., E.2(a) through E.2(d)) are addressed in EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, Section 4.2, Aesthetics.

E.3 POPULATION AND HOUSING

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
3. POPULATION AND HOUSING. Would the project:					
a) Induce substantial unplanned population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☒	☐	☐
b) Displace substantial numbers of existing people or housing units, necessitating the construction of replacement housing?	☐	☐	☐	☐	☒

The project would not displace any residents or housing units because no residential uses or housing units currently exist on Ocean Beach or the Great Highway. Therefore, topic E.3(b) related to housing and population displacement does ***not apply*** and is not discussed further in the EIR, including this initial study.

Impact PH-1: The project would not induce substantial unplanned population growth in an area, either directly or indirectly. (*Less than Significant*)

In general, a project would be considered growth-inducing if its implementation were to result in a substantial unplanned population increase.

Construction

Project construction would take approximately four years to complete. The construction phases would range in duration from six to 25 months. The average number of construction workers estimated to be required onsite during a given construction phase would be about 50, and the maximum project workforce demand is estimated to be around 130 during a period when construction phases overlap. According to the California Employment Development Department, the average number of construction jobs from March 2019 to March 2020 was about 43,515 jobs in San Francisco and San Mateo counties (combined).[2] The Association of Bay Area Governments (ABAG) estimates the total number of new project construction jobs that will be added in San Francisco and San Mateo counties by 2040 will be about 4,860.[3] Given the site's proximity to regional population centers, and considering the size of the regional construction work force, the project-related increase in workforce demand would be small relative to the regional labor supply. While some workers might relocate from other areas, the population increase would be negligible and temporary, limited to the construction period. Consequently, construction of the project would not induce substantial unplanned population growth and the effect would be ***less than significant***.

[2] California Employment Development Department, Current Industry Employment Statistics (Industry Employment) Data, *https://www.labormarketinfo.edd.ca.gov/geography/md/san-francisco-redwood-city-south-san-francisco.html*, accessed April 20, 2020.

[3] Plan Bay Area Projections 2040 estimates that there would be 23,320 construction jobs in San Francisco and 27,340 construction jobs in San Mateo County by 2040 (ABAG/MTC, Plan Bay Area Projections 2040, A Companion to Plan Bay Area 2040, November 2018).

Operation

The project has several specific objectives listed in EIR Chapter 2, Project Description, Section 2.3, Project Objectives, none of which are related to increasing population, housing, or employment in the project area. The project does not propose any new homes or businesses that would attract substantial numbers of people to the project area. Additionally, as stated in EIR Chapter 2, Project Description, Section 2.6, Project Operations and Maintenance, the city and NPS do not anticipate changes to agency staffing levels to support project operations and maintenance. As a result, the project would not directly induce population growth.

The project would not increase the capacity of the wastewater system, which could indirectly induce population growth. The project also does not include the extension of roads or other infrastructure into areas lacking such services, and therefore would not indirectly contribute to population growth. The project would preserve and enhance existing coastal public access and recreation within the area. Thus, the project would be expected to continue attracting local and regional recreationists who might walk or bike along the project's new paths or visit the improved beach for the day. These improvements would not be expected to cause people to relocate. For these reasons, the growth-inducing impact of project operation would be ***less than significant***.

Impact C-PH-1: The project, in combination with the cumulative projects, would not induce substantial unplanned population growth in an area, either directly or indirectly. (*Less than Significant*)

The geographical area for cumulative impacts includes all construction projects in the region, which includes San Francisco and San Mateo counties. Cumulative construction information is drawn from the California Employment Development Department Current Industry Employment Statistics as well as the city's Development Pipeline.

Construction

As discussed above, construction is expected to require approximately 50 daily workers per phase during the construction period (approximately four years). The Westside Pump Station Reliability Improvements, Vista Grande Drainage Basin Improvement, Oceanside Treatment Plant Improvements (two projects), San Francisco Zoo Recycled Water Pipeline, Lake Merced West, and Westside Force Main Reliability, and 2700 Sloat Boulevard projects may involve similar numbers of construction workers as the project due to the anticipated area of ground disturbance and project scale. Assuming these projects require a similar average number of construction workers as the project, the project in combination with cumulative projects would create up to 400 temporary construction jobs. This number of jobs is substantially smaller than the anticipated growth in construction jobs projected for the area, and would be less than 1 percent of the existing number of construction jobs. Construction of the project along with cumulative projects would not induce substantial unplanned population growth. Therefore, the cumulative population and housing impact of project construction along with construction of cumulative projects would be ***less than significant***.

Operation

As discussed above, the project would not directly induce population growth because the project would not create housing or result in the need for increased staff levels that could increase population levels in the area, nor would it indirectly contribute to population growth through the extension of roads or other infrastructure into areas lacking such services. Therefore, the project would not contribute considerably to any potential cumulative impact related to unplanned population growth (***less than significant***).

E.4 CULTURAL RESOURCES

Topic	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact	Not Applicable
4. CULTURAL RESOURCES. Would the project:					
a) Cause a substantial adverse change in the significance of a historical resource pursuant to §15064.5, including those resources listed in article 10 or article 11 of the San Francisco Planning Code?	☐	☐	☐	☒	☐
b) Cause a substantial adverse change in the significance of an archeological resource pursuant to §15064.5?	☐	☐	☒	☐	☐
c) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☒	☐	☐

Impact CR-1: The project would not cause a substantial adverse change in the significance of a historical resource as defined in section 15064.5. (*No Impact*)

CEQA Guidelines section 15064.5 requires the lead agency to consider the effects of a project on historical resources. A historical resource is defined as a building, structure, site, object, or district (including landscapes) listed in or determined to be eligible for listing in the California Register of Historical Resources(California Register), included in a local register or identified as significant in an historical resource survey, or determined by a lead agency to be significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, or cultural annals of California. Resources that are eligible for the California Register may also be eligible for the National Register of Historic Places (National Register). The following discussion focuses on architectural resources. This analysis identifies the potential for historic architectural resources listed in or eligible for listing in the California Register to be within the project study area for architectural resources and assesses the project impact on those resources, should any exist. Archeological resources, including archeological resources that are potentially historical resources according to CEQA Guidelines section 15064.5, are addressed under Impact CR-2.

The project study area for architectural resources includes the project site (areas where direct ground disturbance will occur as part of the project), as well as areas adjacent to the project site (areas where no direct ground disturbance would occur, yet architectural resources could be impacted by construction noise, vibration, or visual impacts).

Inventory and Evaluation of Architectural Resources

A historic resources evaluation report (HRE) was prepared in October 2020 to identify and evaluate historic-age buildings and structures located in the project study area for architectural resources.[4] San Francisco Planning Department (planning department) preservation staff reviewed and concurred with the findings of

[4] ESA. Historic Resources Evaluation Report for the Ocean Beach Climate Change Adaptation Project. Prepared for the City and County of San Francisco Planning Department, Environmental Planning Division (Case No. 2019-020115ENV) and the United States Department of the Interior, National Park Service. October 2020.

the HRE.[5] In summary, of the 12 buildings and structures identified, only two are considered to be historical resources for the purposes of CEQA: the San Francisco Zoo and the O'Shaughnessy Seawall. Both of these historical resources are adjacent to, but outside of, the project site; no historical resources have been identified within the project site.

The San Francisco Zoo was evaluated in 1996 and determined to be eligible for listing as a historic district in the California Register under Criterion 1 at the local level.[6] The period of significance is 1925-1940, which represents the period of development of the first and second zoos. Because it is located outside of the C-APE and was previously evaluated, the HRE did not re-evaluate the San Francisco Zoo and presumes it to be eligible for listing in the National Register under Criterion A.[7]

The O'Shaughnessy Seawall had not been previously evaluated. The HRE recommends it as eligible for listing in the National Register and California Register under Criteria A/1 at the local level as a crucial and enduring component of the Ocean Beach Esplanade along the Great Highway and C/3 at the state level as an important work of City Engineer M. M. O'Shaughnessy. The planning department concurred with this determination. The period of significance is 1914-1929, which represents the construction period that was overseen by O'Shaughnessy. The seawall retains sufficient integrity to convey its historical significance.

The remaining 10 buildings and structures identified in the HRE are recommended as ineligible for listing in the California Register and National Register, are less than 50 years old, or were determined to no longer be extant.

Impact Discussion

Ten buildings and structures identified and evaluated in the HRE are not eligible as historical resources. The San Francisco Zoo and the O'Shaughnessy Seawall, both of which are eligible for listing in the National Register and California Register, are located adjacent to, but outside of, the project site. Because there would be no construction activity that would directly impact these resources and no operations that would increase activity at these resources, there would be ***no impact*** to historical resources as a result of project construction or operation. No mitigation is required.

Impact CR-2: The project would not cause a substantial adverse change in the significance of an archeological resource pursuant to section 15064.5. (*Less than Significant*)

Archeological resources can be considered both as historical resources according to CEQA Guidelines section 15064.5 as well as unique archeological resources as defined in CEQA section 21083.2(g). Both Native American and historical archeological resources, including maritime archeological resources, are addressed in this impact discussion. This analysis identifies the potential for archeological resources listed in or eligible for listing in the California Register and National Register to be within the C-APE and assesses the project impact on those resources, should any exist.

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5 San Francisco Planning Department. Note to File, Ocean Beach Climate Change Adaptation Project, Historic Resources Evaluation Report Review, January 7, 2021.

6 Archeological/Historical Consultants. Historic Landscape and Architecture Survey of the San Francisco Zoological Gardens. July 1996. As discussed in the HRE, the 1996 report erroneously states that the San Francisco Zoo is eligible as a historic district under California Register Criterion A, when it should be California Register Criterion 1.

7 As discussed in the HRE, the San Francisco Zoo is presumed to be eligible for listing in the National Register because it is historically significant and retains a high degree of integrity, and it would therefore meet the threshold for National Register eligibility.

An archeological survey report and sensitivity analysis ("archeological sensitivity analysis") was completed for the project.[8] The report provides a detailed context, applicable regulatory framework, and a sensitivity analysis of the potential for Native American and historical archeological resources to be in the archeological CEQA Area of Potential Effects (C-APE) and to be affected by project ground disturbance. The archeological sensitivity analysis includes a review of the *geotechnical*[9] testing program completed for the project. In addition, a *geoarcheological*[10] testing program was completed for the project and reported on in an addendum to the archeological sensitivity analysis, which further augments the sensitivity analysis.[11] Relevant information is summarized below.

The term C-APE is used for the archeological analysis and is modeled after the federal definition of the area of potential effects, and is the geographic area or areas within which a project may directly or indirectly cause alterations in the character or use of historical resources, if any such resources exist. For the purposes of this analysis, the horizontal extent of the C-APE for the project is considered the entire work area footprint, which encompasses approximately 60 acres. The C-APE includes all areas of anticipated ground disturbance, including staging areas, access routes that traverse the work area, and all areas of anticipated vegetation removal grading and excavation associated with the project. There are three distinct areas of the C-APE that are analyzed in this section: the South Ocean Beach portion of the C-APE, the North Ocean Beach portion of the C-APE, and the marine study area of the C-APE (**Figure 1**).

Major project components would be located within an approximately 45-acre work area along Ocean Beach and the present location of the Great Highway south of Sloat Boulevard. This document references this area as the South Ocean Beach portion of the C-APE. **Table 1** provides the vertical and horizontal areas of disturbance for project components in the South Ocean Beach portion of the C-APE.

The C-APE also includes a 14-acre section of beach north of Lincoln Way, where the project may excavate sand to use for replenishment to the south. This area is discussed in this document as the North Ocean Beach portion of the C-APE. The North Ocean Beach portion of the C-APE includes excavation up to 6 feet deep on the beach.

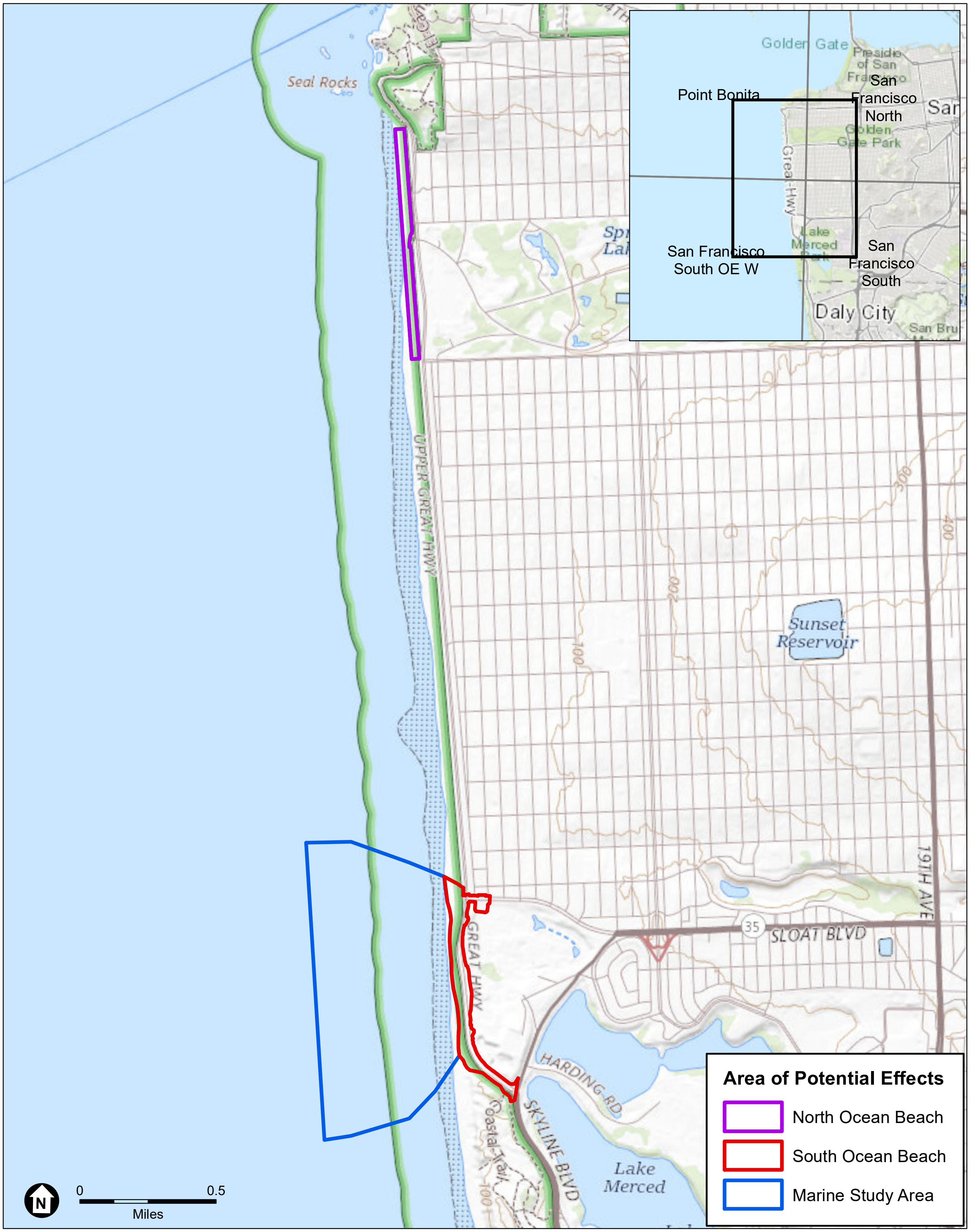
In addition, project activities are proposed for an area extending to approximately 0.5 mile offshore of the South Ocean Beach portion of the C-APE in which a temporary pipeline would be installed to convey dredged sand between a dredge anchored offshore and South Ocean Beach. This area is referred to as the marine study area of the C-APE. Depth of disturbance onshore would be minimal (about 2-3 feet on the beach); offshore, the pipeline would be weighted to the seafloor and little or no ground disturbance would occur. The pipeline is heavy and generally would be expected to stay in place; the pipeline would be placed using a sonar system to ensure avoiding any obstructions on the ocean floor.

8 ESA. Archeological Survey Report and Sensitivity Analysis for the Ocean Beach Climate Change Adaptation Project. Prepared for the City and County of San Francisco Planning Department, Environmental Planning Division (Case No. 2019-020115ENV) and the United States Department of the Interior, National Park Service. December 2020.

9 The geotechnical testing program was completed to explore and characterize the subsurface conditions along the planned pile wall, tiebacks, and associated structures.

10 The geoarcheological testing program was completed as required by the San Francisco Planning Department after review of the initial sensitivity assessment to further investigate and to further determine the presence or absence of cultural resources in the South Beach portion of the C-APE and to further elucidate the results of the geotechnical testing program.

11 ESA. Archeological Survey Report and Sensitivity Analysis for the Ocean Beach Climate Change Adaptation Project Addendum. Prepared for the City and County of San Francisco Planning Department, Environmental Planning Division (Case No. 2019-020115ENV) and the United States Department of the Interior, National Park Service. July 2021.



SOURCE: SFPUC, 2020; USGS National Map

Ocean Beach Climate Change Adaptation Project

Figure 1
Area of Potential Effects

Table 1 Project Components and Areas of Disturbance

Project Component	Horizontal Area of Disturbance	Approximate Vertical Area of Disturbance (Maximum Depth below existing grade)
ROADWAY AND INTERSECTION MODIFICATIONS		
Great Highway • Remove travel lanes and underlying roadbed fill • Remove NPS parking lot and underlying roadbed fill • Remove stormwater pipes and streetlights along Great Highway	• 4,000 feet long, 60 feet wide (Great Highway) • 460 feet long, 60 feet wide (NPS parking lot)	• 5 feet for stormwater pipes • 2 feet everywhere else • 3-8 feet for streetlight poles
Service Road • Construct northbound travel lane • Install storm drain system • Install access gate • Install streetlights	• 4,000 feet long, 60 feet wide	• 2 feet • 3-5 feet for storm drain • 3-8 feet for streetlight poles
Zoo Entrance at Sloat Boulevard • Modify median, curb cuts, repave	• 100 feet long, 100 feet wide	• 2 feet
LAKE MERCED TUNNEL PROTECTION		
• Construct Buried Wall • Slope Stabilization • Tiebacks	• 3,200 feet long, 5 feet wide • 3,200 feet long, 40 to 50 feet wide • 320 tiebacks; 70 feet long, 6 inches wide	• 40 to 80 feet (avg. 60 feet) • 18 to 30 feet (avg. 20 feet) • Tiebacks, 35 feet; drilled and grouted into ground at angle
DEBRIS AND REVETMENT REMOVAL AND BLUFF RECONTOURING AND REVEGETATION		
Debris and Revetment Removal *Limited to removing debris and revetment materials*	• 2,500 feet long, 70 feet wide	• 20 feet
Bluff Recontouring *Includes excavating, recontouring bluff between buried wall and revetment*	• 3,200 feet long, 30 to 50 feet wide	• 30 feet
Revegetation	• 3,200 feet long, 100 feet wide	No additional excavation
PUBLIC ACCESS, PARKING, AND RESTROOM IMPROVEMENTS		
Multi-use Trail and Barrier	• 4,000 feet long, 50 feet wide	• 2 feet
Beach Access (up to three locations)	• 200 feet long, 15-feet wide	• 15 feet long supports (four per stairway) • Landing piles, 60 feet
Restroom	• 50 feet, 40 feet	• 10 feet
Skyline Coastal Parking Lot	• 850 feet long, 110 feet wide	• 5 feet
BEACH NOURISHMENT		
Large volume sand placement	Source: 3,200 feet long – onshore	Pipeline placed on ocean bottom, sand would be placed on beach south of Sloat Blvd could include minimal excavation to level sand (about 2-3 feet)

NOTES:

The following project components are not listed because they would not require any ground disturbance: Skyline Boulevard and Great Highway intersection improvements; transit access; shoreline monitoring program.

Existing grade of the Great Highway ranges from approximately 30 feet NAVD88 at the north end of the proposed buried wall to approximately 60 feet NAVD88 at the south end of the proposed buried wall.

Artificial fill ranges in depth from approximately 1 to 38 feet deep along the length of the Great Highway between Sloat Boulevard and the proposed Skyline coastal parking lot.

Native American Archeological Resources

Previous Studies

There are several recorded Native American archeological resources in the vicinity of the C-APE, on the west side of San Francisco. Site CA-SFR-101/H is recorded east of the Great Highway and the South Ocean Beach portion of the C-APE; the site is recorded as a historic-era well and an isolated obsidian projectile point.[12] The "Outlet Creek Midden" is a referenced but unrecorded buried shell midden deposit, reportedly located east of the South Ocean Beach portion of the C-APE. Both of these sites are outside the C-APE for this project.

An archeological survey along the Great Highway bluff in 2013 revealed possible shell midden on the bluff top and face; the site was recorded as CA-SFR-181.[13] Subsequent geoarcheological coring, small scale test excavations, and radiocarbon dating indicate that the apparent shell midden material appears to consist of modern shell and naturally-occurring animal bone, rather than being a Native American archeological deposit.[14] However, archeologists also recovered an obsidian flake (stone tool manufacturing debris) from a geoarcheological core at the location of the suspected site. As obsidian is not naturally occurring in the Bay Area, but was commonly traded for tool manufacture, the presence of obsidian is indicative of Native American human use. Based on the context of the discovery, in association with modern material, the obsidian flake was interpreted as an isolated artifact; that is, an artifact not associated with the previously-recorded shell deposit and likely redeposited when sand dunes to the south and east of the C-APE were graded during construction of the Great Highway Extension. Nonetheless, together with the isolated projectile point found as part of CA-SFR-101/H, the isolated obsidian flake suggests that an undiscovered Native American archeological deposit likely is (or was) present in the general vicinity of the C-APE.

In addition, a series of Native American sites (some with historical components) have been recorded north of the North Ocean Beach portion of the C-APE. None of these resources is within or in close proximity to the North Ocean Beach portion of the C-APE, nor would any be impacted by the project. The North Ocean Beach portion of the C-APE has been assessed as having low sensitivity for Native American archeological resources, because soil disturbance would be confined to an active ocean beach.

Native American Archeological Resources and Sensitivity Assessment

The previously-discovered obsidian flake was found in a 2016 geoarcheological core at the location of reported site CA-SFR-181 within the C-APE, and the isolated projectile point was recorded in 1981 as part of CA-SFR-101/H, approximately 400 feet east of the C-APE. Together, these discoveries suggest that a Native American archeological deposit may be, or may have been at one time, present in the general vicinity of the South Ocean Beach portion of the C-APE. Thus for this project, San Francisco Planning required additional subsurface investigation (geoarcheological testing) to further identify if buried resources are present. However, no additional Native American archeological material was observed by archeologists during either geotechnical coring (12 cores monitored by an archeologist) or geoarcheological testing (19 cores

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12 Laurence Shoup and Suzanne Baker. Cultural Resource Overview: Lake Merced Transport, San Francisco Clean Water Management Program, San Francisco, California. On file (S-3247), NWIC, 1981, pp. 85–87.

13 Spillane, Tim, Archeological Overview and Assessment: Indigenous Sites of the GGNRA. Prepared for the National Park Service, Golden Gate National Recreation Area, San Francisco. Prepared by BayArcheo, San Francisco. On file at the Northwest Information Center, Rohnert Park, California, 2014.

14 AECOM, Archeological Testing Results, South Ocean Beach Short Term Erosion Protection Project (2015-013754ENV), San Francisco, California. Prepared for the San Francisco Public Utilities Commission, 2016.

performed by an archeologist) completed for the project between 2019-2021. Coring (5 cores) was also performed for the adjacent West Side Pump Station and were also negative for archeological resources.

Disturbed soil (fill). The results of the geotechnical and geoarcheological testing programs completed for the project suggests that the South Ocean Beach portion of the C-APE consists of a stratum of disturbed and redeposited sand dune soils ("fill") ranging from 1 to 38 feet deep, underlain in some areas by a stratum of undisturbed dune and/or beach sand up to 25 feet thick and variably, at 1 to 38 feet depth, by the Colma and/or Merced formation. The fill stratum appears to represent dune sand redeposited from the dune field along which the Great Highway Extension (i.e., the roadway segment south of Sloat Boulevard) was constructed. As described in the archeological sensitivity analysis and addendum, this disturbed soil, which also includes concrete and modern debris of various kinds, is the result of a massive program of grading and filling in conjunction with construction of a wide parking lot constructed along the beach at the west end of Sloat Boulevard (on what became NPS property) around 1930 to serve recreational facilities, and with construction of the Great Highway Extension south of Sloat Boulevard, starting in the 1960s.

Based on pre-road topography shown on historic maps, it is likely that road construction in the Sloat Boulevard and zoo vicinity included grading sand from higher dunes east of the road route, and pushing the sand westward out over the dunes that flanked the beach which moved the coastline westward. Prior to the 1930s and later construction, the landscape in this area was topographically variable, with coastal sand dunes rising from beach level to 100 feet above sea level in some areas. Aerial photographs from 1938, 1941, and 1965 suggest that extensive landscape filling, smoothing, and contouring was necessary to bring this portion of the alignment of the Great Highway Extension to its current grade. Geotechnical studies and the geoarcheological testing program confirm the addition of more than 30 feet of artificially-placed fill in some locations.[15] It can be presumed that this was not primarily imported fill, but more likely was dune material moved along or across the right-of-way to level and expand the road corridor seaward.

Similarly, it is likely that, during construction of the Great Highway Extension, sand from the higher dunes south of the Oceanside Treatment Plant, near the south end of the C-APE, were pushed northward and deposited along the new road alignment in the vicinity of the future plant and to the south of the plant within the South Ocean Beach portion of the C-APE, to reduce the grade as the road ran south toward Fort Funston.

Soil disturbance in some areas also resulted from construction of infrastructure projects beginning in the 1980s, including the Lake Merced Tunnel and the Southwest Ocean Outfall, which caused ground disturbance beneath the Great Highway within the South Ocean Beach portion of the C-APE. This ground disturbance included excavation of two Lake Merced Tunnel access shafts in the Great Highway, one near Sloat Boulevard and another near the Oceanside Treatment Plant and underground boring at 20 to 25 feet depth for the 14-foot diameter tunnel (which did not disturb near-surface soils, but did disturb deeper dune sands and/or Colma formation deposits present at that depth) along the western lane of the Great Highway between the two tunnel shafts. In addition, construction of the Southwest Ocean Outfall entailed excavation of a 30-foot-wide trench to a depth as great as 80 feet across the Great Highway, adjacent to the Oceanside Treatment Plant, and across the beach below. Within the disturbed soil associated with these localized disturbances (primarily backfill of excavations), there is the potential for redeposited Native American material to be present. While there is no potential for intact Native American archeological deposits to be

[15] AGS, Inc., Final Geotechnical Interpretive Report, South Ocean Beach Coastal Erosion and Wastewater Infrastructure Protection, San Francisco, California, July 2021.

present within the redeposited soil, redeposited Native American archeological materials could occur in fill layers. However, no redeposited Native American archeological material was observed in any of the cores during geotechnical or geoarcheological testing.

Dunes. Where present beneath the redeposited fill soil in the South Ocean Beach portion of the C-APE, intact dune and/or beach sand deposits typically comprise a 5- to 25-foot-thick stratum along the shore face that progressively thickens inland to the east, with the deepest dune sands observed in deposits up to 40 feet thick adjacent to Lake Merced. Archeological observation of soil borings collected and test pits excavated during the geotechnical testing program, as well as the geoarcheological coring testing program, did not identify any *paleosols*[16] or archeological materials in the samples of the intact dune stratum examined by archeologists.

The previously recorded obsidian projectile point and obsidian fragment found at two discrete locations in the vicinity of the Oceanside Treatment Plant clearly indicate that this area—or somewhere in the immediate vicinity—was used in prehistory. CA-SFR-101/H, which included an isolate obsidian projectile point, and CA-SFR-181, where the only definitively Native American material was a single obsidian flake, may represent remnants of Native American sites that were disturbed or destroyed by historic activities associated with a U.S. Coast Guard Station; the early components of Fort Funston and the later National Guard facility; and/or the construction of the Great Highway Extension, the Oceanside Treatment Plant, and the Southwest Ocean Outfall. Natural erosion of the bluff top within the dune sand prior to the twentieth century, as well as efforts to slow it, and construction of the Great Highway Extension in the 1960s, may also have disturbed, destroyed or redeposited Native American resources that may have been present in the intact dune stratum near the bluff edge on the Great Highway Extension, between Zoo Road and the Oceanside Treatment Plant, where these dunes were converted into fill. Despite the massive amounts of disturbance along the Great Highway alignment due to both natural and human factors, intact Native American archeological deposits may still be present in association with the intact buried dune sand stratum and as redeposited material in the disturbed sand dune "fill" stratum where it is present within the C-APE, between the locations (about 150 feet apart) sampled by geoarcheological coring. However, based on negative findings during the geoarcheological testing, and extrapolating the results between testing locations spaced approximately 150 feet apart, the sensitivity for intact Native American archeological deposits within the dune deposits along the proposed buried wall alignment (the only part of the South Ocean Beach portion of the C-APE where the project has the potential to impact buried archeological resources) is low.

Lake Merced outlet creek mouth. Geotechnical and geoarcheological testing in the vicinity of the Westside Pump Station near the northern end of the South Ocean Beach portion of the C-APE, in combination with historical map analyses, indicates the Lake Merced outlet creek mouth was intermittently present in that area until around 1926.[17] Based on proximity to both ocean resources and the creek, such a location would be assumed to be highly sensitive for Native American human use. However, based on analysis of historical maps relative to the C-APE, it appears that the creek mouth and an associated small embayment migrated north and south over time. On this basis, it is inferred that intact dune and Colma strata that may have been

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16 A paleosol is a former surface that has been buried by natural alluvial, fluvial, or other processes. Paleosols preserve the composition and character of the earth's surface prior to subsequent sediment deposition and thus have the potential to preserve archeological resources if the area was occupied or settled by humans.

17 A creek outlet from Lake Merced to the sea periodically opened and closed in response to changes in volumes of runoff and seismic events; the old creek bed location runs close to or possibly within the north end of the South Ocean Beach portion of the C-APE, near the alignment of Sloat Boulevard; GTC, Geotechnical Report Westside Pump Station Reliability Improvements. Prepared for MWH Americas on behalf of the San Francisco Public Utilities Commission, January 2016.

present in this area were eroded by the repeated migrations of the creek mouth prior to the 1920s, and therefore would have a low potential for the survival of buried Native American archeological resources. Due to uncertainties related to how the location of this mouth was mapped historically and its subsequent georeferencing to the C-APE map, the exact extent of the affected area within the C-APE has not been determined. However, the area affected by historical creek mouth migrations may extend as far north as the northern end of the South Ocean Beach portion of the C-APE and as far south as the southern edge of the Westside Pump Station facility. A thicker intact dune sand stratum identified in a geotechnical core immediately south of the pump station may represent a more stable southern creek bank. If so, this area would have increased sensitivity for the survival of any buried Native American archeological resources that may be present. Recent geoarcheological testing for the Westside Pump Station Project immediately south of the pump station did not identify any Native American archeological resources or intact paleosols.[18]

Based on the results of both the geoarcheological testing reported herein, as well as the recent negative results of the Westside Pump Station geoarcheological testing, there is a low sensitivity for buried Native American archeological resources to be present in the vicinity of the Lake Merced outlet creek mouth at the northern end of the South Ocean Beach portion of the APE.

Colma/Merced Formation/Paleosols. With respect to the potential for older Native American deposits, the disturbed soils and intact dune and/or beach sands (where present in the C-APE) are underlain by the Colma Formation, or where the Colma is absent, the Merced Formation,[19] at depths ranging from 1 to 38 feet below ground surface (bgs). Although these formations are too old to contain archeological deposits, there is the potential for Native American archeological deposits to be present within the upper surface of the Colma or Merced Formations where they remained exposed, and thus available for settlement after the time of the initial arrival of humans in the bay region, before being later buried by dune sands and thereby preserved. Exposed surfaces that might have been available for Native American settlement are identified by the presence of an intact paleosol on the uppermost portion (approximately 3 feet) of the stratum below the overlying dune sands. The geotechnical core inspections and geoarcheological sampling conducted for this project did not identify any such intact paleosols within the C-APE at the locations sampled. The stratigraphy revealed in the samples suggests that any paleosol that might have been present in the C-APE may have been impacted by twentieth century ground disturbance and/or that the formations on which paleosols might have formed were truncated by erosion such that, if paleosols were at one time present on these surfaces, they were eroded away before they could be buried by later dunes and preserved. Older Native American archeological deposits may be present in the uppermost 3 feet of the Colma or Merced formations where they were not truncated before being buried by dune sand deposits, outside of areas tested during the geoarcheological testing program. However, based on negative findings during the geoarcheological testing, and extrapolating the results between testing locations, the sensitivity for intact Native American archeological deposits on the surface of the Colma or Merced formations within the South Ocean Beach portion of the C-APE where project-related ground disturbance will have the potential to impact buried archeological resources is low.

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[18] ESA, Archeological Testing Results Report for Geoarcheological Testing for the Westside Pump Station Reliability Upgrades Project, San Francisco, California (Environmental Planning Case No. 2016-014160ENV). Prepared for San Francisco Planning Department, Environmental Planning Division. August 2021.

[19] The Colma and Merced formations consists of Late Pleistocene-age estuarine, alluvial, and aeolian sediments deposited between approximately 70,000 and 130,000 years ago. Some areas of the upper portions of the Colma and Merced formations remained exposed into the Middle Holocene, and therefore were available for settlement by Native Americans.

Summary. In summary, there is no potential for intact Native American archeological deposits to be present within the upper stratum of disturbed sand dunes (identified as “fill” in geotechnical reports) throughout the South Ocean Beach portion of the C-APE. Although none was observed during the geoarcheological testing program, there is the potential for redeposited Native American material to be present within these disturbed soils. However, detecting any but a substantial redeposit would be difficult given the small sample of the cores (1.5 to 2-inch diameter cores).

Below the disturbed soils, buried intact dune sand strata are present in some areas along the South Ocean Beach portion of the C-APE. In these areas, and between the borings directly tested during the geoarcheological testing program, there is still the potential to encounter isolated Native American archeological resources ; however, extrapolating the negative results of the geotechnical and geoarcheological investigations, including recent results from the Westside Pump Station, which represent a reasonable effort to identify Native American archeological resources, there is a low potential to encounter a substantial archeological deposit in the South Ocean Beach portion of the C-APE.

Finally, while there may be the possibility for older Native American archeological resources to be present in the upper 3 feet of the Colma or Merced formations in areas where the surface was not truncated prior to being buried, the geoarcheological testing program completed as part of the project, as well as the Westside Pump Station Project, did not identify any Native American archeological materials or intact paleosols anywhere within the South Ocean Beach portion of the C-APE. These results suggest that any paleosols that might have been present may have been eroded away before the Colma/Merced formations were buried by dune sands. Some potential remains that paleosols associated with the Colma or Merced formations, which could contain isolated Native American deposits, may be present between the points that were directly tested during the geoarcheological testing program. However, extrapolating the results of the geoarcheological testing suggests the possibility is low within the parts of the South Ocean Beach portion of the C-APE where project-related ground disturbance will have the potential to impact buried archeological resources.

In summary, no Native American archeological resources were identified through geoarchaeological or geotechnical coring that sampled points at approximately 150-foot intervals within the South Ocean Beach portion of the C-APE. Additionally, cores performed for the adjacent Westside Pump Station Project were also negative. These findings represent a good faith effort to identify Native American archeological resources within the South Ocean Beach portion of the C-APE where there is the potential for project-related ground disturbance to impact buried archeological resources, and to characterize deep stratigraphy with respect to the potential for the Colma/Merced formations in this area to harbor Native American archeological resources. Extrapolating the negative findings of the geoarcheological testing along the buried wall alignment, the potential for project-related impacts to Native American archeological resources within the South Ocean Beach portion of the C-APE where project-related ground disturbance has the potential to impact buried archeological resources is low.

Historical Archeological Resources and Sensitivity Assessment

Historical maps, aerial images, and photographs suggest that the segment of the Great Highway south of Sloat Boulevard is supported on fill consisting of twentieth century redeposited dune sand from the ground surface to depths of 1 to 38 feet bgs, including fill over the former outlet and coastal embayment of the Lake Merced creek which, at various times historically, cut across the Great Highway alignment from just north to just south of Sloat Boulevard. Rubble, riprap, and debris that were incorporated in the dune sand fill are evident in the beach cliff face in this vicinity and were observed during monitoring of geotechnical test pits, as described in the ASA.[20] In this immediate area, an historic ship fragment was encountered and removed during excavation of the northern bore pit for the Lake Merced Tunnel near the intersection of Sloat Boulevard and the Great Highway in 1992.[21] Reportedly, the historic ship remnant was reburied in the bore pit at the conclusion of tunnel boring. Based on this information, the ship's remains are still present, and are within the horizontal extent of the C-APE, within the Great Highway. As no deep excavation is anticipated at this location, the ship remnants appear to be outside the area of deep disturbance for the project and therefore unlikely to be encountered. This find also suggests the potential for additional historic shipwrecks or fragments to be present in the C-APE vicinity of the former Lake Merced outlet creek; however, the potential to encounter such resources during project implementation is low because the only ground disturbance in this area would be installation of the pilings for the buried wall. The geoarcheological testing program (which included two cores in the vicinity) did not encounter any potential historical archeological features in the South Ocean Beach portion of the C-APE near Sloat Boulevard.

In the southern portion of the South Ocean Beach C-APE near the Oceanside Treatment Plant, historical maps show a number of structures on the ocean bluffs immediately opposite the present-day location of the plant's Great Highway entrance.[22] These structures were related to the early twentieth century Southside Coast Guard Station and other nearby military installations, including Battery Walter Howe, a mortar battery constructed in 1918 in the northern portion of Fort Funston. Facilities associated with the Coast Guard Station and Battery Walter Howe were reportedly demolished and buried beneath redeposited fill during construction of the Great Highway Extension during the 1960s.[23]

During geotechnical coring for the project, a core near the southern end of the proposed buried wall alignment (although slightly inland of the wall alignment itself) hit refusal on concrete may be associated with either the coast guard station or Battery Walter Howe at approximately 38 feet bgs. This indicates the potential that features associated with twentieth century military use of the area may still be present within the South Ocean Beach portion of the C-APE, deeply buried beneath the Great Highway Extension.

The geoarcheological cores, which were placed directly along the proposed buried wall alignment, did not encounter any evidence of either the coast guard station or Battery Walter Howe. Although ESA archeologists observed concrete remnants eroding out of the cliff face on the beach immediately seaward of the southernmost core locations, the source of the concrete remnants is unknown. However, given the location, the concrete remnants are unlikely to be associated with either the coast guard station or Battery Walter Howe, as analysis of historical photographs, aerial images and results of the geoarcheological testing indicate that if Battery Walter Howe is still extant it is likely east of the rubble location, buried beneath the Great Highway, while the coast guard station was farther north. This would also be consistent with the location of refusal encountered during geotechnical coring.

Comparison of historical maps and aerial photographs to the present ocean bluff shoreline indicates there has been significant erosion of the coastal bluff and dunes west of the Great Highway, such that buried historic structures or features, if they were located west of what is now the highway alignment, or even under the western lane or shoulder of the highway in this vicinity almost certainly would have eroded into

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20 ESA, Archeological Survey Report and Sensitivity Analysis for the Ocean Beach Climate Change Adaptation Project, 2020: pp.77.

21 Ibid. pp. 67–72.

22 Ibid. pp. 40–60.

23 Laurence Shoup and Suzanne Baker. Cultural Resource Overview: Lake Merced Transport, San Francisco Clean Water Management Program, San Francisco, California. On file (S-3247), NWIC, 1981.

the ocean. However, the geotechnical core result (that is the discovery of a deeply buried concrete obstruction under the highway) indicates the probability that historic feature(s) present beneath the Great Highway. It is unlikely that buried foundation remnants of the military installations would represent significant archeological resources by themselves; however, if buried hollow-filled features such as wells, privy pits, or trash deposits associated with the Southside Coast Guard Station or Battery Walter Howe are preserved beneath the Great Highway, they may represent significant archeological resources. Historical documents indicate that Battery Walter Howe was provided with a sewer or septic system when it was constructed in 1918.[24] On this basis, it is unlikely that privy pits, a common source of significant archeological data, are present. However, the potential for wells, disposal pits or other features that may contain associated artifacts remains. There is high potential for project excavations to encounter historic isolates and structural remains in the southern end of the South Ocean Beach portion of the C-APE which are unlikely to be significant; and some potential to encounter intact historic features or deposits.

Based on a review of the California State Lands Commission Shipwreck Database and the National Oceanic and Atmospheric Administration's Automated Wreck and Obstruction Information System, there are no known shipwrecks or other underwater obstructions in the North Ocean Beach, South Ocean Beach, or the marine study area portions of the C-APE. Furthermore, as part of its ongoing efforts to manage erosion at South Ocean Beach, the city has undertaken several beach nourishment projects over the past decade involving excavation of sand from North Ocean Beach in the same general area as the North Ocean Beach C-APE and placing it along the South Ocean Beach shoreline. No maritime features or other archaeological resources have been encountered during these past projects. On this basis, there is a low potential to encounter historical archeological resources in the North Ocean Beach portion of the C-APE.

Impact Discussion

Construction

Project construction that has the potential to impact buried Native American archeological resources in the South Ocean Beach C-APE includes the buried wall, bluff recontouring, and beach access stairway. Excavations for the new restroom would include ground disturbance to a depth of approximately 10 feet bgs would be entirely within fill, and the proposed site appears to be within the former Lake Merced outlet creek channel, based on stratigraphic data from geotechnical investigations. On this basis, there is a low potential for excavations in this area to encounter buried Native American archeological resources. Elsewhere in the South Ocean Beach area, there remains the potential, albeit low, for project construction activities to encounter buried Native American archeological resources in intact dune sands and/or the Colma or Merced formations, as well as redeposited Native American material in the fill. There is also the potential for project excavations to encounter historic buried features associated with the former U.S. Coast Guard and military installations in the South Ocean Beach C-APE, near the Oceanside Treatment Plant; and shipwreck remnants, near the Sloat Boulevard/Great Highway intersection. While documentation of the exact location of the bore pit that previously exposed the ship remains is not available, the north end of the Lake Merced Tunnel is under the Great Highway adjacent to the Westside Pump Station, which suggests that project excavations, which would occur primarily west of the highway in this area, are not likely to re-encounter the previously discovered ship remains. However, this cannot be determined definitively.

The archeological analysis indicates that there remains the potential for both Native American and historical resources to be present in the C-APE. Based on current project plans, this is limited to the

[24] Report of Completed Works – Seacoast Fortifications, Battery Walter Howe. *http://www.militarymuseum.org/BtyHoweRCW.pdf*.

disturbed fill and dune sand in the area of bluff reshaping along the southern part of the South Ocean Beach portion of the C-APE. In order to ensure that significant impacts to archeological resources would not occur the SFPUC would implement standard construction measures for the project, including Standard Archeological Measures I (Archeological Discovery) and II (Archeological Monitoring). Under Standard Archeological Measure II, a qualified archeologist (as defined in Standard Archeological Measure I.C) would consult with the SFPUC and the ERO to develop an archeological monitoring program to guide archeological monitoring during project-related ground disturbance. The monitoring plan would identify the specific locations and construction activities within the C-APE where monitoring is required (e.g., near the suspected location of Battery Walter Howe and the proposed bluff reshaping in the southern part of the South Ocean Beach portion of the C-APE), as well as the type and frequency of monitoring to be conducted. Under the monitoring program, an archeological monitor would observe excavations. If suspected archeological resources were uncovered during project implementation, ground-disturbing work at the discovery location would be required to halt, pending documentation of the find and evaluation of whether the resource encountered constitutes a historical resource under CEQA. Standard Archeological Measure I also would be implemented, to address the potential for archeological discoveries in the absence of an archeologist. This measure provides that work must halt if a suspected archeological resource is discovered during project implementation, and specifies procedures be followed to protect the resource, ensure that it is assessed by an archeologist and provide appropriate treatment of significant archeological resources. Implementation of SFPUC Standard Archeological Measures I and II would minimize the potential for significant impacts on archeological resources during construction. With implementation of these required measures, impacts to archeological resources would be less than significant.

Operations

Project operations involving ground disturbance which could potentially affect archeological resources, if present, include excavation of sand from North Ocean Beach (for small-batch sand placements), deployment of the slurry pipeline on the sea floor (for large sand placements), and the movement of placed sand along South Ocean Beach (for both small and large sand placements). The surficial sand within the North Ocean Beach portion of the C-APE that would be subject to these activities has no potential for preservation of archeological resources, since it is subject to continuous movement by water and wind. Project excavations would not extend below the depth of natural sand deposition, which averages approximately 13 feet per year. Therefore, sand excavation activities at North Ocean Beach have no potential to result in adverse impacts on archeological resources. The pipe placement and operation offshore associated with the large sand placements would involve no more than surficial, localized disturbance on the sea floor and dropping of anchor by the dredging vessel. As noted previously, there are no known shipwrecks or other underwater obstructions in the marine study area portion of the C-APE. In addition, the contractor would use sonar when placing the pipeline to avoid any resources or obstructions. For these reasons, the offshore work associated with large sand placements would not affect underwater archeological resources.

Movement of sand on the beach during the small and large sand placements on South Ocean Beach would be expected to disturb the upper 6 feet of the beach surface. As these activities would be confined to the beach surface below the higher high tide line, and would occur as part of project operations after completion of substantial construction-related ground disturbance, the potential for sand placement to encounter significant archeological resources is low. Nevertheless, as is standard practice for its projects involving ground disturbance, the SFPUC's Standard Archeological Measure I would apply to the small sand placement activities. As noted for construction, under this measure operational work would halt if a suspected archeological resource were discovered, the resource would be protected, and an archeologist would assess the resource and determine appropriate archeological treatment of any significant resource. Similarly, per the Corps' specifications for its projects,[25] if large sand placement activities were to result in the discovery of previously unidentified or unanticipated historical, archeological or cultural resources, all activities that could impact or destroy the discovery would cease, and the area would be secured to avoid trespass, removal, or other potential disturbance to the potential resource pending assessment. The Corps would be notified, and a qualified archeologist would make a determination as to the significance and appropriate treatment of the find.

For the reasons presented, and with implementation of the SFPUC and Corps standard construction measures and specifications, project operations would have a less-than-significant effect on archeological resources.

Impact CR-3: The project would not cause a substantial adverse change in the significance of human remains pursuant to section 15064.5. (*Less than Significant*)

There are no known human remains, including those interred outside of dedicated cemeteries, located in the immediate vicinity of the project. While unlikely, ground disturbance associated with project activities could uncover previously undiscovered human remains, either in the context of an archeological site or in isolation. In the event that construction or operations activities were to disturb unknown human remains within the C-APE, any inadvertent damage to the remains would be considered a significant impact. The project is subject to the provisions of the California Health and Safety Code, section 7050.5, with respect to the discovery of human remains. The Public Resources Code, section 5097.98, regulates the treatment and disposition of human remains encountered during construction. Furthermore, SFPUC Standard Archeological Measure I (Archeological Discovery) outlines halt work and agency notification protocols in the event human remains or funerary objects are encountered during construction, and requires development of a treatment plan. For Native American burials, a plan for treatment and disposition is to be developed in consultation with the tribal most likely descendant. Compliance with state regulatory requirements and implementation of SFPUC Archeological Measure I would ensure that any human remains uncovered during construction would be promptly identified and appropriately protected and treated, and therefore would minimize the potential for significant impacts to human remains or other funerary objects. Through compliance with statutory requirements and with incorporation of SFPUC standard construction measure Archeological Measure 1, the project would have a less-than-significant impact on previously unknown human remains.

Impact C-CR-1: The project, in combination with the cumulative projects, would not result in significant cumulative impacts on historical resources, archeological resources, or human remains. (*Less than Significant*)

The geographic scope for cumulative effects on historical resources, archeological resources, and human remains consists of the C-APE.

[25] U.S. Army Corps of Engineers, West Coast Hopper Maintenance Dredging 2021 Project Manual, Section 01 57 20.00 82, Subpart 3.11.8 Cultural and Archeological Resources. February 19, 2021.

Federal and state laws protect cultural resources in most cases, either through project redesign to ensure the preservation of the resource, or by requiring archaeological recovery of a samples of the significant data represent by the archeological resource.

As discussed under Impact CR-1, the project would have no impact on historic architectural resources identified in and adjacent to the C-APE. Therefore, the project would not contribute to cumulative impacts to historic architectural resources.

As discussed under Impact CR-2 and Impact CR-3, there are no known archeological resources in the C-APE. While there is the potential for the project to encounter archeological resources, which could include the remains of a ship or other historic features, or Native American archeological features or deposits, the project would not be expected to result in significant impacts even if archeological resources are found. There are cumulative projects (SFPUC Westside Pump Station Reliability Improvements Project and SFPUC Westside Force Main Reliability Project) that could impact the same archeological resources as the proposed project, if any such resource is identified. However, any SFPUC or Corps-permitted project would involve implementation of the same standard archeological measures described above, which would reduce potential for impacts to these resources and any other as yet undiscovered resources to a less-than-significant level. Therefore, the proposed project, in combination with the cumulative projects, would result in a ***less-than-significant*** cumulative impact on archeological resources and human remains.

E.5 TRIBAL CULTURAL RESOURCES

Topic	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact	Not Applicable
5. TRIBAL CULTURAL RESOURCES. Would the project:					
a) Cause a substantial adverse change in the significance of a tribal cultural resource, defined in Public Resources Code section 21074 as either a site, feature, place, or cultural landscape that is geographically defined in terms of the size and scope of the landscape, sacred place, or object with cultural value to a California Native American tribe, and that is:					
i) Listed or eligible for listing in the California Register of Historical Resources, or in a local register of historical resources as defined in Public Resources Code section 5020.1(k), or	☐	☐	☒	☐	☐
ii) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of Public Resources Code section 5024.1. In applying the criteria set forth in subdivision (c) of Public Resources Code section 5024.1, the lead agency shall consider the significance of the resource to a California Native American tribe.	☐	☐	☒	☐	☐

Impact TC-1: The project would not result in a substantial adverse change in the significance of a tribal cultural resource as defined in Public Resources Code section 21074. (*Less than Significant*)

CEQA section 21084.2 requires the lead agency to consider the effects of a project on tribal cultural resources. As defined in section 21074, tribal cultural resources are sites, features, places, cultural landscapes, sacred places, and objects with cultural value to a California Native American tribe that are listed, or determined to be eligible for listing, on the national, state, or local register of historical resources. In San Francisco, all Native American archeological resources are presumed to be potential tribal cultural resources. A tribal cultural resource is adversely affected when a project causes a substantial adverse change in the resource's significance.

Pursuant to CEQA section 21080.3.1(d), within 14 days of a determination that an application for a project is complete or a decision by a public agency to undertake a project, the lead agency is required to contact the Native American tribes that are culturally or traditionally affiliated with the geographic area in which the project is located. Notified tribes have 30 days to request consultation with the lead agency to discuss potential impacts on tribal cultural resources and measures for addressing those impacts. On October 30, 2019, the San Francisco Planning Department contacted Native American individuals and organizations for the San Francisco area, providing a description of the project and requesting comments on the identification, presence, and significance of tribal cultural resources in the project vicinity.

During the 30-day comment period, no Native American tribal representatives contacted the planning department to request consultation. No tribal representatives identified potential tribal cultural resources, and no known tribal cultural resources exist in the C-APE.

The isolated projectile point found as part of CA-SFR-101/H and the isolated obsidian flake found in the vicinity of CA-SFR-181 (discussed in Section E.4, Cultural Resources (Impact CR-2), above) suggests that an undiscovered Native American archeological deposit likely is (or was) present in the general vicinity of the C-APE. Nevertheless, as also discussed for Section E.4, Cultural Resources (Impact CR-2), there is the potential for project construction to result in the inadvertent discovery of Native American archeological resources remains. Any such archeological resource that may be encountered could be identified as a tribal cultural resource at the time of discovery or at a later date. Therefore, the project has the potential to affect tribal cultural resources to the same extent that it would affect unidentified archeological resources. As discussed above, SFPUC Standard Archeological Measures I (Archeological Discovery) and II (Archeological Monitoring), which set forth procedures for identification, protection, and treatment of archeological resources (which may also be tribal cultural resources), would ensure that any potential tribal cultural resources encountered during construction excavation is promptly recognized, appropriately treated in consultation with associated Native American tribal representatives, and, if applicable, subject to an interpretive program developed in consultation with the associated Native American tribal representatives. Due to the inclusion of these standard construction measures in the project, impacts on tribal cultural resources would be ***less than significant***.

Impact C-TC-1: The project, in combination with the cumulative projects, would not result in significant cumulative impacts on tribal cultural resources. (*Less than Significant*)

The geographic scope for cumulative effects on tribal cultural resources consists of the C-APE. State laws protect tribal cultural resources in most cases, either through project redesign to ensure that the resource is preserved in place, or through mitigation efforts designed during consultation with the culturally-affiliated Native American tribe(s).

As discussed under Impact TC-1, there are no known tribal cultural resources in the C-APE, although there is the potential for the presence of undiscovered Native American archeological resources that may also be determined to be tribal cultural resources. There are cumulative projects (SFPUC Westside Pump Station Reliability Improvements Project and SFPUC Westside Force Main Reliability Project) that could impact the same tribal cultural resources as the proposed project, if identified. As discussed above, the project would include implementation of standard construction measures that would ensure that significant archeological impacts to archeological resources would not occur. These same measures, implemented in consultation with a tribal group, would ensure that the project would not result in significant impacts to tribal cultural resources. Any future SFPUC project in the same area would include the same standard construction measures to ensure that significant impacts would not occur. Therefore, the proposed project, in combination with the cumulative projects, would result in a ***less-than-significant*** cumulative impact on tribal cultural resources.

E.6 TRANSPORTATION AND CIRCULATION

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
6. TRANSPORTATION AND CIRCULATION—Would the project:					
a) Conflict with a program, plan, ordinance, or policy addressing the circulation system, including transit, roadway, bicycle, and pedestrian facilities?	☒	☐	☐	☐	☐
b) Conflict or be inconsistent with CEQA Guidelines section 15064.3, subdivision (b)?	☒	☐	☐	☐	☐
c) Substantially increase hazards due to a geometric design feature (e.g., sharp curves or dangerous intersections) or incompatible uses?	☒	☐	☐	☐	☐
d) Result in inadequate emergency access?	☒	☐	☐	☐	☐

The project has the potential to result in significant impacts on transportation and circulation. All transportation and circulation topics (i.e., E.6(a) through E.6(d)) are addressed in EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, Section 4.3, Transportation and Circulation.

E.7 NOISE

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
7. NOISE. Would the project result in:					
a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☒	☐	☐	☐	☐
b) Generation of excessive groundborne vibration or groundborne noise levels?	☒	☐	☐	☐	☐
c) For a project located within the vicinity of a private airstrip or an airport land use plan area, or, where such a plan has not been adopted, in an area within two miles of a public airport or public use airport, would the project expose people residing or working in the area to excessive noise levels?	☒	☐	☐	☐	☐

The project has the potential to result in significant impacts related to noise. All noise topics (i.e., E.7(a) through E.7(c)) are addressed in EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, Section 4.4, Noise and Vibration.

E.8 AIR QUALITY

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
8. AIR QUALITY. Would the project:					
a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☒	☐	☐
b) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal, state, or regional ambient air quality standard?	☐	☒	☐	☐	☐
c) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☒	☐	☐
d) Result in other emissions (such as those leading to odors) adversely affecting a substantial number of people?	☐	☐	☒	☐	☐

SETTING

OVERVIEW

The project would be located within the city and county of San Francisco. The Bay Area Air Quality Management District (BAAQMD) is the regional agency with jurisdiction over the nine-county San Francisco Bay Area Air Basin (air basin), which includes San Francisco, Alameda, Contra Costa, Marin, San Mateo, Santa Clara, and Napa counties and portions of Sonoma and Solano counties. The air district is responsible for attaining and maintaining air quality in the air basin within federal and state air quality standards, as established by the Federal Clean Air Act and the California Clean Air Act, respectively. Specifically, the air district has the responsibility to monitor ambient air pollutant levels throughout the air basin and to develop and implement strategies, rules and regulations to attain the applicable federal and state standards.

The most recent air quality plan, the 2017 Clean Air Plan, was adopted by the air district on April 19, 2017.[26] The 2017 Clean Air Plan updates the 2010 Clean Air Plan, in accordance with the requirement of the California Clean Air Act to implement all feasible measures to reduce ozone; provide a control strategy to reduce ozone, particulate matter, air toxics, and greenhouse gas emissions in a single, integrated plan; and establish emission control measures to be adopted or implemented. The 2017 Clean Air Plan contains the following primary goals:

> ***Protect air quality and health at the regional and local scale***: Attain all state and national air quality standards, and eliminate disparities among Bay Area communities in cancer health risk from toxic air contaminants (TACs); and

[26] Bay Area Air Quality Management District, 2017 Clean Air Plan, April 19, 2017.

Protect the climate: Reduce Bay Area greenhouse gas emissions to 40 percent below 1990 levels by 2030 and 80 percent below 1990 levels by 2050.

The 2017 Clean Air Plan represents the most current applicable air quality plan for the air basin. The plan contains 85 measures to address the reduction of several pollutants: ozone precursors, particulate matter, air toxics, and/or greenhouse gases. Other measures focus on potent greenhouse gases such as methane and black carbon, or harmful fine particles that affect public health. Consistency with the plan objectives are the basis for determining whether the project would conflict with or obstruct implementation of air quality plans.

CRITERIA POLLUTANTS

In accordance with the state and federal clean air acts, air pollutant standards are identified for the following six criteria air pollutants: ozone, carbon monoxide (CO), particulate matter (PM), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead. These air pollutants are termed criteria air pollutants because they are regulated by developing specific public health- and welfare-based criteria as the basis for setting permissible levels. The state and federal air quality standards were developed to protect public health and welfare. Exposure to these criteria air pollutants, even for a short-term period, may increase the risk of health effects.

In general, the air basin experiences low concentrations of most pollutants when compared to federal or state standards. The air basin is designated as either in *attainment*[27] or unclassified for most criteria pollutants with the exception of ozone, $PM_{2.5}$, and PM_{10}, which are designated as non-attainment for either the state or federal standards. By its very nature, regional air pollution is largely a cumulative impact in that no single project is sufficient in size to, by itself, result in non-attainment of air quality standards. Instead, a project's individual emissions contribute to existing cumulative air quality impacts. If a project's contribution to cumulative air quality impacts is "considerable," then the project's impact on air quality would be considered significant.[28]

Projects may contribute to regional criteria air pollutants during the construction and operational phases of a project. **Table 2: Criteria Air Pollutant Significance Thresholds** identifies air quality significance thresholds followed by a discussion of each threshold.[29] Projects that would result in criteria air pollutant emissions below these significance thresholds would not violate an air quality standard, contribute substantially to an air quality violation, or result in a cumulatively considerable net increase in criteria air pollutants within the air basin.

Ozone Precursors. As discussed previously, the air basin is currently designated as non-attainment for ozone. Ozone is a secondary air pollutant produced in the atmosphere through a complex series of photochemical reactions involving reactive organic gases (ROG) and oxides of nitrogen (NO_x). The potential for a project to result in a cumulatively considerable net increase in non-attainment criteria air pollutants are based on the state and federal Clean Air Act's emissions limits for stationary sources. The federal New Source Review program was created by the federal clean air act to ensure that stationary sources of air pollution are constructed in a manner that is consistent with attainment of federal health based ambient air quality standards. Similarly, to ensure that new stationary sources do not cause or contribute to a violation of an air quality standard, air district Regulation 2, Rule 2 requires that any new source that emits criteria air pollutants

27 "Attainment" status refers to those regions that are meeting federal and/or state standards for a specified criteria pollutant. "Non-attainment" refers to regions that do not meet federal and/or state standards for a specified criteria pollutant. "Unclassified" refers to regions where there is not enough data to determine the region's attainment status.

28 Bay Area Air Quality Management District, California Environmental Quality Act Air Quality Guidelines, May 2017, p. 2-1.

29 Ibid.

above a specified emissions limit must offset those emissions. For ozone precursors ROG and NO_x, the offset emissions level is an annual average of 10 tons per year (or 54 pounds [lbs.] per day).[30] These levels represent emissions below which new sources are not anticipated to contribute considerably to non-attainment criteria air pollutants.

Table 2 Criteria Air Pollutants Significance Thresholds

Pollutant	Construction Thresholds	Operational Thresholds	
	Average Daily Emissions (lbs/day)	Average Daily Emissions (lbs/day)	Maximum Annual Emissions (tons/year)
ROG	54	54	10
NO_x	54	54	10
PM_{10}	82 (exhaust)	82 (exhaust)	15
$PM_{2.5}$	54 (exhaust)	54 (exhaust)	10
Fugitive Dust	Construction Dust Ordinance or other Best Management Practices	Not Applicable	

SOURCE: Bay Area Air Quality Management District, *California Environmental Quality Act Air Quality Guidelines*, May 2017

Although this regulation applies to new or modified stationary sources, the project would result in ROG and NO_x emissions, primarily as a result of increases in vehicle miles traveled and construction activities. Therefore, the above thresholds can be applied to the construction and operational phases of the project, and if the project would result in emissions below these thresholds it would not be considered to contribute considerably to non-attainment criteria air pollutants. Due to the temporary nature of construction activities, only the average daily thresholds are applicable to construction phase emissions.

Particulate Matter (PM_{10} and $PM_{2.5}$).[31] The air district has not established an offset limit for $PM_{2.5}$. However, the emissions limit in the federal New Source Review for stationary sources in nonattainment areas is an appropriate significance threshold. For PM_{10} and $PM_{2.5}$, the emissions limit under New Source Review is 15 tons per year (82 lbs. per day) and 10 tons per year (54 lbs. per day), respectively. These emissions limits represent levels below which a source is not expected to have an impact on air quality.[32] Similar to ozone precursor thresholds identified above, the project would result in PM emissions as a result of increases in vehicle miles traveled and construction activities. Therefore, the above thresholds can be applied to the construction and operational phases of the project. Because construction activities are temporary in nature, only the average daily thresholds are applicable to construction-phase emissions.

Fugitive Dust. Fugitive dust is PM suspended in the air by wind action and human activities (e.g., demolition, excavation, grading, and other construction activities). Fugitive dust does not come out of a vent or a stack; instead, fugitive dust particles are mainly composed of soil minerals suspended in the air. Dust can be an irritant causing watering eyes or irritation to the lungs, nose, and throat. Depending on

30 *Bay Area Air Quality Management District,* California Environmental Quality Act Air Quality Guidelines, May 2017, Appendix D, Threshold of Significance Justifications California Environmental Quality Act Guidelines Update Threshold of Significance, page D-47, *https://www.baaqmd.gov/~/media/files/planning-and-research/ceqa/ceqa_guidelines_may2017-pdf.pdf?la=en.*

31 PM10 is often termed "coarse" PM and is made of particulates that are 10 microns in diameter or smaller. PM2.5, termed "fine" PM, is composed of particles that are 2.5 microns or less in diameter.

32 Bay Area Air Quality Management District, California Environmental Quality Act Air Quality Guidelines, May 2017, page 2-3.

exposure, adverse health effects can occur due to this PM in general and also due to specific contaminants such as lead or asbestos that may be constituents of soil. Studies have shown that the application of best management practices (BMPs) at construction sites significantly control fugitive dust.[33] Individual measures have been shown to reduce fugitive dust by anywhere from 30 to 90 percent.[34] The air district has identified a number of BMPs to control fugitive dust emissions from construction activities.[35] The city's Construction Dust Control Ordinance (Ordinance 176-08, effective July 30, 2008), San Francisco Health Code Article 22B, requires a number of measures to control fugitive dust. The BMPs required by the dust control ordinance are an effective strategy for controlling construction-related fugitive dust.

LOCAL HEALTH RISKS AND HAZARDS

In addition to criteria air pollutants, individual projects may emit TACs. TACs collectively refer to a diverse group of air pollutants that are capable of causing chronic (i.e., of long-duration) and acute (i.e., of severe but of short-term) adverse effects to human health, including carcinogenic effects. Human health effects of TACs include birth defects, neurological damage, cancer, and mortality. There are hundreds of different listed TACs with varying degrees of toxicity. Individual TACs vary greatly in the health risk they present; at a given level of exposure, one TAC may pose a hazard that is many times greater than another TAC.

Unlike criteria air pollutants, TACs do not have ambient air quality standards but are regulated by the air district using a risk-based approach to determine which sources and pollutants to control as well as degree of control. A health risk assessment (HRA) is an analysis in which human health exposure to toxic substances from a project is estimated and considered together with information regarding the toxic potency of the substances to provide quantitative estimates of health risks and existing conditions.[36]

Air pollution does not affect every individual in the population in the same way, and some groups are more sensitive to adverse health effects than others. Land uses such as residences, schools, children's day care centers, hospitals, and nursing and convalescent homes are considered to be the most sensitive to poor air quality because the population groups associated with these uses have increased susceptibility to respiratory distress or, as in the case of residential receptors, their exposure time is greater than for other land uses. Therefore, these groups are referred to as sensitive receptors. Exposure assessment guidance typically assumes that residences would be exposed to air pollution 24 hours per day, seven days per week, for 30 years.[37] Therefore, assessments of air pollutant exposure to residents typically result in the greatest adverse health outcomes of all population groups.

Exposures to fine particulate matter ($PM_{2.5}$) are strongly associated with mortality, respiratory diseases, and lung development in children, and other endpoints such as hospitalization for cardiopulmonary disease.[38] In

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33 Western Regional Air Partnership. WRAP Fugitive Dust Handbook. September 7, 2006. Available: *http://www.wrapair.org/forums/dejf/fdh/content/FDHandbook_Rev_06.pdf*. Accessed February 9, 2016.

34 Bay Area Air Quality Management District, California Environmental Quality Act Air Quality Guidelines, May 2017, Appendix D, Threshold of Significance Justifications California Environmental Quality Act Guidelines Update Threshold of Significance, page D-47.

35 Bay Area Air Quality Management District, CEQA Air Quality Guidelines, May 2017. Available: *http://www.baaqmd.gov/~/media/files/planning-and-research/ceqa/ceqa_guidelines_may2017-pdf.pdf?la=en*. Accessed December 20, 2017.

36 In general, a health risk assessment is required if the air district concludes that projected emissions of a specific air toxic compound from a proposed new or modified source suggest a potential public health risk; the applicant is then subject to a health risk assessment for the source in question. Such an assessment generally evaluates chronic, long-term effects, calculating the increased risk of cancer because of exposure to one or more TACs.

37 California Office of Environmental Health Hazard Assessment, Air Toxics Hot Spot Program Risk Assessment Guidelines, February 2015. Pg. 4-44, 8-6.

38 San Francisco Department of Public Health, Assessment and Mitigation of Air Pollutant Health Effects from Intra-Urban Roadways: Guidance for Land Use Planning and Environmental Review, May 2008.

addition to $PM_{2.5}$, diesel particulate matter is also of concern. The California Air Resources Board (air board) identified diesel particulate matter as a TAC in 1998, primarily based on evidence demonstrating cancer effects in humans.[39] The estimated cancer risk from exposure to diesel exhaust is much higher than the risk associated with any other TAC routinely measured in the region.

In an effort to identify areas of San Francisco most adversely affected by sources of TACs, San Francisco partnered with the air district to conduct a Citywide Health Risk Assessment (Citywide-HRA) based on an inventory and assessment of air pollution and exposures from mobile, stationary, and area sources within San Francisco. Areas determined to have poor air quality, termed the "Air Pollutant Exposure Zone" (APEZ), were identified based on health-protective criteria that consider estimated cancer risk, exposures to fine particulate matter, proximity to freeways, and locations with particularly vulnerable populations. These zones are established by the San Francisco Department of Public Health and regulated under San Francisco's Environment Code Chapter 25, Clean Construction Requirements for Public Works. The project site is not currently located within the APEZ. Each of the APEZ criteria is discussed below.

Excess Cancer Risk. The APEZ includes areas where the modeled cancer risk exceeds 100 per one million persons. This criterion is based on United States Environmental Protection Agency (USEPA) guidance for conducting air toxic analyses and making risk management decisions at the facility and community-scale level.[40] As described by the air district, the USEPA considers a cancer risk of 100 per million or less to be within the "acceptable" range of cancer risk. Furthermore, in the 1989 preamble to the benzene National Emissions Standards for Hazardous Air Pollutants rulemaking,[41] the USEPA states that it "…strives to provide maximum feasible protection against risks to health from hazardous air pollutants by (1) protecting the greatest number of persons possible to an individual lifetime risk level no higher than approximately one in one million and (2) limiting to no higher than approximately one in ten thousand [100 in one million] the estimated risk that a person living near a plant would have if he or she were exposed to the maximum pollutant concentrations for 70 years." According to BAAQMD, "One hundred in a million excess cancer cases is also consistent with the ambient cancer risk in the most pristine portions of the Bay Area based on the District's regional modeling analysis."[42]

Fine Particulate Matter. In April 2011, the USEPA published the Policy Assessment for the Particulate Matter Review of the National Ambient Air Quality Standards. In this document, USEPA staff concludes that the current federal annual $PM_{2.5}$ standard of 15 micrograms per cubic meter ($\mu g/m^3$) should be revised to a level within the range of 13 to 11 $\mu g/m^3$, with evidence strongly supporting a standard within the range of 12 to 11 $\mu g/m^3$.[43] The criterion for the APEZ for San Francisco is based on the health protective $PM_{2.5}$ standard of 11 $\mu g/m^3$, as supported by the USEPA's Particulate Matter Policy Assessment, although lowered

39 California Air Resources Board, Fact Sheet, "The Toxic Air Contaminant Identification Process: Toxic Air Contaminant Emissions from Diesel-fueled Engines," October 1998.

40 Bay Area Air Quality Management District, California Environmental Quality Act Air Quality Guidelines, May 2017, Appendix D, Threshold of Significance Justifications California Environmental Quality Act Guidelines Update Threshold of Significance, page D-35.

41 54 Federal Register 38044, September 14, 1989.

42 Bay Area Air Quality Management District, California Environmental Quality Act Air Quality Guidelines, May 2017, Appendix D, Threshold of Significance Justifications California Environmental Quality Act Guidelines Update Threshold of Significance, page D-43.

43 The U.S. EPA published a new policy assessment in January 2020. The policy assessment did not include recommendations to change the standards for particulate matter. See U.S. EPA, Policy Assessment for the Review of the National Ambient Air Quality Standards for Particulate Matter, January 2020, *https://www.epa.gov/sites/production/files/2020-01/documents/final_policy_assessment_for_the_review_of_the_pm_naaqs_01-2020.pdf*, and *https://www.epa.gov/pm-pollution/national-ambient-air-quality-standards-naaqs-pm*, accessed September 9, 2020.

to 10 µg/m^3 to account for uncertainty in accurately predicting air pollutant concentrations using emissions modeling programs.

Proximity to Freeways. According to the air board, studies have shown an association between the proximity of sensitive land uses to freeways and a variety of respiratory symptoms, asthma exacerbations, and decreases in lung function in children. Siting sensitive uses in proximity to freeways increases both exposure to air pollution and the potential for adverse health effects. Evidence shows that sensitive uses in an area within a 500-foot buffer of any freeway are at an increased health risk from air pollution,[44] consequently parcels that are within 500 feet of freeways are included in the APEZ.

Health Vulnerable Locations. Based on the air district's evaluation of health vulnerability in the Bay Area, those zip codes in the worst quintile of Bay Area Health vulnerability scores as a result of air pollution-related causes are afforded additional protection by making the criteria for identifying parcels in the APEZ more stringent to: (1) an excess cancer risk greater than 90 per one million persons exposed, and/or (2) $PM_{2.5}$ concentrations in excess of 9 µg/m^3.[45]

The above Citywide-HRA was used as the basis in approving a series of amendments to the San Francisco Environment and Administrative Codes, referred to as the Clean Construction Ordinance, or Environment Code chapter 25 (ordinance 28-15, effective April 19, 2015). The code has requirements for construction equipment that went into effect starting in 2009. The purpose of the amendments was to further protect the public health, safety, and welfare by requiring contractors on San Francisco public projects to implement more stringent requirements to reduce diesel and other fine particulate emissions generated by construction activities on projects in the APEZ. The project site is not located in the APEZ; however this analysis considers whether the project could substantially affect the geography or severity of the APEZ by conducting a health risk assessment to analyze existing plus project health risks.

CUMULATIVE AIR QUALITY

No single project by itself would be of such size as to result in regional non-attainment of ambient air quality standards. The project-level thresholds for criteria air pollutants are based on levels at which new sources are not anticipated to result in a cumulatively considerable net increase in non-attainment criteria air pollutants. Therefore, a separate cumulative criteria air pollutant analysis is not necessary and not presented in the impact analysis below.

Cumulative health risks are the sum of the increase in health risks experienced at sensitive receptors impacted from project exposure in addition to existing health risks and health risks from reasonably foreseeable cumulative projects. The existing health risk information relies on the Citywide-HRA for existing data for the year 2020, including lifetime excess cancer risk and annual average $PM_{2.5}$ concentrations. Because the Citywide-HRA was completed in 2020, it represents the most up-to-date existing health risk information available. Air pollutant emissions disperse with increasing distance from a source. Therefore, health risk impacts are typically localized and cumulative projects that are within 1,000 feet of the maximally exposed receptor are considered to contribute to cumulative health risks. The cumulative health risk analysis considers the health risk from the following projects: Fort Funston Trail Connection, Westside

[44] California Air Resources Board, Air Quality and Land Use Handbook: A Community Health Perspective, April 2005, *http://www.arb.ca.gov/ch/landuse.htm*.

[45] San Francisco Department of Public Health and San Francisco Planning Department, San Francisco Citywide Health Risk Assessment: Technical Support Documentation, September 2020.

Pump Station Reliability Improvements, Vista Grande Drainage Basin Improvement Project, Reconfiguration of the Sloat Boulevard and State Route 35 (Skyline Boulevard) Intersection, Oceanside Treatment Plant Improvements - Biosolids Cake Hopper Reliability Upgrade, Oceanside Treatment Plant Improvements - Seismic Retrofits, Signalization of State Route 35, San Francisco Zoo Recycled Water Pipeline Project, Lake Merced West Project - 520 John Muir Drive, Westside Force Main Reliability Project, and 2700 Sloat Boulevard. A second cumulative health risk analysis was completed to evaluate the health risk from a cumulative scenario that includes the Potential Upper Great Highway Closure from Sloat Boulevard to Lincoln Way.

AIR QUALITY IMPACTS

This air quality impact analysis is based, in part, on the Air Quality Technical Memorandum prepared for the project, which provides detailed estimates of project-related emissions and associated health risks and is included in **Appendix G**.[46] The project-related air quality impacts are analyzed in the impact discussions identified below, which address short-term impacts from construction and long-term impacts from project operation, as follows:

- Impact AQ-1: Consistency with the Clean Air Plan
- Impact AQ-2: Construction-related criteria pollutant emissions
- Impact AQ-3: Operations-related criteria pollutant emissions
- Impact AQ-4: Health risks from construction-related and operational TAC emissions;
- Impact AQ-5: Construction and operational odor
- Impact C-AQ-1: Cumulative health effects

Impact AQ-1: The project would not conflict with or obstruct implementation of the applicable air quality plan. (*Less than Significant*)

The most recently adopted air quality plan for the air basin is the 2017 Clean Air Plan. The 2017 Clean Air Plan is a road map that demonstrates how the air basin will achieve compliance with the state ozone standards, as well as other pollutants, as expeditiously as practicable and how the region will reduce the transport of ozone and ozone precursors to neighboring air basins. In determining consistency with the 2017 Clean Air Plan, this analysis considers whether the project would: (1) support the primary goals of the 2017 Clean Air Plan, (2) include applicable control measures from the 2017 Clean Air Plan, and (3) avoid disrupting or hindering implementation of control measures identified in the 2017 Clean Air Plan.

As previously discussed, the primary goals of the 2017 Clean Air Plan are to (1) protect air quality and health at the regional and local scale; (2) eliminate cancer health risk disparities among Bay Area communities due to TACs; and (3) protect the climate by reducing greenhouse gas emissions. To meet the primary goals, the 2017 Clean Air Plan recommends 85 specific control measures and actions. These control measures are grouped into various categories that include stationary and area source measures, mobile source measures, transportation control measures, land use measures, and energy and climate measures. The project's

[46] Environmental Science Associates, Memo to Julie Moore, San Francisco Environmental Planning Division, from Matt Fagundes, Sarah Patterson, and Elijah Davidian, Environmental Science Associates, Subject: Ocean Beach Climate Change Adaptation Project - Air Quality Technical *Memorandum* and Health Risk Assessment, November 3, 2021 (see Appendix G).

impacts with respect to greenhouse gas emissions are discussed in Section E.9, Greenhouse Gas Emissions, which demonstrates that the project would comply with the applicable provisions of the city's Greenhouse Gas Reduction Strategy.

The 2017 Clean Air Plan measures that are most applicable to the proposed project are the transportation measures. The 2017 Clean Air Plan transportation control measures describe a comprehensive strategy to reduce emissions from medium- and heavy-duty trucks by providing incentives for the use of new trucks with advanced emissions controls, including hybrid and zero-emission trucks. As discussed below, the project would not conflict with these transportation control measures.

Operation of project-related vehicles and equipment would emit diesel particulate matter and criteria air pollutants. Construction and operational activities would also temporarily generate fugitive dust in the form of PM_{10} and $PM_{2.5}$. Construction crew members would commute to and from the project site, heavy equipment and trucks would be used during construction and operation of the project, and harbor craft would be used during operation of the project. As further discussed under Impact AQ-2, construction-related criteria air pollutant emissions would be temporary and would cease after completion of construction activities. Further, the project would comply with the requirements of the Dust Control Ordinance. As described in Impact AQ-3, criteria air pollutant emissions during project operations would be less than significant.

The 2017 Clean Air Plan includes several transportation control measures related to these activities, including:

- Provide incentives to promote ridesharing (TR8)
- Incentives to purchase new trucks with lower NOx emissions than the standards require, hybrid trucks, or zero-emission trucks (TR19)
- Assisting commercial harbor craft fleets to achieve early compliance with harbor craft air toxic control measure and supporting research efforts to develop and deploy more efficient engines and cleaner, renewable fuels for harbor craft (TR21)
- Deploy construction equipment with Tier 3 or 4 off-road engines (TR22)

The transportation control measures are voluntary incentive measures and do not require vehicle upgrades or retrofits. The proposed use of vehicles and equipment would not conflict with these programs. Therefore, the project would not conflict with or obstruct implementation of the control measures identified to achieve the goals of the 2017 Clean Air Plan.

The proposed permanent closure of Great Highway south of Sloat Boulevard would result in the daily re-routing of approximately 14,600 trips along Sloat and Skyline boulevards that would increase the length of each trip by 0.46 mile compared to the length of existing trips along the affected segment of Great Highway. However, the Great Highway closure would allow pedestrian and cyclist access to and along South Ocean Beach via a new multi-use trail, accessible from the modified Sloat Boulevard/Great Highway and Skyline Boulevard/service road intersections, and the Skyline coastal parking lot. Part of the purpose for the proposed Great Highway closure is to preserve and enhance public access, coastal recreation, and scenic resources at South Ocean Beach that provide recreational opportunities for pedestrians, bicyclists, and other users, which do not generate emissions. The consequence of this is a slight increase in vehicular miles traveled per trip. Therefore, when considering the increased opportunities for zero-emissions access within and through the project area, the proposed permanent closure of Great Highway would support the primary goals of the 2017 Clean Air Plan.

Examples of a project that could cause the disruption or delay of the 2017 Clean Air Plan control measures are those which might preclude the extension of a transit line or bike path, or that propose excessive parking. The project would result in none of these. Thus the proposed project would not conflict with, or hinder implementation of, control measures in the 2017 Clean Air Plan and this impact would be ***less than significant***.

Impact AQ-2: The project's construction activities would generate fugitive dust and criteria air pollutants, and would result in a cumulatively considerable net increase in non-attainment criteria air pollutants. (*Less than Significant with Mitigation*)

As indicated above, the air basin is designated as non-attainment for state or federal ozone, PM_{10}, and $PM_{2.5}$ standards. Construction activities (short-term) typically result in emissions of ozone precursors, NO_x and ROG; and particulate matter (i.e., both PM_{10} and $PM_{2.5}$) in the form of dust (fugitive dust) and exhaust (e.g., vehicle tailpipe emissions). Emissions of ozone precursors and particulate matter are primarily a result of the combustion of fuel from on-road vehicles (e.g., haul trucks) and off-road equipment (e.g., bulldozers, excavators, etc.). However, ROGs are also emitted from activities that involve architectural coatings (such as restroom painting and parking lot and intersection striping) and asphalt paving.

Project construction would span approximately 48 months. Approximately 100,600 cubic yards of demolition, pavement, and excavation debris would be removed from the project site. It is assumed that the exported debris would be hauled off-site to the Ox Mountain Sanitary Landfill in Half Moon Bay. In addition, about 51,800 cubic yards of material, including concrete, steel, asphalt, aggregate, and pavement would be imported to the site. Construction of the project would require operation of dozens of pieces of off-road diesel equipment (e.g., loaders, graders, excavators) on any given day and a total of approximately 66,000 haul truck trips. During the project's construction period, construction activities would have the potential to result in emissions of PM and ozone precursors, as discussed below.

Fugitive Dust

Project-related demolition, excavation, grading, and other construction activities may cause wind-blown dust that could contribute PM into the local atmosphere. Dust can be an irritant causing watering eyes or irritation to the lungs, nose, and throat. Demolition, excavation, grading, and other construction activities can cause wind-blown dust that adds PM to the local atmosphere. Depending on exposure, adverse health effects can occur due to this PM in general and also due to specific contaminants such as lead or asbestos that may be constituents of soil.

Despite federal standards for air pollutants and implementation of state and regional air quality control plans, air pollutants continue to affect human health throughout the country. California has found that PM exposure can cause health effects at lower levels than national standards. The current health burden of PM demands that, where possible, public agencies take feasible available actions to reduce sources of PM exposure. According to the air board, reducing ambient $PM_{2.5}$ concentrations to state and federal standards of 12 $\mu g/m^3$ in the San Francisco Bay Area would prevent between 200 and 1,300 premature deaths annually.[47]

Dust can be an irritant causing watering eyes or irritation to the lungs, nose, and throat. Demolition, excavation, grading, and other construction activities can cause wind-blown dust that adds particulate matter to the local atmosphere. Depending on exposure, adverse health effects can occur due to this

[47] California Air Resources Board, Methodology for Estimating Premature Deaths Associated with Long-term Exposure to Fine Airborne Particulate Matter in California, Staff Report, Table 4c, October 24, 2008.

particulate matter in general and also due to specific contaminants such as lead or asbestos that may be constituents of soil.

The San Francisco Public Utilities Commission (SFPUC) would be required to comply with the Construction Dust Control Ordinance. Because the project site is more than 0.5 acre in size and within 1,000 feet of sensitive receptors, a site-specific dust control plan describing the dust monitoring and control measures that apply to the project would be prepared and implemented per San Francisco Health Code, Article 22B.[48] The measures may include the following or equivalent measures to accomplish the goal of minimizing visible dust: wetting down areas of visibly dry disturbed soil; placement of upwind and downwind particulate dust monitors; particulate monitoring and record keeping; hiring an independent, third-party to conduct inspections and keep a record of those inspections; establishing shut-down conditions based on wind, soil migration, etc.; establishing a hotline for surrounding community members who may be potentially affected by project-related dust; installing dust curtains and windbreaks on the property lines, as necessary; limiting the amount of soil in hauling trucks to the size of the truck bed and securing with a tarpaulin; enforcing a 15-mph speed limit for vehicles entering and exiting construction areas; sweeping affected streets with water sweepers at the end of the day if visible soil material is carried onto adjacent paved roads; and utilizing wheel washers to clean truck tires. The SFPUC would be required to designate an individual to monitor compliance with these dust control requirements. San Francisco ordinance 175-91 restricts the use of potable water for dust control activities undertaken in conjunction with any construction.

The SFPUC requires its projects comply with applicable ordinance requirements through its standard construction measures (Appendix C). Measure 2, Air Quality, specifically requires all contractors working on projects within the city to minimize fugitive dust through compliance with the Construction Dust Control Ordinance. Implementation of the Standard Construction Measures and compliance with the ordinance would be included in the SFPUC's contract specifications for the project. Therefore, construction-related fugitive dust impacts associated with the project would be less than significant.

Criteria Air Pollutants

As discussed above, construction activities would result in emissions of criteria air pollutants from the use of off- and on-road vehicles and equipment. The project's off-road, construction-related emissions were estimated using project-specific data provided by the SFPUC (see Chapter 2, Project Description) and the California Emissions Estimator Model (CalEEMod, version 2016.3.2). The model was developed, including default data (e.g., emission factors, meteorology, etc.), in collaboration with air board staff. The project's on-road, construction-related worker, haul, vendor truck emissions were calculated using EMFAC2017 emission factors. Details on the methodology and assumptions used for estimating emissions as well as modeling results are provided in Appendix G.

In addition to the use of off- and on-road vehicles and equipment discussed above, the project would result in additional construction period criteria air pollutant emissions associated with closure of the Great Highway south of Sloat Boulevard. This segment of roadway would be closed around the end of the first construction year, and would remain closed for the remainder of the construction activities. Consequently, throughout construction years 2 through 4, approximately 14,600 trips would be re-routed along Sloat and Skyline boulevards. This re-routing would increase the length of each trip by 0.46 mile compared to the length of existing trips along the affected segment of Great Highway. The average daily increase in criteria pollutant and

48 San Francisco Health Code, Article 22B, section 1242, Site-Specific Dust Control Plan. *http://sf-ca.elaws.us/code/heco_art22b_sec1242*

precursor emissions associated with this increase in vehicular mileage were estimated using on-road vehicle emission factors from the EMFAC2017 model.

Table 3 presents the air pollutant emissions modeling results for the project construction scenario. Detailed emissions by source for each year of construction are provided in Appendix G. Estimated construction-related emissions include combustion-related emissions (ROG, NO_X, PM_{10}, and $PM_{2.5}$) associated with the use of off-road equipment; on-road worker commute trips, vendor trips, heavy haul truck operations, and re-routed Great Highway trips; and ROG emissions from painting. As shown in Table 3, the total project daily emissions of the criteria pollutants ROG, PM_{10}, and $PM_{2.5}$ would be below the listed criteria pollutant significance thresholds. However, average daily emissions of NOx would exceed the 54 pounds/day significance criterion in construction years 2024 through 2026, and therefore result in a significant impact.

Table 3 Average Daily Criteria Air Pollutant Emissions During Construction

Year	Average Daily Emissions (pounds/day)							
	Project				Mitigated Project			
	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust
Year 1 (2023)	18.56	29.68	1.12	1.07	N/A	N/A	N/A	N/A
Year 2 (2024)	6.15	**58.44**	2.55	2.07	4.75	43.18	1.96	1.54
Year 3 (2025)	27.19	**73.05**	2.98	2.48	25.41	53.10	2.21	1.79
Year 4 (2026)	27.26	**68.18**	2.94	2.44	24.21	45.27	2.07	1.65
Significance Threshold	54	54	82	54	54	54	82	54
Significant Impact?	No	**Yes**	No	No	No	No	No	No

SOURCES: Environmental Science Associates, Memo to Julie Moore, San Francisco Environmental Planning Division, from Matt Fagundes, Sarah Patterson, and Elijah Davidian, Environmental Science Associates, Subject: Ocean Beach Climate Change Adaptation Project - Air Quality Technical Memorandum and Health Risk Assessment, November 3, 2021 (see Appendix G); and Bay Area Air Quality Management District, California Environmental Quality Act, Air Quality Guidelines, May 2017, CalEEMod, version 2016.3.2.

ABBREVIATIONS:

ROG = reactive organic gases
NO_X = oxides of nitrogen
PM_{10} = particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter

N/A = Not applicable

NOTES:

[a] Average daily construction equipment and vehicle emissions were estimated using average equipment use hour and trip factors per day by phase. For example, total hours for each piece of equipment and total truck trips by phase were divided by the number of workdays for that phase to determine the modelled average daily equipment use hours and trips for each phase.
Bold values = threshold exceedance

[b] The project assumption is that off-road construction equipment engine tier status and associated emission factors are CalEEMod defaults, which are average emissions factors for the equipment inventory for the given calendar year of construction, assumed to be 2023 through 2026; however, the first year that the Great Highway would be closed would be 2024; therefore, those associated emissions were modelled for 2024 through 2026.

[c] The mitigated project requirement is that all off-road construction equipment over 125 hp meet Tier 4 Final engine emission standards. Construction ROG, NO_X, PM_{10}, and $PM_{2.5}$ emissions do not exceed thresholds in Year 1 and therefore, mitigation is not required and mitigated emissions are not presented for Year 1.

To address this impact for NO_x, **Mitigation Measure M-AQ-2: Construction Emissions Minimization** was identified. This measure requires off-road equipment greater than 125 horsepower and operating for more than 20 total hours over the entire duration of construction activities to have engines that meet or exceed USEPA or air board Tier 4 Final off-road emissions standards in construction years 2, 3 and 4 (2024 through 2026). With use of Tier 4 Final off-road engines, the project's combined construction-related NOx emissions would be reduced to below the significance criteria listed in Table 3. Other criteria air pollutant emissions not exceeding applicable thresholds would also decrease as a result of this measure.

Table 3 demonstrates that equipment and vehicle exhaust emissions associated with project construction could be reduced sufficiently with implementation of Mitigation Measure M-AQ-2 so as not to result in a cumulatively considerable net increase in non-attainment criteria air pollutants. As a result, the construction criteria air pollutant impact would be reduced to ***less than significant with mitigation***.

Mitigation Measure M-AQ-2: Construction Emissions Minimization

A. Engine Requirements.

All off-road equipment greater than 125 horsepower and operating for more than 20 total hours over the entire duration of construction activities shall have engines that meet the USEPA or California Air Resources Board Tier 4 Final off-road emission standards in construction years 2, 3 and 4 (2024 through 2026).

B. Waivers.

The Environmental Review Officer (ERO) may waive the equipment requirements of section A if: (1) engines that comply with Tier 4 Final off-road emission standards are not available, (2) use of a particular piece of off-road equipment is technically not feasible; (3) the equipment would not produce desired emissions reduction due to expected operating modes; or (4) there is a compelling emergency need to use other off-road equipment.

If the SFPUC seeks a waiver from the requirements of section A, it shall submit documentation to the ERO of the following: 1) evidence that a waiver from the section A requirements meets the criteria set forth in section B; 2) identification of the compliance alternative in **Table M-AQ-2-1** to be implemented (or other compliance alternative that yield sufficient emissions reductions); and 3) analysis demonstrating that with the compliance alternative the project would not exceed the significance threshold for NOx of an average of 54 pounds/day. The SFPUC shall maintain records concerning its efforts to comply with this requirement.

Table M-AQ-2-1 Off-Road Equipment Compliance Step-Down Schedule

Compliance Alternative	Engine Emission Standard
1	Tier 4 Interim
2	Tier 3
3	Tier 2

How to use the table: If the Tier 4 Final emissions standards cannot be met for a specific piece of off-road equipment, then the SFPUC would need to meet Compliance Alternative 1. Should the SFPUC not be able to supply off-road equipment meeting Compliance Alternative 1, then Compliance Alternative 2 would need to be met. Should the SFPUC not be able to supply off-road equipment meeting Compliance Alternative 2, then Compliance Alternative 3 would need to be met.

Significance After Mitigation: As shown in Table 3, above, implementation of Mitigation Measure M-AQ-2 would reduce construction criteria pollutant NO_x emissions to below the NO_x significance threshold, resulting in a less-than-significant impact.

Impact AQ-3: During project operations, the project would not result in a cumulatively considerable net increase in non-attainment criteria air pollutants. (*Less than Significant*)

Under the project's beach nourishment program, operations would consist of the SFPUC undertaking small sand placements (approximately 85,000 cubic yards) about once every four years, or the United States Army Corps of Engineers (the Corps) undertaking large sand placements (up to 575,000 cubic yards) about once every 10 years. Emissions sources associated with the small sand placements would include off-road equipment, haul trucks, and commuting worker vehicles. Emission sources associated with the large sand placements would include off-road equipment, commuting worker vehicles, and diesel operated dredge pumps and tugboat operations (instead of haul trucks). Operational emissions were estimated for the expected first year of beach nourishment activities of 2031.

Emissions from off-road equipment were estimated using project-specific equipment lists provided by the SFPUC and the Corps and the California Emissions Estimator Model (CalEEMod, version 2016.3.2). The on-road worker and haul truck emissions were calculated using EMFAC2017 emission factors and trip data obtained from SFPUC and the Corps. The emissions associated with the dredge equipment and tug boats are based on emission factors for a hopper dredge obtained from the 2013 Port of Long Beach emissions inventory[49] adjusted to reflect California Air Resources Board's Harborcraft Engine Replacement Rule.[50] Emissions for the tug boat were estimated using emission factors obtained from an analysis of Beneficial Use of Sand Dredged from the San Francisco Main Ship Channel for Storm-Damage Reduction at Ocean Beach Project.[51] The primary assumptions used to model operational dredge and tug boat emissions are based on a previous analysis conducted for the Army Corps of Engineers South Ocean Beach Nourishment Project.[52]

In addition to the beach nourishment activities discussed above, permanently closing the Great Highway south of Sloat Boulevard would result in the daily re-routing of approximately 14,600 trips along Sloat and Skyline boulevards. This re-routing would increase the length of each trip by 0.46 mile compared to the length of existing trips along the affected segment of Great Highway. The annual increase in criteria pollutant and precursor emissions associated with this increase in vehicular mileage were estimated using on-road vehicle emission factors from the EMFAC2017 model.

Table 4 presents annual emissions and **Table 5** presents average daily emissions for the year when maximum activity and associated emissions would occur. Both tables include emissions from increased annual vehicular mileage from re-routed traffic. Because large sand placement activities and small sand

49 Starcrest Consulting Group LLC. 2014. Port of Long Beach Air Emission Inventory - 2013, July 2014. Available at *https://thehelm.polb.com/download/14/emissions-inventory/6572/2013-air-emissions-inventory.pdf*.

50 State of California, 2008. 17 CCR § 93118.5 Airborne Toxic Control Measure for Commercial Harbor Craft. October 2008. Available at: *https://govt.westlaw.com/calregs/Document/I0FD137A0A3C111E0BACCB30E82542E24?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=%28sc.Default%29*

51 ICF, 2020. Memorandum: Offshore Equipment Details and Assumptions for Air Emissions Analysis of Beneficial Use of Sand Dredged from the San Francisco Main Ship Channel for Storm-Damage Reduction at Ocean Beach, San Francisco, California. March 2020.

52 Environmental Science Associates, 2020. Memo to Julie Moore, San Francisco Environmental Planning Division, from Sarah Patterson and Elijah Davidian, Environmental Science Associates, Subject: South Ocean Beach Nourishment Project Air Quality Technical Memorandum, December 2, 2020.

placement activities would not occur during the same year, emissions for both activities are presented separately.

The analysis assumes small sand placement events would occur about once every four years; large sand placement events would occur about once every 10 years. It is anticipated that the first sand placement event would occur five years after construction is completed in 2026, which would be 2031.

As summarized in Tables 4 and 5, the total project emissions of all criteria pollutants would be below significance thresholds. Therefore, operations would not result in a cumulatively considerable net increase in non-attainment criteria air pollutants. As a result, the operational air quality impact would be ***less than significant***.

Table 4 Maximum Annual Project Operational Criteria Air Pollutant Emissions

Beach Nourishment	Maximum Annual Emissions (tons/year)			
	ROG	NO_X	PM_{10}	$PM_{2.5}$
MAXIMUM ANNUAL EMISSIONS WITH LARGE SAND PLACEMENTS				
Large Sand Placement	1.17	9.52	0.46	0.45
Increased Great Highway Closure Vehicular Miles	0.08	0.10	0.40	0.09
Total	1.25	9.62	0.86	0.54
MAXIMUM ANNUAL EMISSIONS WITH SMALL SAND PLACEMENTS				
Small Sand Placement	0.03	0.26	0.01	0.01
Increased Great Highway Closure Vehicular Miles	0.08	0.10	0.40	0.09
Total	0.11	0.36	0.40	0.10
Significance Threshold	10	10	15	10
Significant Impact?	No	No	No	No

SOURCE: Environmental Science Associates, Memo to Julie Moore, San Francisco Environmental Planning Division, from Matt Fagundes, Sarah Patterson, and Elijah Davidian, Environmental Science Associates, Subject: Ocean Beach Climate Change Adaptation Project - Air Quality Technical Memorandum and Health Risk Assessment, November 3 2021 (see Appendix G).

ABBREVIATIONS:

ROG = reactive organic gases
NO_X = oxides of nitrogen
PM_{10} = particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter

NOTES: Total values may not add precisely due to rounding. Based upon the project's Sand Management Plan, small or large sand placement activities would first occur about 5 years after completion of project construction, so those activities were modelled for year 2031; however, the analysis assumes 2027 would be the first year of operations period re-routed vehicle emissions from Great Highway closure. Therefore, operation period re-routed vehicle emissions were modelled for year 2027; BAAQMD operational significance thresholds for particulates are for total PM, rather than exhaust only. Particulate emissions from increased Great Highway closure vehicular miles include fugitive dust (i.e., brake-wear, tire-wear, and road dust) in addition to the tailpipe exhaust emissions. Sand placement fugitive emissions would be controlled by BAAQMD's BMP, therefore only exhaust particulate emissions are quantified.

Table 5 Maximum Average Daily Project Operational Criteria Air Pollutant Emissions

Beach Nourishment	Maximum Average Daily Emissions (pounds/day)			
	ROG	NO_X	PM_{10}	$PM_{2.5}$
MAXIMUM AVERAGE DAILY EMISSIONS WITH LARGE SAND PLACEMENTS				
Large Sand Placement	6.41	52.18	2.52	2.45
Increased Great Highway Closure Vehicular Miles	0.42	0.54	2.19	0.51
Total	6.84	52.71	4.71	2.96
MAXIMUM AVERAGE DAILY EMISSIONS WITH SMALL SAND PLACEMENTS				
Small Sand Placement	0.17	1.44	0.03	0.03
Increased Great Highway Closure Vehicular Miles	0.42	0.54	2.19	0.51
Total	0.59	1.98	2.22	0.54
Significance Threshold	54	54	82	54
Significant Impact?	No	No	No	No

SOURCE: Environmental Science Associates, Memo to Julie Moore, San Francisco Environmental Planning Division, from Matt Fagundes, Sarah Patterson, and Elijah Davidian, Environmental Science Associates, Subject: Ocean Beach Climate Change Adaptation Project - Air Quality Technical Memorandum and Health Risk Assessment, November 3, 2021 (see Appendix G).

ABBREVIATIONS:

ROG = reactive organic gases
NO_X = oxides of nitrogen
PM_{10} = particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter

NOTES:

Total values may not add precisely due to rounding.
Total average daily pounds are estimated by dividing the total pounds by 365 days.
BAAQMD operational significance thresholds for particulates are for total PM, rather than exhaust only. Particulate emissions from increased Great Highway closure vehicular miles include fugitive dust (i.e. brake-wear, tire-wear, and road dust) in addition to the tailpipe exhaust emissions. Sand placement fugitive emissions would be controlled by BAAQMD's BMP, therefore only exhaust particulate emissions are quantified.

Impact AQ-4: Construction and operation of the project would generate toxic air contaminants, including diesel particulate matter, but would not expose sensitive receptors to substantial pollutant concentrations. (*Less than Significant*)

As explained in the *Setting,* the project does not fall within an APEZ. This analysis evaluates the existing plus project health risk at modeled sensitive receptor locations in order to determine if the project's emissions would expand the geographic extent of the APEZ to include new sensitive receptor locations (i.e., new sensitive receptor locations meeting the APEZ criteria discussed above). For projects that could result in sensitive receptor locations not presently within the APEZ but where air quality could be degraded to meeting the APEZ criteria that otherwise would not occur without the project, a project that would emit $PM_{2.5}$ concentration above 0.3 µg/m^3 or result in an increase in excess lifetime cancer risk greater than 10.0 per million would be considered to have a significant impact. The 0.3 µg/m^3 $PM_{2.5}$ concentration and the excess cancer risk of 10.0 per million persons exposed are the levels below which the city considers new sources not to make a considerable contribution to cumulative health risks.

The closest sensitive receptors to the project site are residences north of Sloat Boulevard and east of Ocean Beach, approximately 35 feet from the Sloat Boulevard/Great Highway intersection modifications project element. The nearest school is the Ulloa Elementary School located approximately 525 feet north of Sloat Boulevard. No day care centers were identified within the modeling domain (approximately 3,300 feet [1,000 meters] of the project boundary); however, the Pomeroy Recreation and Rehabilitation Center offers programs and resources to children and therefore was conservatively evaluated as a sensitive receptor in assuming children would be present on a regular basis.

The project would require construction activities over an approximately four-year period. Project construction would result in short-term emissions of diesel particulate matter. The Great Highway, south of Sloat Boulevard, would be permanently closed resulting in increased mobile TAC emissions along roadways where vehicular traffic would be redirected. An HRA was conducted to assess the potential impacts of diesel particulate matter and other TAC emissions resulting from project construction and redirected vehicular traffic (Appendix G). Project construction sources include emissions from off- and on-road construction equipment. Operational sources include on-road vehicles traveling along roadways that would have increased vehicular traffic due to the closure of the Great Highway. The HRA was conducted following methods in the air district's Health Risk Screening Analysis Guidelines[53],[54] and in the Office of Environmental Health Hazard Assessment's Air Toxics Hot Spots Program Guidance.[55] Because the emissions from the beach nourishment sand placement activities would involve short exposure durations (approximately 6 to 8 weeks) and infrequent (about once every four years or once every 10 years), these sources are not expected to adversely affect sensitive receptors near the project site and were therefore not included in the HRA.[56] Detailed information and assumptions used to calculate health risks to sensitive receptors are available in Appendix G.

The HRA evaluated two residential exposure scenarios as follows:

> **Scenario 1** represents a child resident, with exposure starting when construction commences and continuing exposure into operations for approximately four years of construction and 26 years of operations, a total of 30 years of exposure.
>
> **Scenario 2** represents a child resident with exposure starting after construction completes (i.e., operational exposure only) for 30 years of operations, a total of 30 years of exposure.

Additionally, the HRA evaluated health risks for children at schools for each scenario. However, health risks resulting from the project for school-child receptor types are lower than the health risks for residential receptors in part because the exposure frequency and duration is shorter for school receptors (8 hours per day, 180 days per year, over 9 years) than it is for residential receptors (24 hours per day, 350 days per year, over 30 years).

Table 6 presents the results of the HRA and identifies the increased lifetime excess cancer risk and localized annual average $PM_{2.5}$ concentrations from exposure to project emissions at the location where the project

53 Bay Area Air Quality Management District, Recommended Methods for Screening and Modeling Local Risks and Hazards, 2012, *http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CEQA/Risk%20Modeling%20Approach%20May%202012.ashx?la=en*, accessed October 2020.

54 Bay Area Air Quality Management District, Air Toxics NSR Program Health Risk Assessment (HRA) Guidelines, December 2016*, Available at http://www.baaqmd.gov/~/media/files/planning-and-research/permit-modeling/hra_guidelines_12_7_2016_clean-pdf.pdf?la=en*, accessed October 2020

55 Office of Environmental Health Hazard Assessment (OEHHA), Air Toxics Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments, February 2015, *http://oehha.ca.gov/air/hot_spots/hotspots2015.html*, accessed March 2017.

56 OEHHA does not recommend a HRA for exposures less than 2 months in duration. Office of Environmental Health Hazard Assessment, Air Toxics Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments, February 2015, *http://oehha.ca.gov/air/hot_spots/hotspots2015.html*, accessed October 2021.

would result in the maximum impact for residential and school child receptors (called the maximally exposed individual sensitive receptors; hereafter, "maximally exposed receptor"). In addition, Table 6 provides the existing modeled cancer risk and annual average $PM_{2.5}$ concentrations from the Citywide-HRA. As shown in Table 6, the existing plus project excess lifetime cancer risk at the maximally exposed receptor for Scenario 1 would be 46.6 per million, which is below the APEZ cancer risk criteria of 100 per one million persons exposed. Similarly, for Scenario 2, the existing plus project excess cancer risk would be 32.2 per million, which is also below the APEZ cancer risk criteria. With respect to annual average $PM_{2.5}$ concentrations, the existing plus project concentration for the Scenario 1 and 2 residential receptors would be 8.62 $\mu g/m^3$ and 8.51 $\mu g/m^3$, respectively, which are below the APEZ $PM_{2.5}$ concentrations of 10 $\mu g/m^3$. As shown in Table 6, the health risks resulting from the project at schools all are lower than the health risks for residential receptors discussed above. Therefore, under existing plus project conditions, the project's maximally exposed receptors would not exceed the APEZ criteria and thus the project would also not expand the geographic extent of the APEZ. Accordingly, the project's activities would not expose sensitive receptors to substantial pollutant concentrations, and the associated health risk impact would be ***less than significant***.

Table 6 Lifetime Excess Cancer Risk and $PM_{2.5}$ Concentration at the Maximally Exposed Individual Sensitive Receptors

Receptor Type/Source	Health Risk: Lifetime Excess Cancer Risk (in one million)	Health Risk: $PM_{2.5}$ Concentration ($\mu g/m^3$)
SCENARIO 1 - RESIDENT[a]		
Existing[b]	42.2	8.51
Project Contribution	4.4	0.11
Existing plus Project[c]	46.6	8.62
SCENARIO 1 - SCHOOL[a]		
Existing[b]	20.9	8.14
Project Contribution	0.4	0.06
Existing plus Project[c]	21.3	8.19
SCENARIO 2 - RESIDENT[d]		
Existing[b]	27.8	8.21
Project Contribution	4.4	0.297
Existing plus Project[c]	32.2	8.51
SCENARIO 2 - SCHOOL[d]		
Existing[b]	20.9	8.14
Project Contribution	0.2	0.06
Existing plus Project[c]	21.1	8.19

SOURCE: Environmental Science Associates, Memo to Julie Moore, San Francisco Environmental Planning Division, from Matt Fagundes, Sarah Patterson, and Elijah Davidian, Environmental Science Associates, Subject: Ocean Beach Climate Change Adaptation Project - Air Quality Technical Memorandum and Health Risk Assessment, November 3, 2021 (see Appendix G).

NOTES:

a Scenario 1 assumes exposure starting when construction starts and continuing exposure into operations.
b Existing values are from the Citywide-HRA.
c Existing plus project total values may appear to not add correctly due to rounding.
d Scenario 2 assumes exposure starting after construction completes (i.e., operational exposure only).

Impact AQ-5: The project would not result in other emissions (such as those leading to odors) adversely affecting a substantial number of people. (*Less than Significant*)

Typical odor sources of concern include wastewater treatment plants, sanitary landfills, transfer stations, composting facilities, petroleum refineries, asphalt batch plants, chemical manufacturing facilities, fiberglass manufacturing facilities, auto body shops, rendering plants, and coffee roasting facilities. During construction and during operational beach nourishment, diesel exhaust from construction equipment and vehicles, as well as volatile organic compounds emitted during paving, would generate some odors, which could increase the odors temporarily in the immediate vicinity of the equipment operation. The odors would dissipate rapidly with distance from the odor-generating activity. The generation of odors from use of diesel engines and paving activities would not be substantial or permanent. A substantial number of people would not be subjected to objectionable odors. Therefore, odor impacts would be ***less than significant***.

Impact C-AQ-1: The project, in combination with the cumulative projects, would result in less-than-significant cumulative air quality impacts. (*Less than Significant*)

As discussed above, the project site is not located in an area considered to experience poor air quality (i.e., it is not within the APEZ). The APEZ, as defined by the Citywide HRA, was updated in early 2020 but does not account for impacts of nearby cumulative projects which are presented in **Table 7**. Both the Westside Pump Station Reliability Improvements and Caltrans Signalization of Great Highway and State Route 35 (Skyline Boulevard) Intersection qualify as a categorically exempt under CEQA and were not required to complete an HRA. Of the nine remaining projects considered in the cumulative analysis, only one has undergone environmental review: the Vista Grande Drainage Basin Improvement Project. The Vista Grande Drainage Basin Improvement Project Final Environmental Impact Report/Environmental Impact Statement (SCH No. 2013032001)[57] found that impacts to health risk would only result from construction emissions, and the impact was analyzed qualitatively (i.e., excess cancer risk and $PM_{2.5}$ concentrations were not quantified). Table 7 presents a summary of the nearby projects and their proximity to the maximally exposed receptor for scenario 1 and scenario 2 discussed above under Impact AQ-4.

Projects that are within 1,000 feet of the maximally exposed receptor have the potential to cause construction-related or operational-related health risk impacts on the receptor. As shown in Table 7 (distances in bold font), three projects are within 1,000 feet of the Scenario 1 maximally exposed receptor: Westside Pump Station Reliability Improvements, Westside Force Main Reliability Project, and 2700 Sloat Boulevard. Similarly, two projects are within 1,000 feet of the Scenario 2 maximally exposed receptor: Reconfiguration of the Sloat Boulevard and State Route 35 (Skyline Boulevard) Intersection and the San Francisco Zoo Recycled Water Pipeline Project.[58] Below is a discussion of each of the projects within 1,000 feet of a maximally exposed receptor.

Westside Pump Station Reliability Improvements. The Westside Pump Station Reliability Improvements project would involve underground utilities and aboveground improvements. TAC emissions associated with the project are anticipated to be from temporary construction with negligible operational emissions (neither were quantified). The project would result in short-term construction emissions primarily from the

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57 City of Daly City National Park Service prepared by ESA, Vista Grande Drainage Basin Improvement Project Final EIR/EIS SCH No. 2013032001, August 2017, *https://www.dalycity.org/DocumentCenter/View/1917/Final-Environmental-Impact-Report-PDF*, accessed October 2021

58 Both the Scenario 1 and Scenario 2 Residential maximally exposed individual sensitive receptor are closer to all projects listed in the Table 7 than any school receptor evaluated under Impact AQ-4.

construction of the electrical building. No operational TAC emissions are anticipated as there would be no changes in operations and improvements to the Westside Pump Station would not require additional employees (which would generate traffic-related emissions) to manage the new facilities.

Table 7 Nearby Projects and Proximity to Maximally Exposed Individual Sensitive Receptors

Nearby Project Information		Distance to Maximally Exposed Individual Sensitive Receptors (feet)[a]	
Project Name (Project Sponsor or Jurisdiction)	Construction Dates	Scenario 1 - Resident[b]	Scenario 2 - Resident[c]
Fort Funston Trail Connection (NPS)	2027	>3,000	>3,000
Westside Pump Station Reliability Improvements (SFPUC)	2021-2023	**195**	2,900
Vista Grande Drainage Basin Improvement Project (City of Daly City)	2021-2026	>3,000	>3,000
Reconfiguration of the Sloat Boulevard and State Route 35 (Skyline Boulevard) Intersection (SFMTA)	2024	2,650	**80**
Oceanside Treatment Plant Improvements - Biosolids Cake Hopper Reliability Upgrade (SFPUC)	2026-2030	2,200	2,850
Oceanside Treatment Plant Improvements - Seismic Retrofits (SFPUC)	2026-2030	2,200	2,850
Signalization of State Route 35 (Skyline Boulevard) and Great Highway Intersection (Caltrans)	2022	>3,000	>3,000
The San Francisco Zoo Recycled Water Pipeline Project (SFPUC, Zoo)	2023-2024	**420**	**65**
Lake Merced West Project -520 John Muir Drive (Rec and Park)	2024-2026	>3,000	>3,000
Westside Force Main Reliability Project (SFPUC)	2027-2030	**195**	2,900
2700 Sloat Boulevard (Sloat Garden Center)	Unknown	**560**	2,050
Potential Upper Great Highway Closure from Sloat Boulevard to Lincoln Way (Rec and Park/SFMTA)[d]	Unknown	**Variable**[d]	**Variable**[d]

SOURCE: Environmental Science Associates, Memo to Julie Moore, San Francisco Environmental Planning Division, from Matt Fagundes, Sarah Patterson, and Elijah Davidian, Environmental Science Associates, Subject: Ocean Beach Climate Change Adaptation Project - Air Quality Technical Memorandum and Health Risk Assessment, November 3, 2021 (see Appendix G).

NOTES:

a Distance measured from closest edge of the nearby project boundary to the maximally exposed individual sensitive receptor. Distances within 1,000 feet are in bold.
b Scenario 1 assumes exposure starting when construction starts and continuing exposure into operations.
c Scenario 2 assumes exposure starting after construction completes (i.e., operational exposure only).
d The Potential Upper Great Highway Closure project would not be within 1,000 feet of either maximally exposed individual receptor but would impact traffic at varying distances, including areas within 1,000 feet, from these receptors. The Potential Upper Great Highway Closure project is evaluated under the second cumulative analysis.

Reconfiguration of the Sloat Boulevard and State Route 35 (Skyline Boulevard) Intersection. The intersection of State Route 35 (Skyline Boulevard) and Sloat Boulevard would be reconfigured either with a traffic signal or roundabout to improve safety for all road users, increase visibility of pedestrians, and improve or maintain transit and vehicle circulation at the intersection. TAC emissions associated to the project are anticipated to be temporary with negligible operational emissions because the project is anticipated to improve or maintain transit and vehicle circulation.

The San Francisco Zoo Recycled Water Pipeline Project. The San Francisco Zoo Recycled Water Pipeline Project would convert the current groundwater supply and distribution system to a recycled water supply and distribution system, except for end uses that need to be converted to potable water (e.g., drinking water for animals). A new recycled water pipeline would be installed connecting the zoo's groundwater reservoir to the existing Westside Recycled Water Project distribution line. TAC emissions associated with the project are anticipated to be from temporary construction from installation of a pipeline. No operational TAC emissions are anticipated as there would be no changes in operations to the current irrigation system.

Westside Force Main Reliability Project. A redundant force main would be installed between the Westside Pump Station and the Oceanside Treatment Plant. The approximately 2,765 linear-foot pipeline would run from the Westside Pump Station south and parallel to the existing force main. TAC emissions associated to the project are anticipated to be from temporary construction from installation of the pipeline. No operational TAC emissions are anticipated because there would be no significant changes in pipeline operations.

2700 Sloat Boulevard. The preliminary project proposal would demolish the existing Sloat Garden Center and construct a new 85-foot-tall, 252,627 gross square foot residential development with ground floor commercial/retail. The project would result in temporary construction emissions from the off-road equipment and haul trucks required to demolish the existing garden center as well as to construct the mixed-use residential building. This project could potentially increase traffic along Sloat Boulevard from operations of the residential development and ground floor commercial/retail, contributing to mobile source TAC emissions. However, these emissions have not been quantified at the project's current planning stage.[59]

Potential Upper Great Highway Closure. The potential permanent closure of the Great Highway between Sloat Boulevard and Lincoln Way (referred to generally as the Upper Great Highway project) would divert vehicles traveling on the Great Highway to other roadways, primarily to Sunset Boulevard, but also to 19th Avenue and other parallel north-south roadways. Because detailed analyses of the Upper Great Highway project have not been conducted by the SFMTA or SFCTA, an analysis of this cumulative scenario was conducted as a good faith effort with consideration of the best available information.[60] The Potential Upper Great Highway Closure project is only included under the second cumulative analysis.

Cumulative Analysis

Most of these nearby projects would contribute to health risk impacts from construction activities, which are anticipated to be minimal or temporary, as discussed above. Construction health risk impacts for these projects have not been quantified. It is possible that construction-related health risks for these projects could be substantial for certain receptor locations closest to each project's respective construction site. The 2700 Sloat Boulevard project is the only project within 1,000 feet of either maximally exposed receptor that would have the potential for operational health risk impacts.

As presented in Table 6, even if the combined health risks from the cumulative and the proposed projects would result in a total cumulative cancer risk and $PM_{2.5}$ concentration exceeding the APEZ criteria (i.e., an

[59] The 2700 Sloat Boulevard project is conservatively included in the cumulative analysis because there is a reasonable likelihood of an application being filed in the near future and the project's close proximity to the proposed project site. Analysis of its contribution to the cumulative air quality impact is based on preliminary project designs and unknown construction schedule that may overlap given the potential for overlap due to the four-year duration of construction of the proposed Ocean Beach Climate Change Adaptation project.

[60] LCW Consulting, Ocean Beach Climate Change Adaptation Project, Transit Delay Assessment for Additional Cumulative Scenario – Technical Memorandum, August 2, 2021

excess cancer risk greater than 100.0 per million and an annual average $PM_{2.5}$ concentration above 10.0 μg/m^3) at the Scenario 1 maximally exposed receptor location, the project's contribution would still be less than the thresholds for receptors brought into the APEZ. Therefore, for the Scenario 1 receptor the project's contribution would be less than considerable, and the project would result in a less than significant cumulative health risk impact.

Two projects are within 1,000 feet of the Scenario 2 maximally exposed receptor, both of which have the potential to result in health risk impacts from construction activities, and neither of which is assumed to have substantial health risk impacts from operations. For the lifetime excess cancer risk at the resident maximally exposed receptor, and for both the lifetime excess cancer risk and the annual average $PM_{2.5}$ concentration at the school maximally exposed receptor, the project's contribution is less than the thresholds for receptors brought into the APEZ as a result of the proposed project plus cumulative projects (see Table 6). Therefore, even if the combined health risks from these projects would result in a total cumulative cancer risk and $PM_{2.5}$ concentration exceeding the APEZ criteria, the project's contribution would be less than considerable, and the project would result in a less than significant cumulative health risk impact.

The annual average $PM_{2.5}$ concentration at the Scenario 2 resident maximally exposed receptor is 0.297 μg/m^3, which is less than the threshold of 0.3 μg/m^3 for receptors brought into the APEZ as a result of the proposed project plus cumulative projects. Additionally, the existing annual average $PM_{2.5}$ concentration is 8.21 μg/m^3 (value taken from the Citywide-HRA). In order for the Scenario 2 maximally exposed receptor to be brought into the APEZ due to the increased $PM_{2.5}$ concentrations from construction and operation of the two nearby projects in addition to the proposed project, the combined increase in annual average $PM_{2.5}$ concentrations would have to be greater than 1.79 μg/m^3. This value is *six times* greater than the project's increase in $PM_{2.5}$ concentrations at the resident maximally exposed receptor. Given the characteristics of the Sloat Boulevard and State Route 35 (Skyline Boulevard) Intersection project and San Francisco Zoo Recycled Water Pipeline Project, both of which would require minimal construction near the project's maximally exposed receptor, it is improbable for both of these nearby projects to result in combined annual average $PM_{2.5}$ concentrations of this magnitude. Thus, cumulative impacts related to health risk would be ***less than significant***.

Cumulative Analysis with the Upper Great Highway Project

Under the cumulative scenario with Upper Great Highway closure, the number of vehicles on Sloat Boulevard between the Great Highway and Skyline Boulevard and on Skyline Boulevard between Sloat Boulevard and the Great Highway would decrease compared to cumulative conditions without the Upper Great Highway project. The reduction in vehicular traffic along Sloat Boulevard would decrease the TAC emissions from mobile sources nearby both the Scenario 1 maximum exposed receptor and Scenario 2 maximum exposed receptor. Consequently, the Upper Great Highway Closure would not bring the proposed project's maximally exposed receptors into the APEZ. Therefore, the cumulative health risk impact would be ***less than significant.***

Odors

As discussed under Impact AQ-5, construction of the project would generate odors from diesel exhaust emissions. Construction of other nearby projects would also generate odors from diesel exhaust emissions. However, this cumulative odor impact would not be significant because it would also be temporary, highly localized, and would dissipate rapidly. Therefore, cumulative odor impacts would be ***less than significant***.

E.9 GREENHOUSE GAS EMISSIONS

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
9. GREENHOUSE GAS EMISSIONS. Would the project:					
a) Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☐	☐	☒	☐	☐
b) Conflict with any applicable plan, policy or regulation adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☒	☐	☐

Greenhouse gas (GHG) emissions and global climate change represent cumulative impacts. GHG emissions cumulatively contribute to the significant adverse environmental impacts of global climate change. No single project could generate enough GHG emissions to noticeably change the global average temperature; instead, the combination of GHG emissions from past, present, and future projects have contributed and will continue to contribute to global climate change and its associated environmental impacts.

BAAQMD has prepared guidelines and methodologies for analyzing GHGs. These guidelines are consistent with the CEQA Guidelines sections 15064.4 and 15183.5, which address the analysis and determination of significant impacts from a project's GHG emissions. CEQA Guidelines section 15064.4 allows lead agencies to rely on a qualitative analysis to describe GHG emissions resulting from a project. CEQA Guidelines section 15183.5 allows for public agencies to analyze and mitigate GHG emissions as part of a larger plan for the reduction of GHGs and describes the required contents of such a plan. Accordingly, San Francisco has prepared strategies to address GHG emissions,[61] which present a comprehensive assessment of policies, programs, and ordinances that collectively represent San Francisco's qualified GHG Reduction Strategy in compliance with the CEQA Guidelines. These GHG reduction actions have resulted in a 41 percent reduction in GHG emissions in 2019 compared to 1990 levels,[62] exceeding the year 2020 reduction goals outlined in the air district's Bay Area 2017 Clean Air Plan, Executive Orders (EO) S-3-05 and B-30-15, and Assembly Bill (AB) 32 (also known as the Global Warming Solutions Act), and the city's 2017 GHG emissions reduction goal.[63]

In 2008, the San Francisco Board of Supervisors established citywide GHG reduction limits through Ordinance 81-08 that added chapter 9 to the San Francisco Environment Code and required each city department to begin annually reporting on its own GHG emissions and climate protection initiatives. In compliance with Chapter 9 of the San Francisco Environment Code, section 903, the SFPUC has developed annual departmental climate action reports. The reports, like all departmental climate action plans developed pursuant to environment code section 903, are part of San Francisco's qualified GHG reduction strategy.

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61 San Francisco Planning Department, 2017 Greenhouse Gas Reduction Strategy Update Revised July 2017, *https://sfmea.sfplanning.org/GHG/GHG_Strategy_October2017.pdf,* accessed February 2, 2020.

62 San Francisco Environment, *2019 San Francisco Sector-Based Greenhouse Gas Emissions Inventory at a Glance, https://sfenvironment.org/sites/default/files/fliers/files/2019_sfe_ee_climate_at_a_glance.pdf*, accessed October 22, 2021.

63 EO S-3-05, AB 32, and the air district's 2017 Clean Air Plan (continuing the trajectory set in the 2010 Clean Air Plan) set a target of reducing GHG emissions to below 1990 levels by year 2020.

In July 2021, the city adopted an updated GHG ordinance[64] to demonstrate the city's commitment to the Paris Climate Agreement by establishing GHG reduction targets for 2030, 2040, and 2050 and setting other critical sustainability goals. The updated ordinance sets goals for both sector-based emissions and consumption-based emissions. The GHG targets established under ordinance 81-08 applied solely to sector-based emissions, which are those emissions that are generated within the geographic boundaries of the city. The updated ordinance reflects a more comprehensive effort to reduce GHG emissions by setting consumption-based targets as well. Consumption-based emissions are those that are associated with producing, transporting, using, and disposing of products and services consumed by people within the city, even those emissions that are generated outside of the city boundaries. The city's updated GHG reduction targets are as follows:

- By 2030, reduce sector-based GHG emissions to 61 percent below 1990 levels.
- By 2030, reduce consumption-based GHG emissions to 30 metric tons of CO_2e per household or less, equivalent to a 40 percent reduction compared to 1990 levels.
- By 2040, reach net-zero sector-based emissions and sequester any residual emissions using nature-based solutions.[65]
- By 2050, reduce consumption-based GHG emissions to 10 metric tons of CO_2e per household or less, equivalent to an 80 percent reduction compared to 1990 levels.

These sector-based GHG reduction targets are more ambitious than those set forth in Governor Brown's EO B-30-15 (e.g., a 61 percent reduction in sector-based GHG emissions by 2030 rather than a 40 percent reduction by 2030) and in B-55-18 (e.g., achieving carbon neutrality by 2040 rather than by 2045). The consumption-based targets are consistent with the 2030 goal of EO B-30-15 and the 2050 goal of EO S-3-05 (80 percent below 1990 levels, by 2050).

The updated GHG ordinance also serves to codify the city's "0-80-100-Roots" climate action framework, which comprises climate and sustainability goals in these key areas: waste, transportation, energy, and carbon sequestration. The framework also emphasizes the importance of housing in implementing meaningful climate solutions, which require an increased supply of high-quality housing that is both affordable and near transit service.

To support the 2021 Housing and Buildings goal of zero onsite fossil fuel emissions from all new buildings, the Board of Supervisors passed an all-electric new construction ordinance in November 2020. Taking effect on June 1, 2021, the ordinance, which applies to all new buildings, prohibits the construction of natural gas or propane infrastructure.[66]

The updated GHG ordinance also requires the San Francisco Department of the Environment to prepare and submit to the mayor a citywide climate action plan by December 31, 2021, to address the updated GHG

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64 City of San Francisco *Office of the Mayor,* News Release San Francisco Adopts New Climate Action Goals*,* July 20, 2021, *https://sfmayor.org/article/san-francisco-adopts-new-climate-action-goals*, accessed October 21, 2021.

65 Nature-based solutions are those that remove remaining emissions from the atmosphere by storing them in natural systems that support soil fertility or employing other carbon farming practices.

66 San Francisco Department of Building Inspection*, All-Electric New Construction Ordinance, https://sfdbi.org/AllElectricNewConstructionOrdinance*, accessed October 21, 2021.

goals. This requirement will result in new policies, programs, and implementing actions that could apply to SFPUC operations.

The SFPUC's current climate action plan is aimed at contributing to and facilitating the city's strategy to reduce carbon dioxide emissions generally, while advancing San Francisco's goal to have a greenhouse gas-free electric system citywide by 2030. SFPUC's latest climate action plan annual report summarizes the GHG emissions (carbon footprint) associated with electricity, natural gas, and fleet fuels consumed by the SFPUC for fiscal year 2012-2013 for its own operations and highlights the SFPUC's activities to reduce GHG emissions. Compared to the previous year, the SFPUC's carbon footprint slightly increased by 2.26 percent mostly due to a five percent increase in demand for fleet fuels associated with active capital projects and infrastructure upgrades; however, there was a 2.9 percent decrease in natural gas consumption, and no emissions generated associated with consumption of electricity. The annual report describes emission reduction projects and programs designed to allow SFPUC to continue to contribute to the city's strategies to reduce overall GHG emissions.[67]

Given that the city has met the state's 2020 GHG reduction targets and met the state and region's 2030 GHG reduction target under executive order B-30-15,[68,69] Senate Bill 32[70,71] and the 2017 Clean Air Plan,[72] more than 10 years before the target date, and San Francisco's GHG reduction goals are consistent with, or more aggressive than, the longer-term goals established under order S-3-05,[73] the city's GHG reduction goals are consistent with order S-3-05, order B-30-15, Assembly Bill 32, Senate Bill 32, and the 2017 Clean Air Plan. Therefore, projects that are consistent with the city's GHG Reduction Strategy would be consistent with the aforementioned GHG reduction goals, would not conflict with these plans or result in significant GHG emissions, and would, therefore, not exceed San Francisco's applicable GHG threshold of significance.

The following analysis of the project's impact on climate change focuses on the project's contribution to cumulatively significant GHG emissions. Because no individual project could emit GHGs at a level that could result in a significant impact on the global climate, this analysis is in a cumulative context, and this section does not include an individual project-specific impact statement.

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67 San Francisco Public Utilities Commission, Departmental Climate Action, Annual Report, Fiscal Year 2012-2013, March 18, 2014. Available at *https://sfenvironment.org/sites/default/files/fliers/files/sfe_cc_2014_sfpuc_cap_fy1213.pdf*; Accessed on October 21, 2021.

68 Office of the Governor, *Executive Order B-30-15,* April 29, 2015*, https://www.gov.ca.gov/news.php?id=18938*, accessed March 3, 2016. Executive Order B-30-15, issued on April 29, 2015, sets forth a target of reducing GHG emissions to 40 percent below 1990 levels by 2030 (estimated at 2.9 million $MTCO_2E$).

69 San Francisco's GHG reduction goals are codified in Section 902 of the Environment Code and include: (i) by 2008, determine City GHG emissions for year 1990; (ii) by 2017, reduce GHG emissions by 25 percent below 1990 levels; (iii) by 2025, reduce GHG emissions by 40 percent below 1990 levels; and by 2050, reduce GHG emissions by 80 percent below 1990 levels.

70 Senate Bill 32 amends California Health and Safety Code Division 25.5 (also known as the California Global Warming Solutions Act of 2006) by adding Section 38566, which directs that statewide greenhouse gas emissions to be reduced by 40 percent below 1990 levels by 2030.

71 Senate Bill 32 was paired with Assembly Bill 197, which would modify the structure of the State Air Resources Board; institute requirements for the disclosure of greenhouse gas emissions criteria pollutants, and toxic air contaminants; and establish requirements for the review and adoption of rules, regulations, and measures for the reduction of greenhouse gas emissions.

72 The 2017 Clean Air Plan establishes the following GHG reduction targets: reduce Bay Area greenhouse gas emissions to 40 percent below 1990 levels by 2030 and 80 percent below 1990 levels by 2050.

73 Office of the Governor, Executive Order S-3-05, June 1, 2005, http://static1.squarespace.com/static/549885d4e4b0ba0bff5dc695/t/54d7f1e0e4b0f0798cee3010/1423438304744/California+Executive+Order+S-3-05+(June+2005).pdf. Executive Order S-3-05 sets forth a series of target dates by which statewide emissions of GHGs need to be progressively reduced, as follows: by 2010, reduce GHG emissions to 2000 levels (approximately 457 million metric tons of carbon dioxide equivalents ($MTCO_2E$)); by 2020, reduce emissions to 1990 levels (approximately 427 million $MTCO_2E$); and by 2050 reduce emissions to 80 percent below 1990 levels (approximately 85 million $MTCO_2E$). Because of the differential heat absorption potential of various GHGs, GHG emissions are frequently measured in "carbon dioxide-equivalents," which present a weighted average based on each gas's heat absorption (or "global warming") potential.

Impact C-GG-1: The project, in combination with the cumulative projects, would not generate GHG emissions at levels that would result in a significant impact on the environment and would not conflict with a policy, plan, or regulation adopted for the purpose of reducing GHG emissions. *(Less than Significant)*

Individual projects contribute to the cumulative effects of climate change by directly or indirectly emitting GHGs during both construction and operational phases. GHG emissions generated by the project are discussed below.

Construction Emissions

Project construction activities, would result in the temporary generation of emissions over the approximately four-year construction period. In addition to these construction activities, the project would also result in increased construction-related emissions through the small sand placements under the beach nourishment program.

The waste-related construction emissions would be reduced through compliance with the city's Recycling and Composting Ordinance, Construction and Demolition Debris Recovery Ordinance, and Green Building Code requirements. All material removed from the project site, including concrete, metal, and green waste, would be recycled to the maximum extent feasible, with a goal of 75 percent diversion or disposed of at an appropriate landfill in compliance with applicable federal, state, and local regulations. In addition, consistent with the Construction and Demolition Debris Recovery Ordinance, a Construction and Demolition Debris Management Plan would be prepared and implemented.[74] These regulations reduce the amount of materials sent to a landfill, reducing GHGs emitted by landfill operations. These regulations also promote reuse of materials, conserving their *embodied energy*[75] and reducing the energy required to produce new materials.

The proposed construction activities would be subject to the San Francisco Clean Construction Ordinance provisions for projects located outside of the APEZ, including the use of renewable diesel fuel grade B20 for all off-road equipment and off-road engines. In addition, pursuant to Executive Directive 06-02 (Biodiesel for Municipal Fleets), all SFPUC and San Francisco Recreation and Parks Department diesel vehicles used during construction and operation of the project would use renewable fuel.[76] Use of renewable diesel, which is made of nonpetroleum renewable resources such as natural fats, vegetable oils, and greases, results in a net reduction in life cycle CO_2 emissions compared to the use of conventional diesel fuel.

The small sand placements (approximately 85,000 cubic yards), which would involve the use of off-road equipment, haul trucks to transport sand from north Ocean Beach to south Ocean Beach, and worker vehicles, would be undertaken by the city about once every four years. These activities would be subject to the city's Construction and Demolition Debris Recovery Ordinance and the Clean Construction Ordinance, both of which regulate and reduce GHG emissions (i.e., on-road truck trips)off-road equipment use, energy use, and waste disposal).

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[74] San Francisco Planning Department. Compliance Checklist Table for Greenhouse Gas Analysis: Table 2. Municipal Projects, for the Ocean Beach Climate Change Adaptation Project, Case Number 2019-020115ENV.

[75] Embodied energy is the total energy required for the extraction, processing, manufacture and delivery of building materials to the building site.

[76] San Francisco Planning Department. Compliance Checklist Table for Greenhouse Gas Analysis: Table 2. Municipal Projects, for the Ocean Beach Climate Change Adaptation Project, Case Number 2019-020115ENV.

Other Off-Road Equipment and Vehicle Emissions

The large sand placements (up to 575,000 cubic yards)[77] would be undertaken by the Corps about once every 10 years and would require the use of similar off-road equipment and worker vehicles as the small sand placement activities, but would also require off-shore emission sources including barge pumps to pump sand ashore and tug boat operations that would not be under the city's control or subject to city requirements. The Corps project specifications requires that the contractor use "optimized" or diesel powered equipment with the "Best Available Control Technology" emission devices or retard injection timing on diesel powered dredges and equipment by two degrees from manufacturer's recommended setting to reduce air pollutant emissions, prohibit equipment from idling when not performing work, require that equipment be given at least annual tune-ups, and implement other measures to reduce air pollutant emissions, with the co-benefit of reduction in GHGs, and comply with applicable BAAQMD air quality requirements.[78]

Transportation Emissions

Regarding long-term operational transportation emissions, existing city fleet passenger vehicles and light-duty trucks would be used that when purchased or leased were the cleanest and most efficient vehicles available on the market in compliance with the city's Healthy Air and Clean Transportation Ordinance.[79] Also, bike parking would be provided at the proposed Skyline coastal parking lot and at the proposed restroom pursuant to pursuant to San Francisco Planning Code sections 155.2 and 155.3.[80] Further, the project would comply with the city's Healthy Air and Clean Transportation Ordinance by relocating the MUNI bus terminal and rerouting the bus line to allow continued access to the project site via bus, as well by providing access to new trail and bicycle facilities.[81]

With respect to increased vehicular mileage from re-routed traffic, based on the traffic analysis conducted for the project, permanently closing the Great Highway south of Sloat Boulevard would result in the daily re-routing of approximately 14,600 trips from the Great Highway to Sloat and Skyline boulevards. The analysis assumes the northbound trips would be rerouted from Great Highway onto Skyline Boulevard, then to westbound Sloat Boulevard, and back to northbound Great Highway; and the southbound trips would be rerouted from Great Highway onto eastbound Sloat Boulevard, then to southbound Skyline Boulevard, and back to southbound Great Highway. This re-routing would increase the per-trip vehicular mileage by 0.46 mile, compared to the vehicle mileage for existing trips along the affected segment of Great Highway. Thus, the Great Highway closure south of Sloat Boulevard would increase the total daily vehicle miles traveled in San Francisco by 6,716 miles, representing a 0.07 percent increase in vehicle miles travelled in San Francisco.[82] However, as discussed in Impact AQ-1, the Great Highway closure would allow pedestrian and cyclist access to and along South Ocean Beach via a new multi-use trail, accessible from the modified Sloat Boulevard/Great Highway and Skyline Boulevard/service road intersections, and the Skyline coastal

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77 The analysis assumes a 15 percent loss of material in handling of the dredge material during placement, and so assumes a haul volume that is 15 percent greater (i.e., 575,000 cubic yards) than the proposed placement volume.

78 U.S. Army Corps of Engineers, 2021. West Coast Hopper Maintenance Dredging 2021 Project Manual, Section 01 57 20.00 82, Environmental Protection, Part 3.1 Implementation, Part 3.3 Air Quality Requirements, and Part 3.4 Air Resources. February 19, 2021.

79 San Francisco Planning Department. Compliance Checklist Table for Greenhouse Gas Analysis: Table 2. Municipal Projects, for the Ocean Beach Climate Change Adaptation Project, Case Number 2019-020115ENV.

80 Ibid.

81 San Francisco Planning Department. Compliance Checklist Table for Greenhouse Gas Analysis: Table 2. Municipal Projects, for the Ocean Beach Climate Change Adaptation Project, Case Number 2019-020115ENV.

82 EMFAC2017 model output for year 2027 (first year of operation) indicates that total daily vehicle miles travelled in San Francisco for the year 2027 will be 10,206,297 miles.

parking lot. Part of the purpose for the proposed Great Highway closure is to preserve and enhance public access, coastal recreation, and scenic resources at South Ocean Beach that provide recreational opportunities for pedestrians, bicyclists, and other users, which do not generate emissions. The consequence of this is a slight increase in vehicular miles traveled per trip. Therefore, when considering the increased opportunities for zero-emissions access within and through the project area the increased vehicular mileage in San Francisco (i.e., 0.07 percent increase) that would be associated with the project's closure of the Great Highway is negligible at the regional/city level and would not prevent the city from meeting its GHG/transportation targets, nor would it be inconsistent with the city's GHG Reduction Strategy.

Furthermore, the city has many programs in place for reducing transportation-related GHG emissions. Measures within this sector include a transportation demand management program, the city's bike plan, the transportation sustainability program, and other measures that are designed to reduce reliance on cars and reduce vehicle miles travelled at the citywide level. Based on the city's latest GHG emissions inventory, these programs have successfully reduced the city's transportation-related emissions by 16 percent from 1990 to 2019.[83]

Building Emissions

The project would include a service road, multi-use trail, parking, and restroom that would include construction of impervious surfaces. These components would be required to comply with the city's Stormwater Management Ordinance and the stormwater design guidelines to reduce the volume of stormwater entering the city's wastewater systems (see Initial Study Section E.17, Hydrology and Water Quality).[84] The proposed dune landscaping and temporary irrigation would be subject to the city's Water Conservation and Irrigation ordinances because the landscaped area would be over 1,000 square feet.[85] Compliance with these ordinances and guidelines would promote energy and water efficiency, thereby reducing the project's energy-related GHG emissions.[86] Also, the toilets, urinals, and faucets installed in the proposed restroom would comply with the Commercial Water Conservation Ordinance of Chapter 13A of the San Francisco Building Code.[87] Additionally, the project elements that would require use of electricity, such as the bathroom and lighting, would be required to meet the renewable energy and energy performance criteria of the Green Building Code.[88,89]

The only new building that would be constructed under the project is a restroom near the western terminus of Sloat Boulevard, which would replace the existing nearby NPS restroom. The restroom would not be subject to the Green Building Code because it would not be considered an occupancy Group A, B, I, E, and M building type, and it would have a physical footprint of less than 2,000 square feet (the proposed restroom

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83 San Francisco Department of the Environment, 2021. San Francisco's Carbon Footprint. Available at: *https://sfenvironment.org/carbonfootprint*. Accessed October 20, 2021.

84 San Francisco Planning Department. Compliance Checklist Table for Greenhouse Gas Analysis: Table 2. Municipal Projects, for the Ocean Beach Climate Change Adaptation Project, Case Number 2019-020115ENV.

85 San Francisco Public Utilities Commission. San Francisco's Water Efficient Irrigation Ordinance. Available at *https://infrastructure.sfwater.org/fds/fds.aspx?lib=SFPUC&doc=631757&data=243226445#:~:text=San%20Francisco%E2%80%99s%20Water%20Efficient%20Irrigation%20Ordinance%3A%20%E2%80%A2%20Protects,costs%20on%20renters%20and%20homeowners.%20Common%20name%3A%20Feverfew*

86 Compliance with water conservation measures reduce the energy (and GHG emissions) required to convey, pump, and treat water required for the project.

87 San Francisco Planning Department. Compliance Checklist Table for Greenhouse Gas Analysis: Table 2. Municipal Projects, for the Ocean Beach Climate Change Adaptation Project, Case Number 2019-020115ENV.

88 Ibid.

89 San Francisco Department of Building Inspection Administrative Bulletin 093, Attachment H. Available at: *https://sfdbi.org/sites/default/files/AB-093.pdf.*

would be 1,080 square feet).[90] Regardless, GHG emissions that would be associated with operations of the new bathroom would be minimal and would be at least partially offset by removing the existing restroom and eliminating its operations emissions.

Tree Removal

Site preparation for the project could require removal of up to 17 and disturbance to approximately three trees.[91] Trees are not proposed to be planted as part of the project and the city's street tree planting requirements are not applicable to the project because the proposed restroom building would be less than 10,000 square feet.[92] Removal of the trees would serve to decrease carbon sequestration in the project area, but the overall effect on net GHG emissions would be minor.

Impact Conclusion

The project would be subject to applicable regulations described above and that are referenced in the city's GHG reduction strategy. Although some project elements would be carried out by the Corps, as discussed above, the Corps contract specifications for the project include measures to reduce air pollutants, with the co-benefit of reduction in GHGs. Therefore, the project was determined to be consistent with the city's GHG Reduction Strategy.[93]

Furthermore, the project is a climate adaptation project that would have an overall benefit with respect to climate change impacts, and would indirectly reduce future GHG emissions from maintenance and inundation cleanup activities (and other reactive, instead of preventative, actions) along the South Ocean Beach shoreline. For example, the project would protect the Lake Merced Tunnel, avoiding the need to remove and relocate this piece of critical wastewater infrastructure inland, which would result in a long-term net reduction in GHG emissions.

The SFPUC and other city agencies are required to comply with the regulations identified above. These regulations have proven effective, as San Francisco's GHG emissions have measurably decreased when compared to 1990 emissions levels. Between 1990 and 2019, the city's carbon footprint was reduced by 41 percent, while the population increased 22 percent, and the city's gross domestic product increased by 199 percent.[94] Therefore, the city exceeded its 2017 GHG emissions reduction goal and is well on its way meeting its goal of reducing GHG emissions by 40 percent below 1990 levels by 2025. The city also exceeded EO S-3-05, AB 32, and the Bay Area 2017 Clean Air Plan GHG reduction goals for the year 2020. Other existing regulations, such as those implemented through AB 32, will continue to reduce a project's contribution to climate change. In addition, San Francisco's local GHG reduction targets are consistent with the long-term GHG reduction goals of EO S-3-05, EO B-30-15, EO B-55-18, SB 32, and the Bay Area 2017 Clean Air Plan. Therefore, because the identified project elements are consistent with the city's GHG Reduction Strategy, they are also consistent with the GHG reduction goals of EO S-3-05, EO B-30-15, EO B-55-18, SB 32, and the

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90 City and County of San Francisco Green Building Code, 2019 Edition. Available at *https://codelibrary.amlegal.com/codes/san_francisco/latest/sf_building/0-0-0-87478*.

91 Environmental Science Associates, Memo to Karen Frye, San Francisco Public Utilities Commission, from Liz Hill and Joe Sanders, Environmental Science Associates, Subject: Ocean Beach Climate Change Adaptation Project Tree Survey Memorandum, August 11, 2021.

92 San Francisco Planning Department. Compliance Checklist Table for Greenhouse Gas Analysis: Table 2. Municipal Projects, for the Ocean Beach Climate Change Adaptation Project, Case Number 2019-020115ENV.

93 San Francisco Planning Department. Compliance Checklist Table for Greenhouse Gas Analysis: Table 2. Municipal Projects, for the Ocean Beach Climate Change Adaptation Project, Case Number 2019-020115ENV.

94 San Francisco Department of the Environment, 2021. San Francisco's Carbon Footprint. Available at: https://sfenvironment.org/carbonfootprint. Accessed October 21, 2021.

Bay Area 2017 Clean Air Plan, would not conflict with these plans, and therefore would not exceed San Francisco's applicable GHG threshold of significance.

Therefore, the project would not generate GHG emissions at levels that would result in a significant impact on the environment and would not conflict with a policy, plan, or regulation adopted for the purpose of reducing GHG emissions; the impact would be ***less than significant***.

E.10 WIND

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
10. WIND. Would the project:					
a) Create wind hazards in publicly accessible areas of substantial pedestrian use?	☐	☐	☒	☐	☐

Impact WI-1: The project would not create wind hazards in publicly accessible areas of substantial pedestrian use. (*Less than Significant*)

This analysis considers whether the project would create new wind hazards in publicly accessible areas of substantial pedestrian use through the development of built structures in the project area. Based upon the experience of the planning department in reviewing wind analyses and expert opinion on other projects, it is generally the case that built structures under 80 feet in height do not have the potential to generate significant wind hazard impacts. Further, project-related wind hazard impacts are generally caused by large building masses extending substantially above their surroundings, and by buildings oriented such that a large wall catches a prevailing wind, particularly if such a wall includes little or no articulation.

The project would create a new multi-use trail in the approximate location of the northbound lanes of the Great Highway between Sloat and Skyline boulevards.[95] The proposed multi-use trail would introduce a new trail facility providing new opportunities for substantial pedestrian use in the project area. Pedestrians using the facilities would be subject to naturally occurring winds because Ocean Beach is a coastal area subject to strong winds originating from the Pacific Ocean.

The project would not include new built structures of sufficient height or mass to amplify or redirect winds resulting in wind hazards for pedestrians or bicyclists. The project would remove an existing one-story restroom building near Sloat Boulevard, and replace it with a new one-story restroom structure. The proposed restroom building would be one-story, similar in height or shorter than other nearby structures, and therefore would not substantially change pedestrian-level wind hazards in the area. Other built features including the proposed multi-use trail, roadway modifications, parking areas, buried wall, and storm drain system for the multi-use trail and service road would be at- or below-grade, and would not affect local wind patterns.

Thus, while the project would include new built structures that could affect wind patterns in the area, these structures would not be of sufficient height to redirect or amplify winds resulting in wind hazards for pedestrians or bicyclists. Therefore, the project would have a ***less-than-significant*** impact related to the creation of new wind hazards.

[95] Skyline Boulevard is also State Route 35 (S.R. 35) at this location.

Impact C-WI-1: The project, in combination with the cumulative projects, would not create wind hazards in publicly accessible areas of substantial pedestrian use. (*Less than Significant*)

The geographic scope for the analysis of potential cumulative impacts related to changes in wind hazards in publicly accessible areas generally includes the areas around the project area, including pedestrian-accessible areas at the western terminus of Sloat Boulevard. Given that wind effects are highly localized, the geographic context for cumulative wind effects encompasses the immediate project area vicinity—generally a few blocks (less than one-quarter mile) in each direction. It is in this vicinity that cumulative development, when combined with the project, would have any effect on wind on the same locations. While multiple cumulative projects would be within this distance, these projects would not construct new buildings near the proposed facilities with the exception of the Westside Pump Station Reliability Improvements Project and the 2700 Sloat Boulevard project. The Westside Pump Station Reliability Improvements Project would construct a one-story electrical building at the southeast corner of the Sloat Boulevard and Great Highway intersection, along with underground infrastructure improvements. The electrical building would replace trees, a tall wall, and a sculpture garden. The 2700 Sloat Boulevard project could be up to 85 feet tall and could result in pedestrian-level wind hazard impacts. However, as discussed above, the project (i.e., the Ocean Beach Climate Change Adaptation Project) would not substantially affect pedestrian-level wind speeds, and therefore would not contribute to any potential cumulative wind hazard impacts in the project vicinity. Due to the distance between cumulative structures and their heights, the project in combination with cumulative projects would not substantially increase hazardous wind conditions. The cumulative impact related to wind hazards would be ***less than significant***.

E.11 SHADOW

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
11. SHADOW. Would the project:					
a) Create new shadow that substantially and adversely affects the use and enjoyment of publicly accessible open spaces?	☐	☐	☒	☐	☐

Impact SH-1: The project would not create new shadow that substantially and adversely affects the use and enjoyment of publicly accessible open spaces. (*Less than Significant*)

San Francisco Planning Code section 295, adopted in 1984 pursuant to voter approval of Proposition K (also known as the Sunlight Ordinance), prohibits the issuance of building permits for structures over 40 feet in height that would cast shade or shadow on property under the jurisdiction of, or designated to be acquired by, the San Francisco Recreation and Park Commission from one hour after sunrise to one hour before sunset at any time of year unless the San Francisco Planning Commission determines that the shade or shadow would have an insignificant adverse impact on the use of such property. However, section 295 applies neither to buildings less than 40 feet tall nor to buildings constructed on park property for recreational or park-related proposes. As described in EIR Chapter 2, Project Description, the project would remove the existing one-story public restroom building at the western terminus of Sloat Boulevard, and would construct a new one-story restroom building of similar design inland of this location. The proposed restroom would be less than 40 feet tall and constructed on park property for recreational purposes; therefore, the facilities would not be subject to review under San Francisco Planning Code section 295.

Publicly accessible open spaces that are used for recreation purposes in the project area include Ocean Beach, paths and sidewalks along the western terminus of Sloat Boulevard, and the Lake Merced trail. The project does not propose any built features that would result in shadow patterns that would substantially and adversely affect the use and enjoyment of these publicly accessible open spaces. Because of its single-story height and siting relative to surrounding uses, the proposed restroom would create limited new shadow that would not substantially affect outdoor recreational facilities or other public areas. In addition, the proposed restroom would replace the existing restroom with a new structure that is similar in size and scale, and would be located in the same vicinity of the project area. Other built features including the proposed roadway modifications, parking areas, buried wall, and storm drain system for the multi-use trail and service road would be at- or below-grade, and would not affect shadow patterns. The project would have a ***less-than-significant*** impact related to the creation of new shadows that would substantially affect outdoor recreational facilities or other public areas.

Impact C-SH-1: The project, in combination with the cumulative projects, would not create new shadow that substantially and adversely affects the use and enjoyment of publicly accessible open spaces. (*Less than Significant*)

The geographic scope of impacts related to changes in shadow includes projects that would cast shadows affecting different portions of the same public areas affected by shadows from the project. As discussed above, the project would cast limited new shadows near the proposed restroom. The Westside Pump Station Reliability Improvements Project would be constructed in the same vicinity as the proposed restrooms at Sloat Boulevard. The Westside Pump Station Reliability Improvements Project would construct an electrical building at the southeast corner of the Sloat Boulevard and Great Highway intersection, along with underground infrastructure improvements. The electrical building would replace trees, a tall wall, and a sculpture garden, which shade the areas near the proposed restroom under current conditions. While the project in combination with the Westside Pump Station Reliability Improvements Project would alter shadows along paths and sidewalks near the western terminus of Sloat Boulevard, the cumulative impact would be ***less than significant*** because the shadows would not substantially and adversely affect the use and enjoyment of this area.

E.12 RECREATION

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
12. RECREATION. Would the project:					
a) Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facilities would occur or be accelerated?	☒	☐	☐	☐	☐
b) Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?	☒	☐	☐	☐	☐

The project's effects on recreational facilities have the potential to result in significant impacts on the environment. All recreation topics (i.e., E.12(a) through E.12(b)) are addressed in EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, Section 4.5, Recreation.

E.13 UTILITIES AND SERVICE SYSTEMS

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
13. UTILITIES AND SERVICE SYSTEMS. Would the project:					
a) Require or result in the relocation or construction of new or expanded, water, wastewater treatment, or storm water drainage, electric power, natural gas, or telecommunications facilities, the construction or relocation of which could cause significant environmental effects?	☐	☐	☒	☐	☐
b) Have sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry, and multiple dry years?	☐	☐	☒	☐	☐
c) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has inadequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☒	☐	☐
d) Generate solid waste in excess of state or local standards, or in excess of the capacity of local infrastructure, or otherwise impair the attainment of solid waste reduction goals?	☐	☐	☒	☐	☐
e) Comply with federal, state, and local management and reduction statutes and regulations related to solid waste?	☐	☐	☒	☐	☐

Project construction would involve removal of all or portions of the Great Highway and excavations and pile installation to the west of the Great Highway, in the vicinity of the Lake Merced Tunnel. Utility investigations performed for the project design indicate the presence of various utility lines that could interfere with this work, including sewer/stormwater conveyance, an abandoned natural gas pipeline, electrical lines, and street lights.[96] As a result, project construction would require these facilities be removed and/or relocated.

In addition, the project would remove the existing restroom at the western terminus of Sloat Boulevard and the remnants of a stormwater conveyance system that once existed along the Great Highway but has since failed due to exposure from coastal bluff erosion. The project would construct a new public restroom to replace the existing restroom, and install a new stormwater collection and conveyance system to replace the damaged system. The new restroom and stormwater conveyance would connect to the existing

[96] Moffatt & Nichol, AGS, McMillan Jacobs Associates, CHS Consulting Group, San Francisco Public Works, Ocean Beach Long-term Improvements Project Conceptual Engineering Report (CER). Prepared for San Francisco Public Utilities Commission. September 2019.

Oceanside Treatment Plant via existing conveyance pipelines, most likely at the zoo pump station. The construction of these utilities are components of the project analyzed in this initial study and EIR.

Impact UT-1: The project would not require the relocation or construction of new or expanded water, wastewater treatment, stormwater drainage, electric power, natural gas, or telecommunications facilities, the construction or relocation of which could cause significant environmental effects. (*Less than Significant*)

Construction

The project would construct new utilities, the impacts of which are evaluated in this document. As noted above, various utility lines exist within the project area. Where such facilities would interfere with project facilities, the utilities would be relocated within the project area. Utility relocation would not require or result in the relocation or construction of new or expanded utilities in areas outside of the project area.

Project construction would require a limited amount of potable water for drinking, on-site sanitary needs, and concrete/slurry mixing. San Francisco Public Works Code article 21 restricts the use of potable water for soil compaction and dust control associated with any construction project in the city and requires the use of recycled water. As discussed further in Impact UT-2, below, the limited amount of water required would not result in the need for an additional water supply, nor would it require construction of new or expanded water facilities.

Operation

Operation of the new restroom and new path and parking area lighting would require water, wastewater, and electricity. The demand for these services under the project would be comparable to that for existing conditions. The new restroom would replace an existing restroom, using newer fixtures. Electricity demands associated with new lighting would be partially offset by the project's removal of overhead street lighting near the Great Highway/Sloat Boulevard intersection. Regardless, considering the project's operational utility demands relative to the capacity of utility service providers (i.e., SFPUC and Pacific Gas and Electric Company), the project would not require the construction of new facilities or expansion of existing facilities to serve the project.

For the reasons presented, the project would have a ***less-than-significant impact*** related to the expansion or relocation of utility services that could result in environmental effects.

Impact UT-2: Project construction and operation would have sufficient water supplies available to serve the project and reasonably foreseeable future development during normal, dry, and multiple dry years. (*Less than Significant*)

The San Francisco Public Utilities Commission (SFPUC) adopted the 2020 Urban Water Management Plan (2020 plan) in June 2021.[97] The 2020 plan estimates that current and projected water supplies will be sufficient to meet future demand for retail water[98] customers through 2045 under wet- and normal-year

97 SFPUC, 2020 Urban Water Management Plan for the City and County of San Francisco, adopted June 11, 2021. This document is available at *https://www.sfpuc.org/about-us/policies-plans/urban-water-management-plan*.

98 "Retail" demand represents water the SFPUC provides to individual customers within San Francisco. "Wholesale" demand represents water the SFPUC provides to other water agencies supplying other jurisdictions.

conditions; however, in dry years, the SFPUC would implement water use and supply reductions through its Water Shortage Contingency Plan and a corresponding Retail Water Shortage Allocation Plan.[99]

In December 2018, the State Water Resources Control Board adopted amendments to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary, which establishes water quality objectives to maintain the health of our rivers and the Bay-Delta ecosystem (the Bay-Delta Plan Amendment).[100] The state water board has indicated that it intends to implement the Bay-Delta Plan Amendment by the year 2022, assuming all required approvals are obtained by that time. Implementation of the Bay-Delta Plan Amendment would result in a substantial reduction in the SFPUC's water supplies from the Tuolumne River watershed during dry years, requiring rationing to a greater degree in San Francisco than previously anticipated to address supply shortages.

Implementation of the Bay-Delta Plan Amendment is uncertain for several reasons and whether, when, and the form in which the Bay-Delta Plan Amendment would be implemented, and how those amendments could affect SFPUC's water supply, is currently unknown. In acknowledgment of these uncertainties, the 2020 plan presents future supply scenarios both with and without the Bay-Delta Plan Amendment, as follows:

1. Without implementation of the Bay-Delta Plan Amendment wherein the water supply and demand assumptions contained in Section 8.4 of the 2020 plan would be applicable
2. With implementation of a voluntary agreement between the SFPUC and the State Water Resources Control Board that would include a combination of flow and non-flow measures that are designed to benefit fisheries at a lower water cost, particularly during multiple dry years, than would occur under the Bay-Delta Plan Amendment)
3. With implementation of the Bay-Delta Plan Amendment as adopted wherein the water supply and demand assumptions contained in Section 8.3 of the 2020 plan would be applicable

Water supply shortfalls during dry years would be lowest without implementation and highest with implementation of the Bay-Delta Plan Amendment. Shortfalls under the proposed voluntary agreement would be between those with and without implementation of the Bay-Delta Plan Amendment.[101]

Under these three scenarios, the SFPUC would have adequate water to meet demand in San Francisco through 2045 in wet and normal years.[102] Without implementation of the Bay-Delta Plan Amendment, water

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99 San Francisco Public Utilities Commission, 2020 Urban Water Management Plan for the City and County of San Francisco, Appendix K – Water Shortage Contingency Plan, adopted June 11, 2021. This document is available at *https://www.sfpuc.org/about-us/policies-plans/urban-water-management-plan*.

100 State Water Resources Control Board Resolution No. 2018-0059, Adoption of Amendments to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary and Final Substitute Environmental Document, December 12, 2018, available at *https://www.waterboards.ca.gov/plans_policies/docs/2018wqcp.pdf*.

101 On March 26, 2019, the SFPUC adopted Resolution No. 19-0057 to support its participation in the voluntary agreement negotiation process. To date, those negotiations are ongoing under the California Natural Resources Agency. The SFPUC submitted a proposed project description that could be the basis for a voluntary agreement to the state water board on March 1, 2019. As the proposed voluntary agreement has yet to be accepted by the state water board as an alternative to the Bay-Delta Plan Amendment, the shortages that would occur with its implementation are not known with certainty; however, if accepted, the voluntary agreement would result in dry year shortfalls of a lesser magnitude than under the Bay-Delta Plan Amendment.

102 Based on historic records of hydrology and reservoir inflow from 1920 to 2017, current delivery and flow obligations, and fully implemented infrastructure under the 2018 Phased Water System Improvement Program Variant, normal or wet years occurred 85 out of 97 years. This translates into roughly nine normal or wet years out of every 10 years. Conversely, system-wide rationing is required roughly one out of every 10 years. This frequency is expected to increase as climate change intensifies.

supplies would be available to meet demand in all years except for a 4.0 million gallons per day (5.3 percent) shortfall in years four and five of a multiple year drought based on 2045 demand.

With implementation of the Bay-Delta Plan Amendment, shortfalls would range from 11.2 million gallons per day (15.9 percent) in a single dry year to 19.2 million gallons per day (27.2 percent) in years two through five of a multiple year drought based on 2025 demand levels and from 20.5 million gallons per day (25.4 percent) in a single dry year to 28.5 million gallons per day (35.4 percent) in years four and five of a multiple year drought based on 2045 demand.

The project does not require a water supply assessment under the California Water Code. Under sections 10910 through 10915 of the California Water Code, urban water suppliers like the SFPUC must prepare water supply assessments for certain large "water demand" projects, as defined in CEQA Guidelines section 15155.[103] The project would not result in any housing units or commercial space; as such it does not qualify as a "water-demand" project as defined by CEQA Guidelines section 15155(a)(1) and a water supply assessment is not required and has not been prepared for the project. The following discussion considers the potential water supply impacts for projects – such as the project – that do not qualify as "water-demand" projects.

No single development project alone in San Francisco would require the development of new or expanded water supply facilities or require the SFPUC to take other actions, such as imposing a higher level of rationing across the city in the event of a supply shortage in dry years. Therefore, a separate project-only analysis is not provided for this topic. The following analysis instead considers whether the proposed project in combination with both existing development and projected growth through 2045 would require new or expanded water supply facilities, the construction or relocation of which could have significant impacts on the environment. It also considers whether a high level of rationing would be required that could have significant cumulative impacts. It is only under this cumulative context that development in San Francisco could have the potential to require new or expanded water supply facilities or require the SFPUC to take other actions, which in turn could result in significant physical environmental impacts related to water supply. If significant cumulative impacts could result, then the analysis considers whether the project would make a considerable contribution to the cumulative impact.

Based on guidance from the California Department of Water Resources and a citywide demand analysis, the SFPUC has established 50,000 gallons per day as the maximum water demand for projects that do not meet the definitions provided in CEQA Guidelines section 15155(a)(1).[104] The project includes a replacement public restroom and temporary irrigation, but otherwise would not require water supply and would demand substantially less water than required by a 500 dwelling unit project (CEQA guidelines section 15155(a)(1)(G)

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[103] Pursuant to CEQA Guidelines section 15155(1), "a water-demand project" means:
(A) A residential development of more than 500 dwelling units.
(B) A shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet of floor space.
(C) A commercial office building employing more than 1,000 persons or having more than 250,000 square feet of floor area.
(D) A hotel or motel, or both, having more than 500 rooms,
(E) An industrial, manufacturing, or processing plant, or industrial park planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 square feet of floor area.
(F) A mixed-use project that includes one or more of the projects specified in subdivisions (a)(1)(A), (a)(1)(B), (a)(1)(C), (a)(1)(D), (a)(1)(E), and (a)(1)(G) of this section.
(G) A project that would demand an amount of water equivalent to, or greater than, the amount of water required by a 500 dwelling unit project.

[104] Memorandum, from Steven R. Ritchie, Assistant General Manager, Water Enterprise, San Francisco Public Utilities Commission to Lisa Gibson, Environmental Review Officer, San Francisco Planning Department – Environmental Planning, May 31, 2019.

uses this threshold to identify a water-demand project that does not fit into other common land use categories). In addition, the project would incorporate water-efficient fixtures as required by Title 24 of the California Code of Regulations and the city's Green Building Ordinance. It is therefore reasonable to assume that the project would result in an average daily demand of substantially less than 50,000 gallons per day of water.

Assuming the project would demand no more than 50,000 gallons of water per day, its water demand would represent a small fraction of the total projected demand, ranging at most from 0.07 to 0.06 percent between 2025 and 2045. As such, the project's water demand would not require or result in the relocation or construction of new or expanded water facilities the construction or relocation of which could cause significant environmental effects.

Sufficient water supplies are available to serve the project and reasonably foreseeable future development in normal, dry, and multiple dry years unless the Bay-Delta Plan Amendment is implemented. As indicated above, the project's maximum demand would represent less than 0.06 percent of the total demand in 2045 when the retail supply shortfall projected to occur with implementation of the Bay-Delta Plan Amendment would be up to 35.4 percent in a multi-year drought. The SFPUC has indicated that it is accelerating its efforts to develop additional water supplies and explore other projects that would improve overall water supply resilience through an alternative water supply program. The SFPUC has taken action to fund the study of additional water supply projects, but it has not determined the feasibility of the possible projects and has determined that the identified potential projects would take anywhere from 10 to 30 years or more to implement. The potential impacts that could result from the construction and/or operation of any such water supply facility projects cannot be identified at this time. In any event, under such a worst-case scenario, the demand for the SFPUC to develop new or expanded dry-year water supplies would exist regardless of whether the project is constructed.

Given the long lead times associated with developing additional water supplies, in the event the Bay-Delta Plan Amendment were to take effect sometime after 2022 and result in a dry-year shortfall, the expected action of the SFPUC for the next 10 to 30 years (or more) would be limited to requiring increased rationing. The SFPUC has established a process through its Retail Water Shortage Allocation Plan for actions it would take under circumstances requiring rationing. The level of rationing that would be required of the project is unknown at this time. Both direct and indirect environmental impacts could result from high levels of rationing. However, the potential small increase in potable water demand attributable to the project compared to citywide demand would not substantially affect the levels of dry-year rationing that would otherwise be required throughout the city. Therefore, the project would not make a considerable contribution to a cumulative environmental impact caused by implementation of the Bay-Delta Plan Amendment. Project impacts related to water supply would be ***less than significant***.

Impact UT-3: The project would not result in a determination by the wastewater treatment provider which serves the project that it has inadequate capacity to serve the project's projected demand in addition to the provider's existing commitments. (*Less than Significant*)

Construction

During the four years of project construction, new sources of wastewater discharges to the city's combined wastewater system would be mainly limited to wastewater resulting from sanitary needs of construction workers and from dewatering of groundwater encountered during project excavations. The number of workers at the project area during a peak construction work day would be about 130. Sanitary facilities would be serviced by a vendor and sanitary drainage would be hauled off-site for disposal. The resulting effect on the wastewater system capacity would be negligible.

Regarding dewatering, recent geotechnical investigations encountered groundwater at depths ranging from 21 to 24 feet below existing grade.[105] Excavation necessary to construct the buried wall would range from 20 to 40 feet below existing grade. The volume of groundwater that would be encountered would depend upon depth of excavation and groundwater elevations at time of construction, and therefore cannot be estimated with precision. Groundwater pumped from the excavated areas and not used for dust control would be discharged to the combined wastewater system via existing manholes in the Great Highway. Construction-related discharges to the wastewater system would require a discharge permit from the SFPUC that would specify the types and rate of allowable discharges.

Combined stormwater and wastewater flows collected by the SFPUC-operated combined sewer and stormwater system from the west side of the city are pumped to the Oceanside Treatment Plant. The plant can treat up to 43 million gallons per day during average dry weather, and during rain events the wet-weather treatment capacity is 65 million gallons per day.[106] In 2020, the average dry weather flow to the treatment plant was 12 million gallons per day.[107] The discharges to the Oceanside Treatment Plant during project construction would be small relative to overall available capacity of the treatment system. In addition, the discharge permit requirements would ensure that wastewater system discharges would not exceed the volume or treatment requirements of the SFPUC. Therefore, project construction would not cause the SFPUC to determine it has inadequate capacity to meet project demands in addition to its existing commitments. For these reasons, the impact would be ***less than significant***.

Operation

The project's operational wastewater needs would be limited to sewage production at the new public restroom and stormwater runoff from the new service road, trail, and parking areas. These would replace existing sources of wastewater and stormwater. The Oceanside Treatment Plant and wastewater and stormwater collection system's treatment capacity would be sufficient to serve the project. The service road, trail, and parking areas would generally be developed within the alignment of the removed Great Highway travel lanes, and the project would replace existing stormwater drainage pipelines in the project area with a similar system or with a swale system that drains to the Pacific Ocean. In either case the stormwater drainage facilities would comply with the Stormwater Management Ordinance (discussed in greater detail in Section E.17, Hydrology and Water Quality), which requires use of low-impact design measures that generally slow or reduce volumes of stormwater runoff. Therefore, the project would not substantially increase the amount of impervious surface area draining to the wastewater collection system. The project would not generate demand beyond the Oceanside Treatment Plant and collection system's available capacity. For these reasons, project operations would have a ***less-than-significant impact*** regarding adequacy of existing wastewater system capacity.

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[105] AGS, Final Geotechnical Data Report South Ocean Beach Coastal Erosion and Wastewater Infrastructure Protection, San Francisco, California. Prepared for San Francisco Public Utilities Commission. July 2020.

[106] San Francisco Bay Regional Water Quality Control Board, Waste Discharge Requirements and National Pollutant Discharge Elimination System Permit for City and County of San Francisco Oceanside Water Pollution Control Plant, Wastewater Collection System, and Westside Recycled Water Project, Order No. R2-2019-0028, adopted September 11, 2019.

[107] SFPUC, Annual Self-Monitoring Report for the Oceanside Water Pollution Control Plant (NPDES No. CA0037681, Regional Water Quality Control Board Order Nos. R2-2009-0062 and R2-2019-0028), January 29, 2021

Impact UT-4: The project would be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs and would not impair the attainment of solid waste reduction goals. (*Less than Significant*)

Residential and commercial solid waste collection, recycling, and disposal services for San Francisco are provided by Recology, Inc. Recyclable materials are taken to Recology's Pier 96 facility, where they are separated into commodities (e.g., aluminum, glass, and paper) and transported to other users for reprocessing. Compostables (e.g., food waste, plant trimmings, soiled paper) are transferred to a Recology composting facility in Solano County, where they are converted to soil amendment and compost. The remaining material that cannot otherwise be reprocessed (*trash*) is primarily transported to a landfill.

In 2018, San Francisco generated a total of about 740,000 tons of landfill waste.[108] Approximately 453,000 tons were directed to the Hay Road Landfill, with the remaining 287,000 tons received at roughly 23 other landfills. Among these alternate landfills, Corinda Los Trancos (Ox Mountain) Landfill received the highest volume (80,000 tons).[109] All facilities used by the city are permitted to accept the type of construction waste generated by the project.

Pursuant to the city's Construction and Demolition Debris Recovery Ordinance, construction and demolition debris must be transported by a registered transporter to a registered facility that can process mixed construction and demolition debris. The ordinance requires that at least 65 percent of construction and demolition debris from a site go to a registered construction and demolition recycling facility.[110] This requirement has been augmented by the city's Green Building Ordinance, which requires that at least 75 percent of construction and demolition debris be diverted from landfills.[111]

Construction

Over the four-year construction period, project construction and demolition activities would generate construction debris that would add to San Francisco's overall solid waste disposal volume. The project would be subject to various solid waste diversion requirements, including the Construction and Demolition Debris Recovery Ordinance, the 2016 Green Building Ordinance, and the California Green Building Standards Code. In accordance with San Francisco Environment Code section 708, the city would require the construction contractor to submit a Construction and Demolition Debris Management Plan for approval; the plan would demonstrate how the project would meet the required minimum diversion rates for the approximately 100,600 cubic yards of project-related construction and demolition debris (e.g., the existing restrooms, Great Highway pavement, revetments, rubble, and other construction waste; refer to EIR Chapter 2, Project Description, Section 2.5.4, Site Preparation, Earthwork, and Haul Truck Trips).

The Corinda Los Trancos Landfill (referred to as Ox Mountain) would most likely receive the portion of the remaining solid waste that cannot be diverted. Its total capacity was estimated at 60.5 million cubic yards in 2019, with approximately 18.2 million cubic yards of capacity remaining. The landfill can accept roughly 2,600 cubic yards of solid waste per day, and is estimated to reach capacity around 2039.[112] Compliance with

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[108] CalRecycle Disposal Reporting System, Jurisdiction Disposal and Alternative Daily Cover (ADC) Tons by Facility, *https://www2.calrecycle.ca.gov/LGCentral/DisposalReporting/Destination/DisposalByFacility*, accessed May 19, 2020.
[109] Ibid.
[110] San Francisco Environment Code, chapter 14, sections 1400-1417.
[111] San Francisco Environment Code, chapter 7, section 708.
[112] Republic Services. Memo from Agustin Moreno to Gordon Tong (County of San Mateo) re: Report of Landfill Activity, Corinda Los Trancos Landfill (Ox Mountain). Available online at: *https://ccag.ca.gov/wp-content/uploads/2019/08/Ox-Mountain-Landfill-Capacity.pdf*, accessed July 28, 2020.

mandatory state and local diversion requirements would reduce project effects on landfill capacity. The portion of construction waste that could not be diverted (approximately 25,000 cubic yards) would represent approximately 0.14 percent of the landfill's remaining capacity. Therefore, through adherence to applicable regulations, and considering the landfill's remaining capacity, the project's effect on landfill capacity and impairment of waste reduction goals would be ***less than significant***.

Operation

As under current conditions, project operational waste streams would generally be limited to visitor trash and that generated from regular facility cleaning and maintenance. As discussed in Section E.3, Population and Housing, and EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, Section 4.5, Recreation, the project would not induce population growth and, therefore, would not result in an increased use of recreational facilities that could expand solid waste generation. Trash containers would be placed within the project area, and either these containers would include separate receptacles for recyclables or the recyclables would be sorted from the trash after collection, in accordance with City Ordinance 100-09, the Mandatory Recycling and Composting Ordinance. For these reasons, project operation would not exceed available permitted landfill capacity or impair attainment of solid waste reduction goals; the impact would be ***less than significant***.

Impact UT-5: The project would comply with federal, state, and local management and reduction statues and regulations related to solid waste. (*Less than Significant*)

The California Integrated Waste Management Act of 1989,[113] enacted through AB 939 and modified by subsequent legislation, requires municipalities to implement programs to divert at least 50 percent of all solid waste generated by the year 2000 and establishes the goal of diverting at least 75 percent of generated waste (based on per capita disposal rates) by 2020. A jurisdiction's diversion rate is the percentage of its total waste that it diverts from disposal through reduction, reuse, recycling, and composting programs. As part of their integrated waste management plans, counties must ensure that a minimum of 15 years of disposal capacity is available to serve the county and its cities. Since 2007, the achievement of waste diversion rates has been measured based on per capita disposal rates, expressed in pounds per person per day of wastes disposed of in landfills. To achieve the target waste diversion rates, the California Department of Resources Recycling and Recovery (CalRecycle) has established a target disposal rate target for San Francisco of 6.6 pounds per person per day calculated based on the most recent reports filed by the San Francisco Environment Department (SF Environment).[114] In 2018, San Francisco generated 740,000 tons of waste, which amounts to 4.1 pounds per person per day, well below the California Integrated Waste Management Act target of 6.6 pounds per person per day for San Francisco.[115]

The California Green Building Standards Code was adopted in 2013.[116] The code mandates recycling or salvage for reuse of at least 50 percent of nonhazardous construction and demolition waste wherever a more stringent local standard does not exist. San Francisco Ordinance 27-06 requires a minimum of 65 percent of all construction and demolition debris to be recycled and diverted from landfills. The San Francisco Green Building Code also requires certain projects to submit a recovery plan to

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113 California Public Resources Code division 30, sections 40000-49620.

114 CalRecycle Annual Reporting System, Jurisdiction Diversion/Disposal Rate Detail for San Francisco, reporting years 2016, 2017, 2018, 2019, *https://www2.calrecycle.ca.gov/LGCentral/AnnualReporting/DiversionDisposal*, accessed May 22, 2020.

115 CalRecycle Annual Reporting System, Jurisdiction Diversion/Disposal Rate Detail for San Francisco, reporting years 2016, 2017, 2018, 2019, *https://www2.calrecycle.ca.gov/LGCentral/AnnualReporting/DiversionDisposal*, accessed May 22, 2020.

116 California Code of Regulations title 24, part 11, chapter 5, division 5.4.

SF Environment demonstrating recovery or diversion of at least 75 percent of all demolition debris. Furthermore, the city's Ordinance 100-09, the Mandatory Recycling and Composting Ordinance, requires everyone in San Francisco to separate their refuse into recyclables, compostables, and trash.

The project would comply with the solid waste disposal policies and regulations identified above. In addition, the Ox Mountain landfill, along with the other facilities serving the city, are also required to meet federal, state, and local solid waste regulations. Therefore, the project would have a ***less-than-significant*** impact with respect to compliance with solid waste statutes and regulations.

Impact C-UT-1: The project, in combination with the cumulative projects, would not result in significant utilities and service systems impacts. (*Less than Significant*)

The geographic scope for potential cumulative utilities and service systems impacts consists of the project area, its immediate vicinity, and the service areas of regional service/utility providers. Wastewater system facilities in the project vicinity include San Francisco's combined wastewater system and the Oceanside Treatment Plant. Multiple landfills are located within 100 miles, and these landfills could be used by the cumulative projects listed in Table 4.1-3, in EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, as well as by a wide variety of additional users.

Construction

Similar to the project, cumulative projects under construction at the same time within the vicinity would use or improve the same wastewater systems, which in some cases would increase the demand on such facilities. Construction of projects listed in Table 4.1-3 could occur at the same time as the project. These projects would all be subject to the same regulations, which would reduce stormwater runoff, potable water needs, and waste generation.

The project in combination with cumulative projects listed in Table 4.1-3 would not exceed the capacity of the wastewater collection system. Five of the projects (the Westside Pump Station Reliability Improvements, Vista Grande Drainage Basin Improvement, Oceanside Treatment Plant Improvements, San Francisco Zoo Recycled Water Pipeline, and Westside Force Main Reliability projects) would improve wastewater or stormwater collection or treatment facilities. While excavations for the cumulative projects could require groundwater dewatering, the amount of water generated would not exceed the capacity of the wastewater system because dewatered water could be stored if needed to comply with the requirements of discharge permits to which all cumulative projects would be subject.

Most of the cumulative projects listed in Table 4.1-3, regardless of construction date, would dispose of construction debris at available landfills, which would contribute to reductions in available landfill capacity. As discussed in Impact UT-4, the project would dispose of approximately 25,000 cubic yards of nonhazardous solid waste, which would be deposited in a landfill (assuming compliance with the city's 75 percent diversion requirement). Similarly, the other cumulative projects would also be required to divert at least 75 percent of construction waste generated; however, construction debris could be disposed at any number of landfills.

During the project's construction period, the Ox Mountain landfill would receive waste from the project and other projects outside of San Francisco but within the landfill's service area. For the purposes of this analysis, given the finite nature of landfill capacity, it is conservatively assumed there could be a significant cumulative impact on landfill capacity to which both the project and other projects could contribute. As noted above, as of 2019, the Ox Mountain landfill had a remaining capacity of over 18 million cubic yards and is capable of accepting about 2,600 cubic yards of material per day. The incremental effect of the project's daily and overall solid waste contribution to the Ox Mountain landfill would be small relative to the total daily and overall landfill capacity. As a result, the effects of the project's contribution to a potential cumulative impact on landfill capacities would not be cumulatively considerable (i.e., would be ***less than significant***).

Operation

Once operational, the project along with the cumulative projects would generally improve the stormwater and wastewater collection and treatment system and would not exceed the system's capacity. The only other cumulative projects that could generate solid waste during operation are the Lake Merced West project and the 2700 Sloat Boulevard project. Similar to the project, both of these projects are in San Francisco and would be subject to the city's Ordinance 100-09, the Mandatory Recycling and Composting Ordinance. Compliance with the Mandatory Recycling and Composting Ordinance would ensure that the cumulative impact on landfill capacity or attainment of solid waste reduction goals during project operation would be ***less than significant***.

E.14 PUBLIC SERVICES

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
14. PUBLIC SERVICES. Would the project:					
a) Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or other performance objectives for any of the public services such as fire protection, police protection, schools, parks, or other public facilities?	☐	☐	☒	☐	☐

Issues related to parks, which are referred to in topic E.14(a), are addressed in EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, Section 4.5, Recreation. Issues related to access for emergency vehicles are discussed in EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, Section 4.3, Transportation and Circulation. Issues related to wildland fires are addressed in initial study Section E.22, Wildfire.

Impact PS-1: Construction and operation of the project would not result in an increase in demand for fire protection, police protection, schools, or other services to an extent that would result in substantial adverse physical impacts associated with the construction or alteration of governmental facilities. (*Less than Significant*)

The project could have a significant impact on public services if (1) it would require the construction of new or physically altered governmental facilities in order to maintain acceptable levels of public services, *and* (2) the construction or alteration of such facilities would result in one or more substantial adverse impacts on the environment.

The project area currently receives services from the relevant city departments. The South Ocean Beach project site is served by several San Francisco Fire Department fire stations. Nearby stations include Station 19 at 390 Buckingham Way (approximately 1.25 miles to the northeast) and Station 18 at 1935 32nd Avenue (approximately 2.5 miles to the northeast). Stations near the North Ocean Beach project site include Stations 23 at 1348 54th Avenue and Station 34 at 499 41st Avenue (both less than 1 mile to the east).[117] The South Ocean Beach project site is served primarily by the San Francisco Police Department's Taraval Station at 2345 24th Avenue (approximately 2 miles to the northeast).[118] The North Ocean Beach project site is served by the Richmond and Taraval stations (both approximately 2.5 miles to the east). The

[117] San Francisco Fire Department (SFFD), available online at: *https://sf-fire.org/fire-station-locations*, accessed April 7, 2020.
[118] San Francisco Police Department (SFPD), available online at: *https://www.sanfranciscopolice.org/station-finder*, accessed April 7, 2020.

San Francisco Unified School District provides school services to residents in the project vicinity, and the San Francisco Public Library system provides library services to residents in the project vicinity.

Construction

Incidents requiring law enforcement, fire protection, or emergency medical services could occur during construction. Responding to such incidents is routine for the police and fire departments as construction projects are common and ongoing in the city. As described in EIR Chapter 2, Project Description, construction of the project would occur over a period of about four years and would require that an estimated average of 50 workers and a maximum of 130 workers be onsite during a given construction phase. Construction workers likely would commute from San Francisco and other Bay Area counties. Construction workers who are residents of San Francisco are currently being served by city services and thus would not represent an increase in demand for city services. While it is possible that some workers might temporarily relocate from other areas, project construction is not expected to result in a substantial unplanned increase in the local population (as described in Section E.3, Population and Housing) and thus would not result in increased response times such that new or physically altered facilities would be required to maintain service. Construction also would not result in the need for new or expanded schools or parks due to relocation of construction workers. Any increase in demand for public services during construction would be temporary and within the existing capacity of the city's existing emergency response service providers. For these reasons, the project would not require construction of new or physically altered facilities to maintain public services and the impact would be ***less than significant***.

Operation

The project does not include construction of residences, and operation of the project would not require increases in city staffing levels. For these reasons, and as discussed further in Section E.3, Population and Housing, the project would not be expected to result in a substantial unplanned population increase and so would not increase the need for public services including fire protection, police protection, schools, or libraries. Recreational use of the project area during operation would generally be similar to existing use (walking, running, bicycling through the project area, or surfing or other water activities) and would not increase demand for police or emergency responders. Because the project would not substantially increase the local population, the project would not result in substantial adverse physical impacts associated with the need for new or altered governmental facilities, and the impact would be ***less than significant***.

Impact C-PS-1: The project, in combination with the cumulative projects, would not result in significant impacts associated with the provision of new or physically altered governmental facilities. (*Less than Significant*)

The geographic scope for potential public service impacts encompasses the service areas of the police districts and fire stations that would serve the project. The project would contribute to a significant cumulative effect if (1) an increase in demand during project construction or operation would make a cumulatively considerable contribution to the public service demands of other projects described in EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, Section 4.1.5, Approach to Cumulative Impacts Analysis and Cumulative Projects, that, in combination, would require the construction of new or physically altered governmental facilities (i.e., fire or police stations); *and* (2) the construction of such facilities would have a significant adverse impact on the environment.

Table 4.1-3 in EIR Section 4.1 presents cumulative projects near the project area that could be under construction during some portion of the project's approximately four-year construction period.

Construction

During construction, the project could result in the need for law enforcement, fire protection, or emergency medical services response. Cumulative projects could result in the same need for police, fire, and emergency services during construction, from the same public service providers that serve the project area. The potential increase in demand for police, fire, and emergency services during construction of the project and cumulative projects would be temporary. Any increased need for law enforcement or fire protection services resulting from the project and cumulative projects would not be expected to exceed the level of demand anticipated by the police and fire departments or require the construction of new or physically altered governmental facilities that were not already planned. As a result, the project in combination with the cumulative projects would result in a ***less-than-significant*** cumulative impact related to emergency services.

Construction of the project would have not result in the need for new or expanded schools or parks due to the relocation of construction workers. As a result, project construction would not contribute to any potential cumulative impact on schools or parks resulting in the need for new or physically altered governmental facilities.

Operation

Cumulative development in the geographic scope would include improvements to existing wastewater collection system infrastructure, intersection improvements, new recreational trails or recreational facilities, and mixed-use development (2700 Sloat Boulevard). The Fort Funston Trail Connection, Signalization of State Route 35 and Great Highway Intersection, and Lake Merced West projects would enhance recreational use of the area by connecting the project area to adjacent recreational areas and by constructing a new recreational facility (in the case of Lake Merced West). These cumulative projects are designed to support future recreational use and would not result in the need for additional parks or public service facilities. Cumulative development would be within the city's planned growth projections and, as discussed in Impact C-PH-1, the project would not induce population growth. Therefore, the project would not contribute considerably to any associated cumulative impact concerning the provision of new or physically altered governmental facilities (***less-than-significant)***.

E.15 BIOLOGICAL RESOURCES

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
15. BIOLOGICAL RESOURCES: Would the project:					
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?	☒	☐	☐	☐	☐
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Wildlife or U.S. Fish and Wildlife Service?	☒	☐	☐	☐	☐
c) Have a substantial adverse effect on federally protected wetlands (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☒	☐	☐	☐	☐
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☒	☐	☐	☐	☐
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☒	☐	☐	☐	☐
f) Conflict with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or state habitat conservation plan?	☒	☐	☐	☐	☐

The project has the potential to result in significant impacts on biological resources. All biological resources topics (i.e., E.15(a) through E.15(f)) are addressed in EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, Section 4.6, Biological Resources.

E.16 GEOLOGY AND SOILS

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
16. GEOLOGY AND SOILS. Would the project:					
a) Directly or indirectly cause potential substantial adverse effects, including the risk of loss, injury, or death involving:					
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☒	☐	☐
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☒	☐	☐
iv) Landslides?	☐	☐	☒	☐	☐
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐	☐
c) Be located on geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☐	☒	☐	☐
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial direct or indirect risks to life or property?	☐	☐	☒	☐	☐
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of waste water?	☐	☐	☐	☐	☒
f) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☒	☐	☐

The project site is located outside of any Alquist-Priolo Earthquake Fault Zone and the nearest active fault is approximately 1.6 miles southwest of the site.[119] As a result the potential for surface fault rupture is considered very low. For this reason, topic E.16 (a) i) is not discussed further.

[119] AGS, *Final Geotechnical Data Report (GDR),* South Ocean Beach Coastal Erosion and Wastewater Infrastructure Protection, San Francisco, California, July 2020, p. 29.

Sanitary sewer flows generated from the proposed restroom would be conveyed to the city's combined wastewater system. The project would not include septic tanks or other on-site land disposal systems for sanitary sewage. For this reason, topic E.16(e) is not addressed further.

Impact GE-1: Construction and operation of the project would not directly or indirectly cause substantial adverse effects, including the risk of loss, injury, or death involving seismic ground shaking, seismically induced ground failure, or landslides. (*Less than Significant*)

Ground Shaking and Liquefaction

The project site is located in a seismically active region with numerous active faults.[120] The closest active fault is the San Andreas fault, which is offshore, approximately 1.6 miles southwest of the site. Another offshore active fault, the San Gregorio fault, is located approximately 4.8 miles southwest. To the east is the Hayward fault, which is approximately 17 miles from the project site. Other active faults considered capable of causing substantive shaking at the project site include the Mount Diablo Thrust, Calaveras, Green Valley, West Napa, Greenville and Rodgers-Creek faults. Ground shaking may affect areas hundreds of miles distant from the earthquake's epicenter. Historic earthquakes have caused strong ground shaking and damage in the San Francisco Bay Area, such as the 1989 Loma Prieta earthquake and the 2014 West Napa Earthquake.

Based on regional shaking hazard maps in the Community Safety Element of the San Francisco General Plan, which are derived from shaking hazard mapping prepared by ABAG in 2003, the project site could experience violent ground shaking due to an earthquake along the Peninsula-Golden Gate segment of the San Andreas Fault.[121] More recent mapping developed in 2013 by ABAG, in conjunction with the U. S. Geological Survey and California Geological Survey, confirms the project site could be subjected to violent ground shaking.[122] The effects of an earthquake of such magnitude would vary depending on a number of factors including distance to the epicenter and duration of shaking and would likely have the highest potential for damage to above ground improvements. In general, subsurface improvements are not as susceptible to damage from groundshaking as above ground improvements where the damage is caused by amplification of ground surface seismic waves.

However, subsurface and above ground improvements could both be affected by liquefaction. Liquefaction is a phenomenon in which shallow (less than 50 feet deep), loose, cohesion-less soils lose their strength due to the built-up water pressure from ground shaking. The primary geologic units found at the project site include historical artificial fill, Holocene-age dune sand and beach sand, Pleistocene-age Colma Formation (generally consisting of poorly consolidated sand), Pliocene-age Merced Formation (consisting of poorly consolidated sand, clay, gravel and silt), and Jurassic- and Cretaceous-age *Franciscan Complex* (greywacke sandstone, a sandstone variety characterized by its dark color and composition, siltstone, claystone and shale).[123] Depth to groundwater was measured at approximately 22 to 25 feet below ground surface along the Great Highway (or elevation of between +16 and +19 feet above sea level) during a 2019 geotechnical investigation. Groundwater levels from earlier investigations in 1989 and 1977 show groundwater depths

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[120] A fault is considered active if it has shown evidence of displacement during the last 11,700 years.

[121] San Francisco Planning Department, Community Safety Element of the General Plan of the City and County of San Francisco, October 2012, p. 10.

[122] Association of Bay Area Governments (ABAG), Resilience Program. San Francisco County Earthquake Hazard, *http://resilience.abag.ca.gov/earthquakes/sanfrancisco/*, accessed November 22, 2019.

[123] The Holocene age includes the time since the last major glacial epoch beginning approximately 11,700 years ago. Pleistocene time period began approximately 2.6 million years ago and lasted until the Holocene, approximately 11,700 years ago. The Pliocene time period ranges from approximately 5.3 to 2.6 million years ago. Jurassic period was approximately 199.6 to 145.5 million years ago. Cretaceous is defined as 145.5 to 65.5 million years ago.

ranging from approximately 20 to 35 feet below ground surface. Research shows that Colma and Merced Formation deposits, although both characterized as poorly consolidated sandy units, generally have a low to very low susceptibility to liquefaction.[124]

While the geotechnical investigation prepared for the buried wall identifies some relatively thin intermittent layers of medium dense sands as potentially being susceptible to liquefaction, the fact that they are localized, thin, and at greater depths indicate a low potential to affect the proposed improvements.[125] However, the report also concludes that liquefaction of saturated loose to medium dense sandy soils may occur during a major earthquake and result in liquefaction-induced settlement. The estimated settlement is expected to be variable across the site ranging from less than 0.25 inch to 3.5 inches.[126] In addition, much of the project site is located within an area mapped by the California Geological Survey (formerly known as the California Department of Mines and Geology) as susceptible to liquefaction in accordance with the Seismic Hazards Zonation Program.[127]

Roadway, Public Access, Parking, and Restroom Improvements

The project includes only minor above ground improvements, such as the new restroom, beach access stairs, the multi-use trail, and roadway improvements. Regardless, the project would not expose people or structures to substantial adverse effects related to ground shaking or liquefaction, because the proposed improvements would be designed and constructed in accordance with the most current San Francisco Building Bode (building code) or SFPUC's General Seismic Requirements for Design of New Facilities and Upgrade of Existing Facilities Revision 3 (general seismic requirements), as discussed in greater detail below.[128]

Section 1803 of the building code, applicable to the proposed new restroom facility, utilities, sidewalks, and road improvements, requires that a site-specific geotechnical investigation must be conducted by a state licensed geotechnical engineer. This report provides information about geotechnical hazards and recommendations to ameliorate those hazards which are to be addressed in the project's design.[129]

Recommendations must include the appropriate foundation type, structural systems, ground stabilization, or any combination of these to address the effects of ground shaking, liquefaction and related phenomena. The appropriate foundation type and depths and selection of the effective structural systems, for example ground stabilization, would be made in order to accommodate anticipated ground displacements and forces based on site specific conditions. Ground stabilization is a method of improving soil properties by blending and mixing other materials which can be employed to accommodate certain foundation and structural design. The recommendations of the geotechnical report to address such geotechnical hazards must be incorporated into the design of proposed improvements, such as the restroom, utilities, and sidewalk and roadway elements. The building code requires that project designs, including site utilities, be consistent

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124 AGS, Final Geotechnical Interpretive Report (GIR), South Ocean Beach Coastal Erosion and Wastewater Infrastructure Protection, San Francisco, California, July 2021, p. 26.

125 Ibid.

126 Ibid, Table 7 p. 26.

127 California Division of Mines and Geology (CDMG), Seismic Hazard Zones, City and County of San Francisco, Official Map, released November 17, 2000.

128 San Francisco Public Utilities Commission (SFPUC), General Seismic Requirements for Design of New Facilities and Upgrade of Existing Facilities, Revision 3, June 2014.

129 City and County of San Francisco Department of Building Inspection, Information Sheet S-05, Geotechnical Report Requirements, May 7, 2019.

with the recommendations of the final site-specific geotechnical report which would reduce the potential for impacts related to liquefaction and earthquake-induced settlement to less-than-significant levels.

Buried Wall

The SFPUC's general seismic requirements set forth consistent criteria for the seismic design and retrofit of San Francisco's water and wastewater infrastructure.[130] The general seismic requirements state that improvements must be capable of withstanding design ground motion that has a 5 percent probability of exceedance in 50 years (975-year return period). In accordance with these design standards, every project that includes modifications to an existing facility or construction of a new facility must assign the facility a seismic performance class based on the seismic environment at the site and importance of the facility in meeting level of service goals for the water or wastewater system. These design standards may even exceed applicable building code requirements and industry standards based on the seismic performance class or other factors.

SFPUC has prepared a geotechnical report with design recommendations for the buried wall consistent with the general seismic requirements, and is requiring design and construction of the proposed facilities in accordance with the state building code and American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) 7-16,[131] which incorporate other well-established industry design criteria (such as those described above). Incorporation of the appropriate engineering and design features would enable the proposed facilities to withstand the calculated seismic forces suchthat they would not be substantially damaged in the event of a major earthquake.

Under the project, incorporation of the engineering and design features recommended by the qualified geotechnical engineering professional, in accordance with the San Francisco Building Code and SFPUC's general seismic requirements, would ensure that the proposed improvements would not exacerbate the potential for people or structures to be exposed to substantial adverse effects associated with seismic ground shaking. Therefore, impacts related to ground shaking would be less than significant.

Lateral Spreading

Lateral spreading is the lateral movement of a liquefiable surficial soil mass towards a free face (such as the coastal bluff and beach slopes) during earthquakes. The geotechnical investigation for the project site concluded that construction of the proposed buried wall (secant pile wall) would not interfere with the continuity of any potentially liquefiable soils making the potential for lateral spreading low once the wall is completed.[132] The preliminary geotechnical report also includes measures to reduce the risk of lateral movement of soil during construction such as ground improvements with deep soil mixing or chemical grouting. Deep soil mixing adds a cement slurry to strengthen the existing soil. These recommendations have been incorporated into the project design. Therefore, impacts related to lateral spreading would be less than significant.

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[130] San Francisco Public Utilities Commission (SFPUC), General Seismic Requirements for Design of New Facilities and Upgrade of Existing Facilities, Revision 3, June 2014.

[131] American Society for Civil Engineers and the Structural Engineering Institute have published the ASCE/SEI 7-16 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures, which is incorporated into the San Francisco Building Code and the SFPUC general seismic requirements, most recently updated in 2016.

[132] AGS, Final Geotechnical Interpretive Report (GIR), South Ocean Beach Coastal Erosion and Wastewater Infrastructure Protection, San Francisco, California, July 2021, p. 29.

Earthquake Induced Landslides

Project components are primarily proposed along the coastal bluffs on the southwest side of the San Francisco Peninsula. Within this area, referred to generally in this document as "South Ocean Beach,"[133] the bluffs consist of uplifted sedimentary bedrock units (the Merced and Colma Formations) that reflect landward and seaward movement of the shoreline over episodes of glacial changes and tectonic activity.[134] The result is a stratigraphy of alternating layers of marine sediments, such as silts and clays; coarser sediments of sand and gravel deposited in the surf zone; backshore sediments consisting of fine-grained sands, silts and muds; as well as non-marine estuarine fine-grained sediments and wind-blown sands.[135] The bluffs at the southern end of the project site are composed of Colma material, and stand vertical, compared to the northern 1,800 feet which is characterized by eroding imported fill and concrete rubble. Topographically, the ground surface elevation of the coastal bluffs between the Great Highway and the shoreline generally range from 20 to 25 feet above sea level at the north end and greater than 60 feet above sea level at the south end.[136] Within the South Ocean Beach portion of the project area, the ground surface elevation increases gradually along the Great Highway from approximately 30 feet above sea level at the north end to approximately 60 feet above sea level at the south end. The bluffs slope gently westward at the northern end and steepen at the south end, where they are currently in varying stages of erosion and instability.[137]

The project alignment is outside of any State of California-designated Seismic Hazard Zone for earthquake-induced landslides; however, the Fort Funston bluffs immediately south of the southern end of the project site are mapped by the California Geological Survey as an area susceptible to earthquake-induced landslides.[138] The nearest project components to this area are the southern end of the buried wall and the associated slope stabilization, for which a geotechnical report has been prepared. The steepness of the bluffs within the project site range from gentle (3.5:1 horizontal to vertical slope) in the northern portion to steeper (1.75:1 horizontal to vertical slope) in the southern portion.[139] Past periods of heavy storm events have caused some years of increased wave run-up which has eroded the base of the bluffs resulting in areas of instability, bluff failure, and some collapse of the Great Highway shoulder of the southbound lane.

The project would reshape the bluff to provide a more gradual and stable slope face that includes a buried wall with associated slope stabilization to improve overall slope stability (see EIR Figure 2-6 for a conceptual cross section of the reshaped bluff configuration). The slope stabilization would consist of a 3-foot-thick, gently sloping (3 foot horizontal to 1 foot vertical slope) layer of either a cement soil mixture or controlled low strength material. The north and south ends of the wall would also receive additional slope stabilization measures as described in more detail in Chapter 2, Project Description, which includes use of deep soil

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133 Note that the project also includes harvesting sand from North Ocean Beach for small sand placements. As discussed in Chapter 2, Project Description, the area from where sand would be excavated is currently used as a source for as-needed beach nourishment. The majority of project elements are located south of Sloat Boulevard and are the focus of the setting information.

134 AGS, Final Geotechnical Data (GDR), South Ocean Beach Coastal Erosion and Wastewater Infrastructure Protection, San Francisco, California, July 2020, p. 23.

135 Ibid.

136 AGS, Final Geotechnical Data Report (GDR), South Ocean Beach Coastal Erosion and Wastewater Infrastructure Protection, San Francisco, California, July 2020, p. 5.

137 Slopes are estimated to be sloping at approximately 3.5H:1V (horizontal to vertical) in the northern end of the site and 1.75H:1V in the southern end of the site.

138 California Division of Mines and Geology (CDMG), Seismic Hazard Zones, City and County of San Francisco, Official Map, released November 17, 2000. Note that the stability of these bluffs south of the project site are also discussed in Impact GE-5, below, as it relates to erosion and the potential for the project to exacerbate erosional conditions.

139 AGS, Final Geotechnical Data Report (GDR), South Ocean Beach Coastal Erosion and Wastewater Infrastructure Protection, San Francisco, California, July 2020, p. 5.

mixing (blending of cement with existing soil) to increase slope stability. This slope stabilization and any fills or backfills would be placed in accordance with the site-specific geotechnical report recommendations that would include compaction and inclination specifications necessary to meet SFPUC's general seismic requirements. In addition, the restored dune slope face would include native vegetation planting to provide stability to the dune slopes. Continued beach nourishment to replace future erosion and redistribution of the dune sand would also be part of the project. Construction of the buried wall and stabilization of the underlying slopes, consistent with geotechnical recommendations as overseen by a state licensed geotechnical engineer, would improve overall slope stability compared to existing conditions such that the potential for earthquake-induced landslides would be less than significant.

Conclusion

Because the project would be designed to withstand geotechnical hazards including slope stability, erosion, liquefaction, and ground shaking by incorporating recommendations identified in a required site-specific geotechnical report, in accordance with the San Francisco Building Code and the SFPUC's general seismic requirements, as described above, the project would not exacerbate the potential for people or structures to be exposed to substantial adverse effects associated with seismic hazards, including seismic ground shaking, liquefaction and seismically-induced ground failure, seismically-induced lateral spreading, or seismically-induced landslides. In addition, the project would not exacerbate existing or future seismic hazards. Therefore, this impact would be ***less than significant*** and no mitigation is required.

Impact GE-2: The project would not result in substantial soil erosion or loss of topsoil. (*Less than Significant*)

As noted in Impact GE-1, the project site is underlain by artificial fills, dune sands, beach sands, Colma Formation, Merced Formation, and Franciscan Complex. There are no materials present that would be considered topsoil.[140] Erosion of the bluffs is a current hazard at the site and is discussed further in Impact GE-3.

Implementation of the project would include earthwork activities to reconfigure roadways, utilities, and other appurtenances that could increase the potential for soil erosion in the area of ground disturbance. Construction activities would be required to implement an erosion and sediment control plan for construction activities in accordance with article 4.2 of the San Francisco Public Works Code and the state *General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities* (discussed in more detail in Section E.17, Hydrology and Water Quality) to reduce amount of erosion at the construction site from stormwater runoff. The SFPUC must review and approve the erosion and sediment control plan completed in accordance with article 4.2 prior to implementation and would conduct periodic inspections throughout construction to ensure compliance with the plan.

Once construction is completed, developed portions of the project site would be occupied by pavement and landscaping with drainage features consistent with San Francisco Stormwater Management Requirements and Design Guidelines (discussed in greater detail in Section E.17, Hydrology and Water Quality), which would serve to reduce soil erosion from stormwater during operations. Therefore, with compliance with stormwater management requirements during construction activities, and with appropriate project design,

[140] Topsoil typically refers to the top 2 to 8 inches of soil containing large amounts of organic material and microorganisms.

impacts related to soil erosion would be ***less than significant*** during construction and operation of the project.

The project's effects on coastal processes, and associated beach and bluff erosion, are discussed below in Impact GE-3.

Impact GE-3: The project site would not be located on a geologic unit or soil that is unstable, or that could become unstable as a result of the project. (*Less than Significant*)

The project is designed and engineered to provide multiple benefits including protecting the Lake Merced Tunnel from erosion, enhancing public access, and maintaining coastal habitat. Other than the relocation of the restroom and addition of the beach access stairway,[141] the project does not include any above ground buildings or structures. The impacts of constructing and operating the few improvements that could be subject to unstable geologic units or otherwise affect site stability are discussed below. In addition to analysis of potential project effects associated with project construction activities, the impact discussion also examines potential post-construction project effects related to physical shoreline processes, focusing specifically on whether the project would substantially modify offshore sand bars that contribute to suitable surfing conditions or cause accelerated erosion of adjacent shoreline areas. To provide context for the operations impact analysis, the existing coastal process setting is summarized, followed by discussion of potential project effects.

Coastal Processes

Overview

Physical processes that shape coastal shorelines, referred to generally as "coastal processes," are complex interactions between the atmosphere, land, and sea. These processes drive the movement of sediment; those that move sand onshore generally contribute to the formation of beaches, while those that move sand offshore contribute to shore erosion and can also cause the expansion of sand bars in the surf zone. These *cross-shore* (perpendicular to shore) sand transport processes can be reversible or can accumulate to the point of causing long-term shore migration. Reversible changes in coastal shoreline morphology are associated with sand exchange between the beach and surf zone bars in response to seasonal changes in wave climate, and also individual events such as storms and large swells (**Figure 2**).[142] Over time, long-term morphological changes can indirectly result from direct shoreline changes, such as due to wave reflection from a seawall, as well as a change in sand supply. *Along shore* (also called *longshore*[143]) sand transport also can have both reversible and long-term effects on beach widths and surf zone geometry. Longshore transport is typically associated with waves approaching the shore at an angle (e.g., from the south or north at South Ocean Beach) and driving sand transport alongshore (e.g., to the north or south, respectively).

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[141] See EIR Chapter 2, Project Description, for further description of beach access stairway which would span over the buried wall and slope stabilization, be constructed of concrete and supported on concrete piers.

[142] Adapted from U.S. Army Corps of Engineers (USACE), 2003. Coastal Engineering Manual 1110-2-1100, Part III, Chapter 3, Cross-shore Sediment Transport Processes, Figure III-3-2.

[143] A longshore current is current formed when an obliquely approaching wave pushes water into the surf zone that then flows away from the direction of the approaching wave. The resulting current runs parallel to the shore. Longshore currents exist along most of California's beaches.

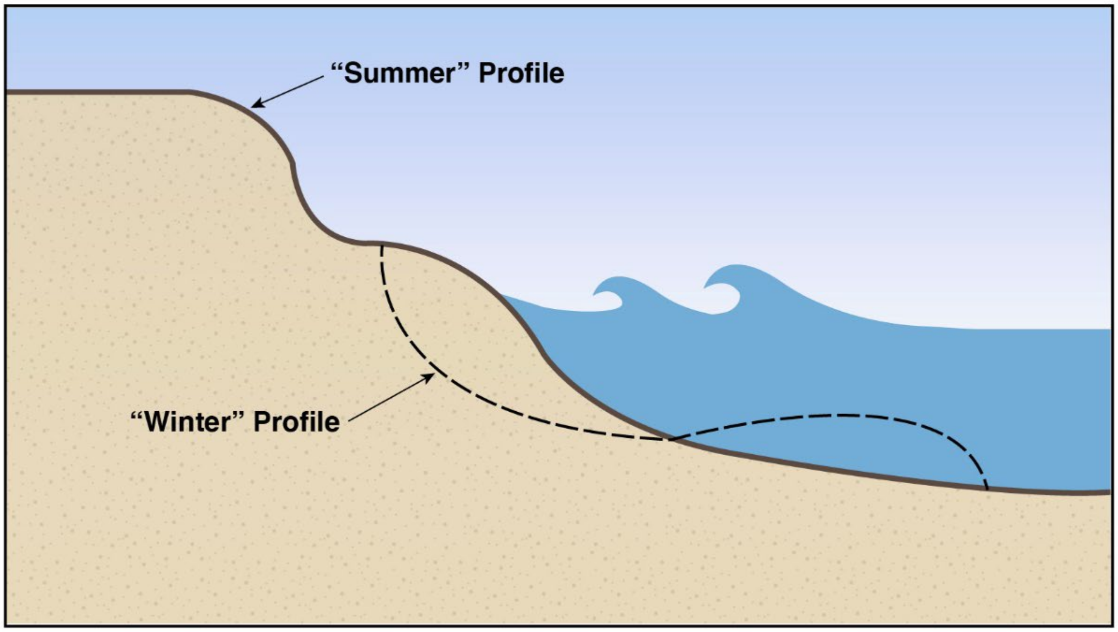

FIGURE 2 CONCEPTUAL SCHEMATIC OF SEASONAL CHANGES OF A SANDY SHORE PROFILE

Human manipulation of shorelines can disrupt natural coastal processes, resulting in unintended effects on adjacent coastal areas. Shore protection structures (e.g., seawalls, revetments) are designed to prevent erosion of the land behind the structures. Such features can change wave energy dissipation and the rate of sand transport locally.[144] During elevated wave events, scour can occur in front of and adjacent to an exposed shoreline protection structure, lowering the beach, increasing wave reflection, and increasing offshore and alongshore sand movement. The offshore sand movement and reflected waves can change the shape of the nearshore sand bars and associated breaking wave patterns (**Figure 3**).[145] However, the importance of wave reflection and its effects on the surf zone are not well defined in the coastal engineering literature and are the subject of further research.[146,147,148,149,150]

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144 Griggs, Gary; Kiki Patsch and Lauret Savoy. Living with the Changing California Coast, University of California Press, Berkeley and Los Angeles California, USA. 2005.

145 Adapted from USACE, 2003. Coastal Engineering Manual 1110-2-1100, Part III, Chapter 3, Cross-shore Sediment Transport Processes, Figure III-3-2.

146 Kraus, N.C., 1988. The Effects of Seawalls on the Beach: An Extended Literature Review. In The Effects of Seawalls on the Beach, N.C. Kraus and O.H. Pilkey (Editors), Journal of Coastal Research, Si 4, 1-29.

147 Barnett Michael R., A. M., ASCE, and Hsiang Wang. Effects of a Vertical Seawall on Profile Response. Chapter 111, Twenty-first Coastal Engineering Conference Proceedings of the International Conference Volume 1 June 20-25, 1988 Costa del Sol-Malaga, Spain, American Society of Civil Engineers New York, New York, USA.

148 Kraus, Nicholas C., and William G. McDougal. "The Effects of Seawalls on the Beach: Part I, An Updated Literature Review." Journal of Coastal Research, vol. 12, no. 3, 1996, pp. 691–701. JSTOR, *www.jstor.org/stable/4298517*. Accessed 17 May 2021.

149 William G. McDougal, et al. "The Effects of Seawalls on the Beach: Part II, Numerical Modeling of SUPERTANK Seawall Tests." Journal of Coastal Research, vol. 12, no. 3, 1996, pp. 702–713. JSTOR, *www.jstor.org/stable/4298518*. Accessed 17 May 2021.

150 US Army Corps of Engineers (USACE), 2003, Coastal Engineering Manual 1110-2-1100. Part V, Chapter 3. pp 28-43.

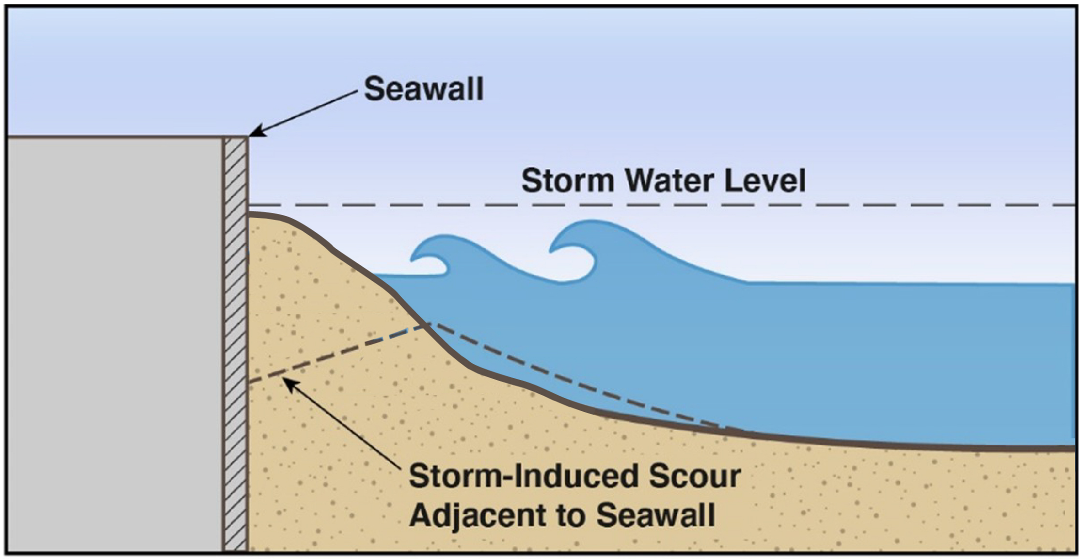

FIGURE 3 **CONCEPTUAL SCHEMATIC OF A SANDY SHORE PROFILE RESPONSE WITH A SEAWALL**

Natural coastal processes are expected to change further with sea level rise. The best available science and most recent guidance adopted by the California Coastal Commission is provided in the Ocean Protection Council's (OPC) State of California Sea-Level Rise Guidance 2018 Update.[151] The OPC guidance presents probabilistic projections of sea level rise based upon greenhouse gas emissions levels. Under a high emissions scenario, the guidance indicates that by 2100, sea level along the San Francisco shoreline could rise between 2.5 feet (50 percent probability) and 6.9 feet (0.5 percent probability). The guidance also includes an extreme sea level rise scenario (referred to as H++) in which the Western Antarctic ice sheet melts, resulting in a 10.2-foot increase in sea level by 2100; the guidance does not assign a probability of occurrence to this scenario. With increased sea levels, the effects of storm surge, high tides, and wave action on shorelines is expected to increase. As a result, depending upon the amount of sea level rise, the types of effects identified above (e.g., exposure of shoreline infrastructure, wave-structure interactions, changes in sand transport, shore erosion) are also expected to increase.

Beach nourishment projects can help to dissipate wave energy by increasing sand supply to the surf zone and adjacent shores and buffering the shore from erosion (**Figure 4**).[152] However, sand placement can also alter offshore sand bar geometry by changing sand transport rates and patterns through the surf zone.[153] These changes can, in turn, affect wave breaks and patterns.

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[151] Ocean Protection Council, 2018. State of California Sea-Level Rise Guidance. California Ocean Protection Council, 2018 Update.
[152] Adapted from USACE, 2003. Coastal Engineering Manual 1110-2-1100, Part III, Chapter 3, Cross-shore Sediment Transport Processes, Figure III-3-2.
[153] Stauble, Donald K. PhD, PG, 2005. A Review of the Role of Grain Size in Beach Nourishment Projects. U.S. Army Engineer Research and Development Center Coastal and Hydraulics Laboratory 3909 Halls Ferry Road Vicksburg, MS 39180-6199.

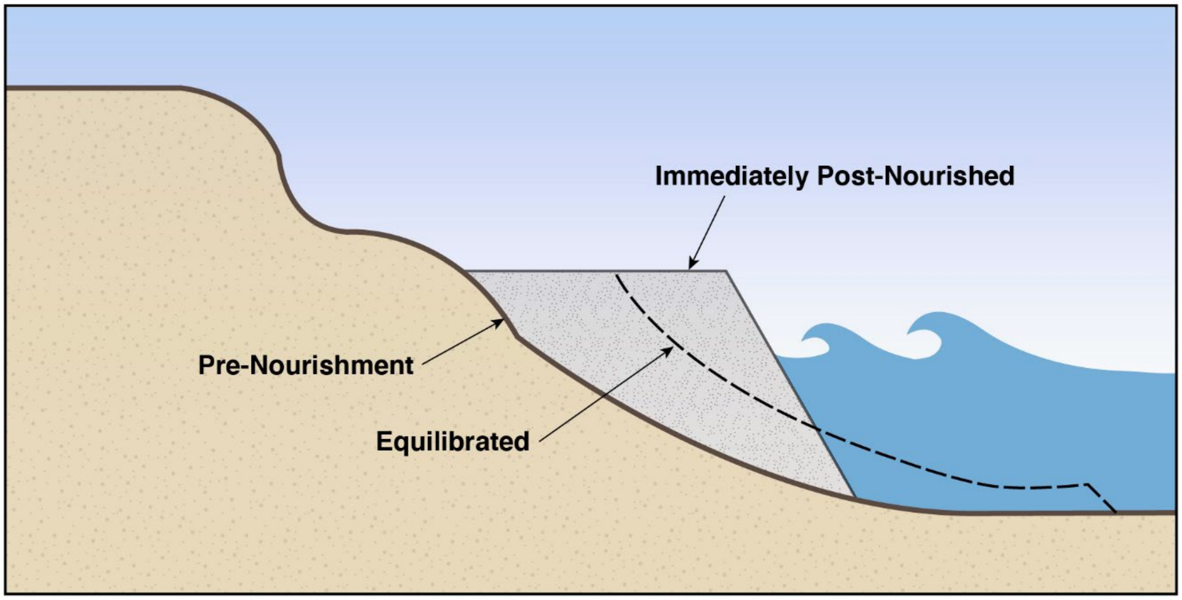

FIGURE 4 **CONCEPTUAL SCHEMATIC OF A SANDY SHORE PROFILE RESPONSE TO BEACH NOURISHMENT**

Project Setting

As noted in EIR Chapter 1, Introduction, Ocean Beach is located within the San Francisco Littoral Cell,[154] which extends along approximately 17 miles of coastline between the Golden Gate and San Pedro Point. Along this stretch of coastline, coastal processes are driven primarily by waves, tidal currents, and freshwater outflow from the San Francisco Bay. Within this system, the *swell* – collections of waves formed by wind and organized during travel from the wind source – from the Pacific Ocean is responsible for substantial localized changes in shoreline position over short periods (e.g., winter storm season). The surf zone and shore at Ocean Beach is very dynamic, as documented by extensive field data collection and analysis by the United States Geological Survey (USGS).[155] However, regional sediment supply and transport mechanisms are primarily responsible for large-scale, long period (i.e., multi-year) shoreline changes.[156]

Prominent features of the littoral cell are the San Francisco Bay bar and the 300-foot deep narrow channel at the Golden Gate. Together, these features focus wave energy and tidal currents that drive large-scale sediment movement along Ocean Beach.[157] Notably, wave *refraction*[158] over the San Francisco Bay bar focuses wave energy north of the South Ocean Beach project site, approximately offshore of Taraval Avenue. In this area, the refracted waves converge with each other yielding high wave energy near the shore. To the south of this high wave energy area, the waves diverge, typically resulting in slightly lower wave

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154 A littoral cell is a sandy stretch of the coast that contains its own sediment sources and sinks.

155 Hansen, Jeff E. and Patrick L. Barnard, Sub-weekly to interannual variability of a high-energy shoreline, Coastal Engineering, Volume 57, Issues 11–12, 2010, Pages 959-972

156 Battalio, R.T., 2014, Littoral processes along the Pacific and bay shores of San Francisco, California, USA, Shore & Beach, 82(1), Winter 2014, 3-21.

157 ESA, 2015, San Francisco Littoral Cell Coastal Regional Sediment Management Plan, Prepared for U.S. Army Corps of Engineers and the Coastal Sediment Management Workgroup. August 2015

158 The bending of a wave as it travels over different depths.

energy along the South Ocean Beach project site, and a fluctuating net sand transport away from the site.[159,160]

Natural coastal processes within the littoral cell have been substantially altered by human activities over the past century and a half.[161] The most notable of these alterations include changes to the natural sediment supply and pathways (e.g., elimination of coastal watershed connection to the ocean such as the Lake Merced creek, commercial sand mining within the San Francisco Bay,[162,163] main ship channel dredging with deep ocean disposal of dredged material[164]), and shoreline modifications (e.g., substantially widening Ocean Beach throughout the 20th century through placement of fill and sand,[165] and conventional shoreline protection).

As discussed further in Appendix H, studies have suggested that the sediment system that encompasses Ocean Beach is becoming finer in some areas, but the data is very limited so the overall trend is not clear.[166,167] Over time, the sand grain size at Ocean Beach appears to have decreased, and the sand grain size of sediment being dredged from the main ship channel has decreased considerably.[168] Little data exists to characterize the native grain size at South Ocean Beach, aside from samples that have been collected in the swash zone on the beach face where waves break.[169] Sand grain sizes in the swash zone tend to be the coarsest sediment across the entire active coastal profile. The recommended approach for determining the native grain size for compatibility to nourishment materials is by developing a composite grain size, which is based on samples from the dunes and back-beach, across the beach face, the intertidal zone, and to subtidal depths seaward to the depth of closure, estimated to be at least -30 feet NAVD contour or deeper.[170] Because

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159 Battalio R.T., and Trivedi, D., 1996, Sediment transport processes at Ocean Beach, San Francisco, CA, Proc. 25th Int. Conf. Coastal Engineering, Orlando, FL, ASCE, 2691-2704.

160 Hanes, Daniel M. Patrick L. Barnard, Kate Dallas, Edwin Elias, Li H. Erikson, Jodi Eshleman, Jeff Hansen, Tian Jian Hsu, and Fengyan Shi, 2011. Recent Scientific Advances and Their Implications for Sand Management Near San Francisco, California. The influences of the Ebb Tidal Delta, The Proceedings of the Coastal Sediments Conference

161 Barnard, P.L.; Hansen, J.E., and Erikson, L.H., 2012. Synthesis study of an erosion hot spot, Ocean Beach, California (USA). Journal of Coastal Research, 28(4), 903–922. West Palm Beach (Florida).

162 Dallas, K. L., & Barnard, P. L. (2011). Anthropogenic influences on shoreline and nearshore evolution in the San Francisco Bay coastal system. Estuarine, Coastal and Shelf Science, 92(1), 195–204.

163 Barnard, P.L., Foxgrover, A.C., Elias, E.P.L., Erikson, L.H, Hein, J.R., McGann, M., Mizell, K., Rosenbauer, R.J., Swarzenski, P.W., Takesue, R.K., Wong, F.L., and Woodrow, D.L., 2013, Integration of bed characteristics, geochemical tracers, current measurements, and numerical modeling for assessing the provenance of beach sand in San Francisco Bay Coastal System, Marine Geology, 345, 181-206.

164 Until 1971, clean sand removed from the main ship channel was dumped into the deep ocean, which permanently removed that sand from the region's littoral system. Starting in 1971, the sand was placed southeast of the Main Shipping Channel atop the Bar (known as disposal site SF-8). In 2005, the dredged sand began to be placed close to a southern stretch of Ocean Beach just offshore of an erosional hotspot (near Sloat Avenue; known as demonstration site SF-17).

165 North of Sloat Boulevard, the placement of sand on Ocean Beach between 1915 and 1929 to support Great Highway construction shifted the shoreline approximately 200 to 300 feet seaward of its 1899 position; leading up to the 1960s construction of the Great Highway Extension south of Sloat Boulevard, the roadway alignment was filled with sand and other materials to depths of 5 to 38 feet, including fill over the former outlet and coastal embayment of the Lake Merced creek; in the early 1970s, the city sanctioned dumping of construction rubble along 0.66 mile of bluff west of the Great Highway Extension to protect the road from erosion - large chunks of broken concrete, blocks of road asphalt and rusty cable and reinforcing steel, mostly from an underpass project at Geary Boulevard and Masonic Avenue, was dumped over the bluff, on to the beach.

166 Barnard, P.L., Hansen, J.E., Erikson, L.H., 2012, Synthesis study of an erosion hot spot, Ocean Beach, CA (USA), *Journal of Coastal Research*, 28 (4), 903-922.

167 Barnard, P.L., Foxgrover, A.C., Elias, E.P.L., Erikson, L.H., Hein, J.R., McGann, M., Mizell, K., Rosenbauer, R.J., Swarzenski, P.W., Takesue, R.K., Wong, F.L., and Woodrow, D.L., 2013, Integration of bed characteristics, geochemical tracers, current measurements, and numerical modeling for assessing the provenance of beach sand in the San Francisco Bay Coastal System, *Marine Geology*, 336, 120-145.

168 Battalio, R.T., 2014, Littoral processes along the Pacific and bay shores of San Francisco, California, USA, Shore & Beach, 82(1), Winter 2014, 3-21.

169 Barnard et al., 2007, Coastal Processes Study at Ocean Beach, San Francisco, CA: Summary of Data Collection 2004-2006, United State Geological Survey (USGS), Open-File Report 2007–1217.

170 Dean, R.G., 2002, *Beach Nourishment Theory and Practice*, Advanced Series on Ocean Engineering – Volume 18, World Scientific, River Edge, NJ, 399 pp.

the sand grain size is finer at back-beach and subtidal areas, data that do not include samples of sediments from these areas will suggest that the native beach grain size is larger than exists across the beach and subtidal portions of the shore profile.

These factors have altered the coastal processes and, under current conditions, the middle and northern portions of Ocean Beach are experiencing sand accumulation, while the southern portion is experiencing substantial erosion.[171,172] The past 20 years have seen several severe erosion episodes, typically during El Niño seasons, which have resulted in bluffs receding 70 feet over a decade in some stretches south of Sloat Boulevard.[173] In one winter alone (2009–2010), sections of the coast eroded up to 40 feet inland, undermining parking lots and the shoulder of the Great Highway and resulting in closure of the southbound lanes.[174] As noted above, with sea level rise, the rate of erosion along Ocean Beach is expected to increase over background rates. The amount of erosion is expected to vary depending upon location (i.e., less erosion along North Ocean Beach and more erosion along South Ocean Beach), and amount of sea level rise.[175]

Past and present efforts to address erosion at South Ocean Beach have involved further shoreline modifications, including constructing sandbag and rock revetments, and implementing beach nourishment projects using sand from North Ocean Beach. These interventions, in turn, may have resulted in additional localized coastal process effects. For example, annual shoreline monitoring has documented segments of South Ocean Beach with revetments as having the narrowest beach, suggesting wave reflection off the revetments may be causing localized beach scour.[176] Similarly, a recent review of historic shoreline erosion rates along South Ocean Beach indicate accelerated bluff retreat immediately adjacent to and downcoast of the project area and the 2010 emergency riprap revetment (Figure 1-5). Wave reflection off the revetment appears to be causing accelerated beach and bluff erosion adjacent to the southern end of the structure, a phenomenon commonly referred to as *end effects*.[177,178]

Construction

Roadway, Public Access, Parking and Restroom Improvements

As discussed in Impact GE-1, the San Francisco Building Code requires a site-specific geotechnical report be prepared prior to construction of the proposed improvements. The report would include recommendations that detail the site preparation methods (i.e., removal of unsuitable fills, backfill composition, moisture content and compaction standards), and set forth structural and foundation design criteria for conformance with applicable code requirements to ensure that the potential settlement effects of excavation and earthwork activities during construction are adequately addressed. With implementation of these recommendations, the project would comply with the San Francisco Building Code and include measures identified by a state licensed geotechnical engineer to ensure above ground project improvements,

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171 Battalio, R.T., 2014, Littoral processes along the Pacific and bay shores of San Francisco, California, USA, Shore & Beach, 82(1), Winter 2014, 3-21.
172 ESA, 2015, San Francisco Littoral Cell Coastal Regional Sediment Management Plan, Prepared for U.S. Army Corps of Engineers and the Coastal Sediment Management Workgroup. August 2015
173 Ibid.
174 MN + AGS JV, Ocean Beach Long-Term Improvements Project Conceptual Engineering Report, Prepared for SFPUC, September 2019.
175 ESA, 2015, San Francisco Littoral Cell Coastal Regional Sediment Management Plan, Prepared for U.S. Army Corps of Engineers and the Coastal Sediment Management Workgroup. August 2015
176 ESA, Ocean Beach Short-term Erosion Protection Measures Project – 2018-2019 Monitoring Report. Prepared for San Francisco Public Utilities Commission. July 2019.
177 Warrick, J.A.; Ritchie, A.C.; Adelman, G.; Adelman, K., and Limber, P.W., 2017. New techniques to measure cliff change from historical oblique aerial photographs and Structure-from-Motion photogrammetry. Journal of Coastal Research, 33(1), 39–55. Coconut Creek (Florida)
178 ESA, 2021. Coastal Process Analysis for Ocean Beach Climate Change Adaptation Project. Technical Report, December 2021.

including the roadway, public access, parking, and restroom facility, would be founded on a stable unit(s) and would not become unstable once constructed.

Buried Wall

During construction, excavation would be required to complete the top of the buried wall (see also Chapter 2, Project Description). The buried wall would consist of two stages of a pile wall to support the horizontal grade beam as shown on EIR Figure 2-9. Following pile construction, the excavated area behind the wall would be backfilled with improved soil (e.g., mixed with soil cement) to enhance soil strength immediately behind the wall. A trench would be excavated within the improved soil to the depth of the pile tops (ranging in depth from approximately 20 feet to a maximum depth of 40 feet below ground surface) and a grade beam measuring approximately 5 feet wide and 4 feet deep would be cast on top of the piles. In accordance with the recommendations of the geotechnical interpretive report prepared for the project and California Occupational Safety and Health Administration regulations pertaining to temporary shoring in title 8 of the California Code of Regulations, these excavations would be appropriately sloped or supported by conventional shoring methods, such as soldier piles and lagging, which would prevent the excavation sidewalls from becoming unstable.

The preliminary geotechnical considerations that have already been included in the project design include performing soil improvement measures (by deep soil mixing, jet grouting from the existing ground surface, or placement of controlled low strength material) for the upper 4 feet of soil cover for the slope stabilization behind the buried wall. The design of the buried wall also includes tiebacks to provide long-term stability to help support the wall from lateral pressures of the backslope. These measures, which are included as part of the recommendations in the preliminary geotechnical report prepared for the site, are consistent with the SFPUC general seismic requirements, the San Francisco Building Code and ASCE/SEI 7-16, which incorporate other well-established industry design criteria to ensure that the buried wall would not be founded on unstable units or cause existing subsurface units to become unstable. Construction activities on the beach would occur under seasonally appropriate conditions to avoid contact between equipment and the ocean; therefore, construction equipment on the beach also would not cause indirect changes to erosion or stability of geologic units at South Ocean Beach or surrounding coastal areas.

Through conformance with recommendations and incorporation of design elements specified in the final site-specific geotechnical report prepared by state licensed geotechnical engineers, consistent with current San Francisco Building Code requirements, impacts related to construction on soil that is unstable, or that could become unstable as a result of the project would be ***less than significant***.

Operation

This analysis examines the potential for project implementation to disrupt existing physical shoreline processes, focusing specifically on changes to shore erosion and sand bars in the surf zone. Specifically, the analysis centers on the potential effects of the ocean's interaction with a substantially modified project shoreline under various project conditions, or "scenarios."

Analysis of Project Effects on Coastal Processes

The project aims to address South Ocean Beach erosion through measures that would also alter the shoreline. The project would remove the existing revetments and rubble, construct a buried wall landward of the toe of the existing revetments and rubble positions, reshape and stabilize the bluff with a gentler (less steep) slope, and implement a long-term beach nourishment program. These managed retreat actions, combined with beach nourishment, would generally result in a wider beach at South Ocean Beach and reduce the incidence of wave interaction with a hardened shoreline. In turn, the project would reduce the risk of damage to the remaining infrastructure at South Ocean Beach from shoreline erosion. As explained in the *Project Setting* discussion, above, the Ocean Beach coastline and associated coastal processes have been substantially modified over the past 150 years.

A coastal engineering study was prepared to assess whether project implementation would result in substantial adverse effects on coastal processes ("coastal process study") beyond the project site, compared to existing conditions. The coastal process study, which is included as EIR **Appendix H** and serves as the basis for this impact discussion, uses a numerical model and other standard coastal engineering analysis techniques, along with empirical evidence, to assess potential changes to sand bars (bar effects) and adjacent shoreline erosion (*end effects*) for baseline and project conditions.

The coastal process study examines the potential project effects on coastal processes over a particularly energetic winter month – with abnormally high water levels, a series of large swell events, and intense wind and precipitation events – when the most pronounced shoreline morphological changes would be expected.[179] Changes in the beach width along Ocean Beach are closely tied to the shape and position of offshore bars. While shoreline changes are sometimes correlated to wave patterns averaged over several months, analysis of USGS beach transects has also shown that major changes (on the order of 30 feet in some areas) can occur during single storm events, and an assessment of the wave-bar correlation as part of the coastal process study showed only modest increases in correlation in bar conditions beyond 30 days;[180,181,182] thus a 30-day period was selected for purposes of the effects analysis. Among the several decades of detailed South Ocean Beach shoreline monitoring data reviewed,[183] the 2016-2017 storm season is the most recent, representative large swell season for which detailed hydrodynamic and morphologic data are available. Therefore, the analysis uses observed data from this period as model inputs to simulate elevated swell conditions and to validate the response of the shore to the event. The study examines coastal process effects under large storm conditions (i.e., similar to January 2017), for each of the following project scenarios:

1. with small sand placement – 85,000 cubic yards of sand
2. with large sand placement – 300,000 cubic yards of sand[184]
3. with partial wall exposure – three 500-foot segments of wall exposed
4. with full wall exposure – the full 3,200-foot-long wall exposed

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179 A one-month period was selected for the duration of analysis based on the finding that major changes to shoreline position can occur during single storm events or otherwise materialize over spans of days or weeks, despite the common use of longer averaging periods.

180 Barnard, P. L., Eshleman, J. L., Erikson, L. H., and Hanes, D. M., 2007. Coastal processes study at Ocean Beach, San Francisco, Ca: summary of data collection 2004–2006. U.S. Geological Survey.

181 Hansen, J. E., and Barnard, P. L., 2010. Sub-weekly to interannual variability of a high energy shoreline. Coastal Engineering, 51, 959-972

182 Yates, M.L., Guza, R.T., O'Reilly, W.C., Hansen, J.E., and Barnard, P.L., 2011, Equilibrium shoreline response of a high wave energy beach, Journal of Geophysical Research, Vol. 116, C04014.

183 Moffatt & Nichol, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020. Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements. Prepared for San Francisco Public Utilities Commission. July 2020.

184 Per the U.S. Army Corps of Engineers' Final Environmental Assessment/Environmental Impact Report for Maintenance Dredging of the Federal Navigation Channels in San Francisco Bay Fiscal Years 2015-2024, the median volume of material dredged from the main ship channel per dredging episode between 2000 and 2014 is 306,000 cubic yards (range of 78,000 to 613,000 cubic yards). Thus, a large sand placement scenario with 300,000 cubic yards per placement event is considered a reasonable case for purposes of the project's coastal process analysis. Moreover, given that a beach nourishment project of 300,000 cubic yards would persist for multiple years and would support the natural coastal processes, the project with a 500,000 cubic yard large placement would not be expected to have substantially different effects.

To determine whether the extent of project change would be substantial, indicating a potentially significant environmental effect under CEQA, the results for each scenario were evaluated against the amount of change that would be expected under similar conditions and over a similar time period without the project. A more detailed summary of the analysis is presented in the subsections below, and the full technical memorandum is provided in Appendix H. Due to the complexity of the littoral system, along with practical challenges of applying numerical models on surf zone dynamics, modeling results alone are not determinative of potential project effects and must be considered in the context of the broader scientific understanding of the system. The impact analysis therefore also includes a qualitative evaluation of potential project effects based upon a review of coastal engineering literature and historical data, anecdotal evidence, and professional engineering judgement.

Effects on Sand Bars

Ocean Beach is characterized by a linear bar-trough system, comprising two sand bars extending approximately parallel to shore in a north-south orientation, each with a deep trough on the inland side of the bar.[185] Referred to generally as the "nearshore" and "offshore" bars, the bars migrate seasonally with storms and associated waves and sediment movement.[186] A review of data from the USGS monitoring program shows South Ocean Beach cross-shore (i.e., perpendicular to shore) bar migration on the order of 500 to 1,000 feet, and vertical elevation variability of 2 to 8 feet.[187]

The bar-trough topography of the South Ocean Beach surf zone influences wave formation and breaking, with bar height, distance from shore, and trough depth playing key roles. Wave breaking in the surf zone is initiated when the water depth is shallow relative to the wave height, and breaking intensity increases over locally steep and shallow sand bars. These sand bars are shaped by the *incident waves*,[188] waves reflected from land and structures, and associated currents. Water transport resulting from incident waves causes longer period (low frequency) surges of water that induce larger water circulation cells in the surf zone, and ocean flowing "rip" currents which scour channels. This dynamic wave energy dissipation zone at Ocean Beach is further characterized by waves that cross due to direction changes when propagating over complex offshore bathymetry.[189,190] Consequently, the shore parallel bar formations are dynamic and are not uniform, and are bisected by rip current channels. The combination of these complex dynamics results in breaking wave patterns that can be exceptional for surfing and often quite challenging and dangerous.[191]

As noted above, the South Ocean Beach shoreline has been highly modified. Under current conditions, approximately 1,200 feet of the site's 3,200-foot shoreline is protected by rock and sandbag revetments. Of the remaining 2,000 feet of beach, the majority is backed by substantial amounts of rubble and debris from legacy shoreline development and erosion prevention efforts (please see EIR Chapter 1, Section 1.4.3, for additional discussion and images). While the city's ongoing sand backpassing projects regularly cover

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185 Hansen, J.E. and Barnard, P.L., 2010. Sub-weekly to interannual variability of a high-energy shoreline. Coastal Engineering, 57(11-12), pp.959-972.

186 Barnard et al. United States Geological Survey. 2007. Coastal Processes Study at Ocean Beach, San Francisco, CA: Summary of Data Collection 2004-2006. USGS Open-File Report 2007-1217.

187 USGS, 2021. Provisional monitoring data provided by via USGS researchers Dan Hoover and Jonathan Warrick, consisting of repeated surveys of ocean floor and beach elevations, photographs and digital elevation models.

188 Incident, as used here, refers to local waves at the coastal area of interest. This distinction is made because local waves may vary considerably from offshore waves measured at a deepwater buoy, due to breaking on bars, refraction, reflection from the shore, and other processes.

189 Battalio, Robert T. Estimating Breaking Wave Height at Ocean Beach, San Francisco. Shore and Beach 62-4, Oct 1994.

190 Battalio R.T., and Trivedi, D., 1996, Sediment transport processes at Ocean Beach, San Francisco, CA, Proc. 25th Int. Conf. Coastal Engineering, Orlando, FL, ASCE, 2691-2704.

191 Surfline, 2021. Ocean Beach Overview Surf Report & Forecast. Available online at: *https://www.surfline.com/surf-report/ocean-beach-overview/5842041f4e65fad6a77087f8?camId=58349e103421b20545c4b563*, accessed May 18, 2021

rubble and sandbag revetments along large segments of beach, roughly half to two-thirds of the back beach is composed of perennially exposed rock revetment and rubble.

During periods of large swells or low beach (i.e., typically during winter and spring months), waves interact with the site's hardened shoreline, resulting in wave energy reflecting offshore. During such events, the reflected wave energy causes scour of the beach directly in front of the hard structure and contributes to the formation of rip currents which cut channels through the sand bars. Under these conditions the remaining sand bars continue to support the formation of surfable waves along most of the exposed hardened shoreline. However, in the immediate vicinity of rip currents, the waves either do not break or are not optimal for surfing. Although rip currents can assist surfers reach the outer surf zone when paddling from the beach, large and persistent rip currents may degrade surfing conditions offshore.

In contrast, during periods of smaller swells or high beach (i.e., typically during the summer and fall months), as well as following sand backpass events, a greater amount of the revetment and rubble is buried in sand and there is less interaction between the waves and shoreline protection. Under these conditions, the beach sand helps dissipate wave energy, and the sand moves alongshore and into the surf zone contributing to the production and elevation of sand bars. The resulting more defined sand bars generally support the formation of surfable waves and surfing conditions have been observed to improve temporarily following South Ocean Beach sand backpass events.[192]

Under the project, the city would remove the existing shore protection structures, rubble and debris, and construct a buried wall along an alignment that is inland of the toe of the bluff and revetments. Through these managed retreat actions, the city would widen the beach along the entire project shoreline – in some areas by more than 100 feet (e.g., through removal of the 2010 emergency riprap revetment). The proposed wall would be buried initially and have a crest elevation that is considerably lower than the existing ground surface elevation along the proposed alignment. By setting the shore back and widening the beach, the project would substantially reduce or avoid the types of wave interactions with shore protection structures that occur under existing conditions. As a result, sand bars would be expected to form in more natural configurations, with increased definition and persistence throughout the year.

While the wall would be buried initially, over time as beach recession continues with shore erosion the wall could become exposed, similar to conditions that periodically occur along the Taraval seawall.[193] The frequency of exposure would be expected to increase with sea level rise. Therefore, under the project, the city would place sand, as needed, to ensure the wall remains covered. As described in EIR Chapter 2, Section 2.4.5, the city would develop and implement a shoreline monitoring program. The program could be a requirement of the Coastal Commission and National Park Service approvals, and would include triggers for sand placement, criteria for evaluating project performance, and annual reporting regarding program effectiveness and whether adjustments are needed.

Modeling performed in support of the project's sand placement program estimates approximately four full wall exposure events over the project's lifetime (modeled as 80 years). The assessment includes consideration for future sea level rise. Partial wall exposures could be more frequent, and would also be

[192] ESA, 2021. Coastal Process Analysis for Ocean Beach Climate Change Adaptation Project. Technical Report, December 2021.

[193] Constructed in the early 1940s, the Taraval seawall extends approximately 665 feet along the back of the beach between Santiago and Taraval streets, roughly 0.5 mile north of the South Ocean Beach project site. The wall is set back from the shoreline and is covered in sand most of the year, but portions of the low-profile wall are periodically exposed, typically during winter storms when beach elevations are low. In subsequent summer and fall months, when beach elevations recover, the wall typically becomes fully buried again.

addressed through sand placements, if a trigger were reached.[194] During periods of wall exposure, there would be opportunity for wave interactions with the hard structure, which could contribute to localized beach scour and the types of effects on sand bars (and surfing conditions) described above for existing conditions. However, unlike existing conditions, the incidence and extent of the localized beach scour would be substantially reduced.

The effects of sand placements on sand bars would generally be restorative – increasing the amount of sediment available for mobilization by waves, reducing reflection and scour, and allowing for more natural bar configurations. However, depending upon the shape of the sand placement and its position on the beach, the constructed sand embankments could also interact with waves. While the reflected energy would be similar to that occurring with a hard structure (e.g., revetment or wall), the effects are expected to be temporary. Waves reflecting off a steep constructed sand berm would refract and spread such that the reflected wave heights would be negligible in the vicinity of offshore sand bars. Wave interactions with a steep sand berm could also result in the formation of *scarps* – near-vertical seaward facing cuts, or cliffs, in the constructed sand embankment. These features can be over 10 feet tall, extend for hundreds of feet along the shore, and persist for several months.[195] Scarp formation can influence nearshore coastal processes, in addition to presenting a public safety hazard. As discussed in EIR Chapter 2, as part of the project the city would smooth, or groom, the slope of the placed sand after initial wave exposure and erosion as needed to prevent scarp formation.

The most recent data available for the main ship channel suggests median grain size within the dredging area is around 0.15 to 0.19 millimeters. By comparison, median grain sizes from samples collected along South Ocean Beach are between 0.18 and 0.32 millimeters.[196] As noted above, what little data exists on Ocean Beach sediment grain sizes appear to be influenced by sampling solely within the swash zone, as opposed to a more representative (and potentially finer on average) composite sample collected over the broader beach profile. As a result, only a general comparison of grain sizes between the sediment source (i.e., main ship channel) and placement site (i.e., South Ocean Beach) is possible. Nevertheless, the available data indicates the grain size difference is minor and would not be expected to substantially influence sand bar formation or persistence. In general, finer sand would mobilize faster and transfer at slightly higher rates than the existing sand (i.e., would move offshore and alongshore more quicky). This may allow for farther distribution of the placed sand across the surf zone, including contributions to offshore bars. In addition, placement of finer sand may result in a beach profile that is relatively flatter than the existing profile.[197]

In addition to its review of historical data and anecdotal evidence, and its consideration of relevant coastal engineering literature and related studies summarized above, the coastal process study evaluates potential changes among the selected sand bar metrics – distance from shore, crest elevation, crest-trough relief.[198] The results are compared to the expected range of variability under similar storm conditions without the project, based upon historic data. The results of the analysis show minor differences between baseline and project conditions for the various metrics. However, due to the complexity of the littoral system, along with

194 Moffatt & Nichol, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020. Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements. Prepared for San Francisco Public Utilities Commission. July 2020.

195 ESA, Ocean Beach Short-term Erosion Protection Measures Project – 2019-2020 Monitoring Report. Prepared for San Francisco Public Utilities Commission. June 2020.

196 ESA, 2021. Memorandum from Hannah Snow, PE (ESA) to Karen Frye (SFPUC), Subject: Comparison of San Francisco Main Ship Channel and Ocean Beach Sediment Grain Sizes. January 28, 2021.

197 ESA, 2021. Coastal Process Analysis for Ocean Beach Climate Change Adaptation Project. Technical Report, December 2021.

198 Crest-trough relief refers to height of the bar crest relative to the trough located immediately shoreward of the bar.

practical challenges of applying numerical models on surf zone dynamics, modeling results alone are not determinative of potential project effects and must be considered in the context of the broader scientific understanding of the system.

In summary, the project would reduce the incidence of interactions between waves and hard structures that contribute to rip current formation and associated bar effects, resulting in the formation and persistence of more natural sand bars. The proposed buried wall could eventually become exposed which, through wave interaction during large swells, could contribute to localized beach scour in front of the wall and scour through sand bars. However, because the wall would be located farther landward of the current shoreline structures and lower in elevation, the frequency of such interactions would be considerably lower than under existing conditions. During such events, as under existing conditions at the project site and offshore of the Taraval seawall 0.5 mile upcoast (north), the remaining sand bars would continue to support the formation of surfable waves. The duration of such effects under the project would be temporary, limited to approximately 12 months, on account of the proposed shoreline monitoring and beach nourishment program. Thus, the analysis shows the impact would be less than significant.

Effects on Adjacent Shoreline Erosion

The analysis of shoreline erosion considers the effects of the project on shoreline segments upcoast and downcoast of South Ocean Beach. Shoreline composition and erosion differ between the project site and adjacent shoreline segments. A brief summary of these shoreline segments, or reaches, is provided below.

Middle Ocean Beach extends approximately 10,500 feet south from Lincoln Way to Sloat Boulevard. This reach is characterized by a moderately wide sandy beach (approximately 180 feet to 210 feet in width),[199] backed by vegetated sand dunes or a seawall (north from Taraval Avenue). Inter-annual variations in shoreline position are substantial, due to the high wave power dissipated on this segment of shoreline. However, the long-term average Middle Ocean Beach shore position is relatively stable or accreting, due in part to alongshore sand transport and erosion of the sand dune barrier constructed as part of the Clean Water Program in the 1980s and 1990s.[200] Annual shoreline data collected by the USGS between 2004 and 2020 indicates Middle Ocean Beach has an average annual accretion rate of about 4.3 feet per year (shoreline or beach accretion and erosion is measured as the horizontal movement of the mean high water line over time). Closer to the project site (i.e., within 1,000 feet upcoast of Sloat Boulevard), the average annual accretion rate is around 0.7 feet per year.[201] Thus, while up to 150 feet of beach erosion has been documented at a single location during in a single storm season, Middle Ocean Beach is generally widening.[202]

South Ocean Beach (the project area) extends approximately 3,000 feet south from Sloat Boulevard to the northern end of the Fort Funston bluffs. This reach is characterized by a narrow to moderately wide beach (approximately 50 feet to 200 feet in width), backed by bluffs composed of sandy fill, combined with concrete and rubble, and uplifted seabed of the Colma Formation. Along South Ocean Beach, the presence of rubble and revetments, along with ongoing beach nourishment, has slowed bluff recession.[203] Average annual backshore erosion along this segment is about 1 foot per year. The USGS shoreline data shows an average

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[199] Hansen, J. E., and Barnard, P. L., 2010. Sub-weekly to interannual variability of a high energy shoreline. Coastal Engineering, 51, 959-972

[200] Battalio, R.T., 2014, Littoral processes along the Pacific and bay shores of San Francisco, California, USA, Shore & Beach, 82(1), Winter 2014, 3-21.

[201] USGS (2020). Ocean Beach LMT Seawall Project Area Erosion Rates. Processed and Provided by Dan Hoover, PhD. Unpublished Data. February 5, 2020.

[202] Moffatt & Nichol, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020. Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements. Prepared for San Francisco Public Utilities Commission. July 2020. Figure 2-1.

[203] Battalio, R.T., 2014, Littoral processes along the Pacific and bay shores of San Francisco, California, USA, Shore & Beach, 82(1), Winter 2014, 3-21.

annual shoreline erosion rate of about 1.7 feet per year, with as much as 4.3 feet per year occurring towards the south end of the project site (i.e., near the Southwest Ocean Outfall).[204] Notably, as much as 150 feet of beach erosion at a single location has been documented in a single storm season along this segment.[205]

Fort Funston extends south from South Ocean Beach about 5,700 feet, comprising the Fort Funston National Park shoreline. This reach is characterized by a moderately wide beach (approximately 120 feet to 200 feet in width), backed by cliffs composed primarily of uplifted marine floor deposits of the Colma and Merced formations. These steep cliffs, which rise to hundreds of feet in height, are subject to periodic slope failures which temporarily narrow the beach and over time nourish the beach as the sloughed bluff material erodes.[206] Average annual bluff or backshore erosion along this segment is about 2 to 3 feet per year, and closer to 5 feet per year towards the north end. The USGS shoreline data shows an average annual shoreline erosion rate of about 2 feet per year along Fort Funston beach. Closer to the project site (i.e., within 1,000 feet downcoast of the 2010 emergency riprap revetment), the average annual erosion rate is up to 4.3 feet per year.[207] Within this area, bluff erosion on the order of 50 feet and beach erosion on the order of 100 to 150 feet can occur in a single location during a single storm season.[208,209]

The analysis of project end effects in the coastal processes study (Appendix H) is focused on the transitions from South Ocean Beach to Middle Ocean Beach to the north and to Fort Funston to the south. As noted above, Middle Ocean Beach is relatively stable or accreting, and end effects associated with South Ocean Beach structures or management have not been observed at Middle Ocean Beach. For these reasons, and because the project would remove existing shoreline protection and widen South Ocean Beach, the project would not result in accelerated erosion along Middle Ocean Beach. Therefore, the following discussion focuses on end effects along the Fort Funston shoreline.

To assess whether the project would substantially accelerate adjacent shoreline erosion, the coastal process study assessed baseline and potential future erosion for each of the project scenarios. The results of the analysis indicate there would be relatively minor differences between baseline and project conditions, owing primarily to the landward shift in the shore position and wider beach, as well as implementation of the Sand Management Plan. The study results suggest the rate of erosion downcoast of the project site would likely be greater under baseline conditions than for the project with small or large sand placements. Conversely, the study concludes there could be minor increases in erosion of the adjacent downcoast shoreline for the project with partial and full wall exposure. In the latter case, the study assesses such change would not be likely to occur in the near-term due to the wall's initial constructed condition (i.e., buried and set back from the shoreline), the wall's engineered transitions to the north and south, and because it would first require a large amount of background erosion along the entire project shore; and would not be substantial relative to the observed historic erosion rates. Such occurrences of wall exposure would be infrequent. Notably, with consideration for sea level rise, the full wall exposure is estimated

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204 USGS (2020). Ocean Beach LMT Seawall Project Area Erosion Rates. Processed and Provided by Dan Hoover, PhD. Unpublished Data. February 5, 2020.

205 Moffatt & Nichol, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020. Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements. Prepared for San Francisco Public Utilities Commission. July 2020.

206 Battalio, R.T., 2014, Littoral processes along the Pacific and bay shores of San Francisco, California, USA, Shore & Beach, 82(1), Winter 2014, 3-21.

207 USGS (2020). Ocean Beach LMT Seawall Project Area Erosion Rates. Processed and Provided by Dan Hoover, PhD. Unpublished Data. February 5, 2020.

208 Barnard, P.L., Hansen, J.E., and Erikson, L.H, 2012, Synthesis Study of an Erosion Hot Spot, Ocean Beach, California, Journal of Coastal Research, 28(4), 903-922.

209 Moffatt & Nichol, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020. Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements. Prepared for San Francisco Public Utilities Commission. July 2020.

approximately four times over the project life (i.e., approximately once every 20 to 25 years), and would be detected and addressed through the project's proposed shoreline monitoring and beach nourishment program.[210] Thus, the impact would be less than significant.

Summary

The coastal process analysis indicates that the sand bars and shoreline erosion rates would not differ substantially under project conditions relative to historical and baseline conditions. Prior analysis in the project's Sand Management Plan indicates that the project would maintain a beach in front of the new buried wall most of the time which would minimize wave-wall interactions. In addition, owing to the landward position of the buried wall relative to the existing bluff and shoreline protection, and with periodic sand placement the project would partially restore physical coastal processes and contribute to a net increase in beach widths.[211]

With increased sea levels, the effects of storm surge, high tides, and wave action on shorelines are expected to increase. The degree of such increase will depend upon the extent of sea level rise. However, these increases would be expected to accelerate bluff and beach erosion along South Ocean Beach, with or without the project. Under project conditions, the placed sand may erode more quickly with sea level rise, resulting in greater potential for wall exposure and associated effects of wave reflection on sand bars and adjacent shore erosion in the future. Accordingly, the frequency of sand placements would be expected to increase in order to cover the wall and maintain a sandy beach. As explained in Section 2.4.5, *Beach Nourishment*, the modeling performed for the Sand Management Plan considers the range of sea level rise projections contained within the State of California Sea-Level Rise Guidance 2018 Update.[212] The modeled average sand placement frequency presented in in Chapter 2, Project Description (Table 2-1), accounts for the anticipated increased frequency later in the century with higher sea levels.

For these reasons, project implementation would not substantially affect sand bars or adjacent shoreline erosion and, therefore, would have a ***less-than-significant*** impact.

Impact GE-4: The project would not create substantial risks to life or property as a result of locating buildings or other features on expansive or corrosive soils. (*Less than Significant*)

Much of the project site is underlain directly by sand, which is not expansive. The artificial fill beneath the project site is composed of dune sand and Colma and Merced formation deposits reworked by grading and mixed with imported gravel and construction debris and is unlikely to have any substantive potential for expansion. Further, any backfill materials used for the project would have a low expansion potential and would be adequately compacted in accordance with the recommendations of the geotechnical reports prepared for the project.

Corrosive soils can damage buried metal and concrete structures such as pipelines and foundations that are in direct contact with soil or bedrock. Corrosivity testing of subsurface materials at the project site was included as part of the preliminary geotechnical report and were found to be classified as "extremely

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210 Full wall exposure would be expected to occur approximately once every 20 to 25 years, on average. (Moffatt & Nichol, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020. Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements. Prepared for San Francisco Public Utilities Commission. July 2020.)

211 Moffatt & Nichol, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020. Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements. Prepared for San Francisco Public Utilities Commission. July 2020.

212 *Ibid.*

corrosive" to "moderately corrosive."[213] Corrosive soils may adversely affect the foundations and buried utilities. Consistent with San Francisco Building Code requirements, the geotechnical interpretive report recommends that all buried metal piping and reinforced concrete be properly protected against corrosion consistent with the recommendations of a corrosion engineer.[214] Therefore, impacts related to expansive and corrosive soils would be ***less than significant***.

Impact GE-5: The project could directly or indirectly destroy a unique paleontological resource or site or unique geological feature. (*Less than Significant with Mitigation*)

Paleontological Resources

Paleontological resources are the fossilized evidence of past life found in the geologic record. Fossils are preserved in sedimentary rocks and may include bones, teeth, shells, leaves, and wood. Despite the abundance of these rocks, and the vast number of organisms that have lived through time, preservation of plant or animal remains as fossils can be a rare occurrence. Paleontological resources are considered nonrenewable resources because the organisms they represent no longer exist; thus, once destroyed, paleontological resources can never be replaced. Not all paleontological discoveries are considered of scientific importance, as such there are several criteria to determine the scientific importance of fossils. These criteria include whether fossils provide data on the following: evolutionary relationships and developmental trends among organisms, both living and extinct; the age of rock units, sedimentary stratum, or depositional history of the region; development of biological communities; or, unusual or spectacular circumstances in the history of life.[215,216] These data are important because they are used to examine evolutionary relationships, provide insight on the development of and interaction between biological communities, establish time scales for geologic studies, and for many other scientific purposes.

The probability for finding paleontological resources can be broadly predicted from the geologic units present at or near the surface. Therefore, geologic mapping classifications of soil units can be used for assessing the potential for the occurrence of paleontological resources. The city, in collaboration with a qualified paleontologist, developed the San Francisco Paleontological Sensitivity Map[217] to classify the potential for areas in the city to yield paleontological resources using the modified Potential Fossil Yield Classification system as the basis for its paleontological potential designations.[218] The classification system is a predictive resource-management tool founded on two basic facts of paleontology: that occurrences of paleontological resources are closely tied to the geologic units (i.e., formations, members, or beds) that contain them, and that the likelihood of the presence of fossils can be broadly predicted from the distribution of geologic units at or near the surface. The paleontological potential designations classify soil potential from very low potential to very high potential. Within the city, paleontological potential ranges from very low to moderate potential, and unknown potential. The type of geologic units that contain a high or very high occurrence were not identified in the city based on currently available data.

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213 AGS, Final Geotechnical Interpretive Report (GIR), South Ocean Beach Coastal Erosion and Wastewater Infrastructure Protection, San Francisco, California, July 2021.
214 Ibid.
215 Murphey, P.C., Knauss, G.E., Fisk, L.H., Deméré, T.A., and Reynolds, R.E. 2019. Best practices in mitigation paleontology: Proceedings of the San Diego Society of Natural History, No. 47.
216 Society of Vertebrate Paleontology (SVP), 2010. Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources. Society of Vertebrate Paleontology, Impact Mitigation Guidelines Revision Committee.
217 Paleo Solutions, Inc. March 15, 2018.
218 United States Department of the Interior, Bureau of Land Management (BLM). Potential Fossil Yield Classification (PFYC) System for Paleontological Resources on Public Lands. IM 2016-124. Instruction Memorandum *https://www.blm.gov/sites/blm.gov/files/uploads/IM2016-124_att1.pdf*

In the online collections database of the University of California Museum of Paleontology there are no records of Holocene-age vertebrate fossils being recovered within San Francisco County; however, there have been discoveries of Holocene-age vertebrates in other areas of California.[219]

As stated in the geotechnical interpretive report prepared for the buried wall, geologic mapping by Bonilla indicates the surficial geology at the project site is predominantly Holocene-age sedimentary deposits (i.e., artificial fill, dune and beach sand).[220] Additionally, while not exposed at the surface, the Pleistocene-age Colma Formation and Pleistocene to Pliocene-age Merced Formation are present at depth, both of which have previously produced vertebrate fossils.[221] According to existing geotechnical boring data, the surface of either the Colma or Merced formations is estimated to be between 20 and 30 feet below ground surface (bgs) and in some locations is overlain by intact dune sand instead of artificial fill.

The artificial fill material underlying the project site ranges in thickness from 5 to 38 feet bgs and consists of dune sand and Colma and Merced formation deposits reworked by grading and mixed with imported gravel and construction debris. Because the Colma and Merced formation deposits were reworked and mixed to create fill, this fill material is considered to have low paleontological potential. Generally, Holocene-age deposits (dune sand in this case) have low paleontological potential at the surface, due to the age of these deposits; however, these sediments increase in age with depth, and therefore fossil resources may be encountered in the deeper levels of this dune sand (i.e., if the sand is over 5,000 years old, as defined by the Society of Vertebrate Paleontology). Therefore, the paleontological potential of Holocene-age intact dune sand deposits gets progressively higher in the deeper levels of these units.

Vertebrate fossils (specifically, mammoth and bison) have been recovered from the Colma Formation in San Francisco, near the Cliff House at the northern end of Ocean Beach, the base of Telegraph Hill and near the Twin Peaks Tunnel.[222] Additionally, vertebrate fossils have been recovered from the Merced Formation, both within San Francisco County and throughout the San Francisco Bay Area.[223] A search of the fossil collections database at the University of California Museum of Paleontology (UCMP) identified the fossil remains of nine vertebrate mammals collected at Fort Funston Beach located in the southwest area of San Francisco from the Merced Formation. Due to the presence of vertebrate fossils, the intact Colma and Merced formations present in the project area at depth are considered to have a moderate paleontological potential.

Although much of the ground disturbance and excavation would occur within more superficial units with very low paleontological potential (i.e., artificial fill, dune and beach sand, and Colma and Merced formation deposits reworked by grading and mixed with imported gravel and construction debris), construction associated with the buried wall, slope stabilization, debris and revetment removal, and bluff reshaping

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219 University of California Museum of Paleontology (UCMP), 2020a. UCMP Localities Search, online database; Holocene vertebrates in California. Online: ucmpdb.berkeley.edu/loc.html. Accessed on July 2, 2020.

220 AGS, Final Geotechnical Interpretive Report (GIR), South Ocean Beach Coastal Erosion and Wastewater Infrastructure Protection, San Francisco, California, July 2021.

221 Clites, Erika. Golden Gate National Recreation Area. No date.

222 Rodda, Peter U., and Nina Baghai. Late Pleistocene Vertebrates from Downtown San Francisco, Journal of Paleontology, 67(6), November 1993; Schlocker, Julius. Geology of the San Francisco North Quadrangle, Geological Survey Professional Paper 782, 1974.

223 UCMP, 2020b. UCMP Localities Search, online database; vertebrate fossils of the Merced Formation within San Francisco County. Online: ucmpdb.berkeley.edu/loc.html. Accessed on July 2, 2020; UCMP, 2020c. UCMP Locality Search, online database; vertebrate fossils of the Merced Formation within California. Online: ucmpdb.berkeley.edu/loc.html. Accessed on July 2, 2020.

would reach depths (ranging from 20 to 100 feet bgs) that could disturb deeper intact sand dunes or the intact Colma and Merced formations.

Based on the reasonable potential that paleontological resources may be present at some locations, these deeper proposed excavations could damage or destroy paleontological resources if present; this impact is therefore considered significant. Implementation of **Mitigation Measure M-GE-5, Paleontological Resources Monitoring and Mitigation Program**, would minimize the project's potential to impact paleontological resources if present such that, if encountered, the scientific significance of the paleontological resource is documented for future public knowledge. This measure would reduce adverse effects on paleontological resources by establishing protocols for responding in the event of an unanticipated discovery of paleontological resources, including monitoring, data recovery, and reporting procedures, among others. Therefore, the potential impact of project construction on paleontological resources would be ***less than significant with mitigation***.

Unique Geologic Features

The Golden Gate National Recreation Area's General Management Plan identifies the steep coastal bluffs that tower more than 100 feet above Fort Funston beach as having unique geology. The management plan calls for preservation of the bluffs, while allowing natural processes to continue unimpeded.[224] The bluffs are therefore considered a unique geologic feature for purposes of this impact discussion. The destruction of the bluffs or disruption of coastal processes such that the natural rate of bluff erosion would be substantially altered, would be significant effects. As discussed in Impact GE 3, under project scenarios with beach nourishment (i.e., project with small and large sand placements) erosion along adjacent shoreline segments would be slightly reduced relative to baseline conditions, while for project scenarios with wall exposure (i.e., project with partial and full wall exposure) erosion would be slightly increased. Overall, the analysis shows that the amount of erosion projected under project conditions is within the range that would be expected for a similar storm season without the project. Thus, the study concludes the project would not cause substantial erosion of the adjacent shoreline. While the analysis suggests the erosion rates could vary, depending upon project conditions at the site (e.g., nourished or exposed), on balance the anticipated erosion along Fort Funston would not be substantially different than under existing conditions. Therefore, the project would not have a significant impact due to the destruction of a unique geologic feature (***less than significant***).

Mitigation Measure M-GE-5: Paleontological Resources Monitoring and Mitigation Program

The SFPUC shall engage a qualified paleontologist meeting standards recommended by the Society for Vertebrate Paleontology (SVP) to develop a site-specific monitoring plan prior to commencing soil-disturbing activities at the project site. The Paleontological Monitoring Plan would determine project construction activities requiring paleontological monitoring based on those activities that may affect sediments with moderate or greater sensitivity for paleontological resources. Prior to any ground disturbing activities, the SFPUC shall submit the Paleontological Monitoring Plan to the Environmental Review Officer (ERO) for approval.

[224] National Park Service. Final General Management Plan/Environmental Impact Statement for the Golden Gate National Recreation Area and Muir Woods National Monument. April 2014. Available online at: *https://parkplanning.nps.gov/document.cfm?parkID=303&projectID=15075&documentID=58777*. Accessed July 24, 2020.

At a minimum, the plan shall include:

a. Project Description

b. Regulatory Environment – outline applicable federal, state, and local regulations

c. Summary of Sensitivity Classification(s)

d. Research Methods, including but not limited to:

   - Field studies conducted by the qualified paleontologist to check for fossils at the surface and assess the exposed sediments.
   - Literature Review to include an examination of geologic maps and a review of relevant geological and paleontological literature to determine the nature of geologic units in the project area.
   - Locality Search to include outreach to the University of California Museum of Paleontology in Berkeley.

e. Results: to include a summary of literature review and finding of potential site sensitivity for paleontological resources; and depth of potential resources if known.

f. Recommendations for any additional measures that could be necessary to avoid or reduce any adverse impacts to recorded and/or inadvertently discovered paleontological resources of scientific importance. Such measures could include:

   - Avoidance: If a known fossil locality appears to contain critical scientific information that should be left undisturbed for subsequent scientific evaluation.
   - Fossil Recovery: If isolated small, medium- or large-sized fossils are discovered during field surveys or construction monitoring, and they are determined to be scientifically significant, they should be recovered. Fossil recovery may involve collecting a fully exposed fossil from the ground surface, or may involve a systematic excavation, depending upon the size and complexity of the fossil discovery.
   - Monitoring: Monitoring involves systematic inspections of graded cut slopes, trench sidewalls, spoils piles, and other types of construction excavations for the presence of fossils, and the fossil recovery and documentation of these fossils before they are destroyed by further ground disturbing actions. Monitoring could identify the need for test sampling.
   - Data recovery and reporting: Fossil and associated data discovered during ground disturbing activities should be treated according to professional paleontological standards and documented in a data recovery report. The plan should define the scope of the data recovery report.

g. The paleontologist shall document the monitoring conducted according to the monitoring plan and any data recovery completed for significant paleontological resource finds discovered, if any. Plans and reports prepared by the paleontologist shall be considered draft reports subject to revision until final approval by the ERO.

CUMULATIVE IMPACTS

Impact C-GE-1: The project, in combination with the cumulative projects, would not result in significant impacts on geology and soils or paleontological resources. (*Less than Significant*)

Geology, soils, and paleontological resources impacts are generally site-specific and localized. As a result, the geographic scope of potential cumulative impacts for these resources generally includes the project area and immediately adjacent areas. The following cumulative projects would have project construction schedules that would overlap, or would be in operation currently: Westside Pump Station Reliability Improvements, Oceanside Treatment Plant Improvements, San Francisco Zoo Recycled Water Project, Vista Grande Drainage Basin Improvement Project, and Westside Force Main Reliability Project.

Seismic Hazards and Soil Stability

Cumulative projects could require various levels of excavation and grading, which would affect local geologic conditions. Of the projects listed above, only the Westside Pump Station Reliability Improvements and Westside Force Main Reliability Project would involve excavation immediately adjacent to the project area. The project area is subject to strong ground shaking. However, as discussed in Impact GE-1, the project components would be designed and constructed in accordance with the most current building code requirements, the SFPUC general seismic requirements, and applicable engineering standards for seismic safety, which would minimize the potential for damage. These cumulative projects, which are also SFPUC-sponsored, would be subject to the same building code and SFPUC requirements for geotechnical review as the project, and would also be required to comply with the state and local building codes. Implementation of the projects in accordance with building code and engineering requirements would minimize safety risks related to seismic hazards. Therefore, cumulative impacts related to seismic hazards would be ***less than significant***.

The project and all of the identified cumulative projects would also be required to implement the requirements of article 4.2 of the San Francisco Public Works Code (discussed in more detail in Section E.17, Hydrology and Water Quality) which would reduce the potential for cumulative impacts of erosion from the construction sites, resulting in less than significant impacts (see in Impact GE-2 for a discussion of these requirements).

Implementation of the recommendations of the geotechnical reports for each project and excavation safety requirements specified in California Code of Regulations title 8 would reduce the likelihood that construction activities undertaken for the cumulative projects and the project would result in unstable soils or geologic units. Therefore, cumulative impacts related to unstable soils and geologic units would be ***less than significant***.

Coastal Processes and Unique Geologic Features

The Vista Grande Drainage Basin Improvement Project, located approximately 4,300 feet downcoast (south) of the South Ocean Beach project site, is the only cumulative project which could affect coastal processes or Fort Funston bluffs. Under that project, Daly City would install a new outlet and adjacent seawalls extending approximately 70 feet to the north (connecting to an existing wall at the SFPUC outlet), and 100 feet to the south. The Vista Grande project’s coastal engineering study concludes that project would reduce the local rate of bluff retreat, but would have no appreciable effect on sand supply, longshore or cross shore sediment movement, or beach scour due to the large volumes of littoral sediment transport at the site. The study notes, however, the Vista Grande project could ultimately lead to the formation of a *promontory*[225] similar to that which currently exists at the SFPUC ocean outlet site immediately adjacent to the north of the Vista Grande project but south of the proposed project area.[226]

The coastal process study prepared for the project (Appendix H) shows that under the most conservative scenario (project plus full wall exposure), the rate of adjacent shoreline erosion would not be substantial relative to the observed historic erosion rates. It also concludes the project would generally result in the formation and persistence of more natural sandbars. Given the distance between these projects and the conclusions of their respective coastal studies, implementation of the proposed project and Vista Grande project would not have a significant cumulative effect on a unique geologic feature (***less than significant***).

Paleontological Resources

The geographic scope of cumulative impacts to paleontological resources includes the South Ocean Beach area where the Pleistocene-aged Colma and Merced formations could be disturbed. As discussed in Impact GE-5, project-related excavation would encounter the Colma and Merced formations, and these geologic units have a moderate paleontological sensitivity based on the identification of several vertebrate fossils in similarly aged sediments in the area (including the Fort Funston bluffs). Cumulative projects would excavate into areas where the Colma and Merced formations may be present adjacent to the project site, including the Westside Pump Station Reliability Improvements, Oceanside Treatment Plant Improvements, and Westside Force Main Reliability projects. Paleontological resource impacts are generally site-specific, and as a result cumulative impacts typically do not occur unless the cumulative projects are immediately adjacent to each other and affect the same resources. If there are paleontological resources that extend across excavation boundaries of the project and these other cumulative projects, the projects could result in the loss of paleontological resources, a potentially significant cumulative impact. However, with implementation of mitigation, the project would effectively avoid damage to or loss of paleontological resources. Therefore, while implementation of cumulative projects could have a significant effect related to paleontological resources, the project's contribution to such effect would be ***less than significant***.

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[225] A promontory is a point of high land that juts out into the sea or a lake.
[226] Moffatt & Nichol. Vista Grande Drainage Basin Improvement Project Coastal Engineering Study. October 16, 2017.

E.17 HYDROLOGY AND WATER QUALITY

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
17. HYDROLOGY AND WATER QUALITY. Would the project:					
a) Violate any water quality standards or waste discharge requirements or otherwise substantially degrade surface or groundwater quality?	☐	☐	☒	☐	☐
b) Substantially decrease groundwater supplies or interfere substantially with groundwater recharge such that the project may impede sustainable groundwater management of the basin?	☐	☐	☐	☐	☒
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river or through the addition of impervious surfaces, in a manner that would:					
i) Result in substantial erosion or siltation on- or offsite;	☐	☐	☒	☐	☐
ii) Substantially increase the rate or amount of surface runoff in a manner which would result in flooding on or offsite;	☐	☐	☒	☐	☐
iii) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff; or	☐	☐	☒	☐	☐
iv) Impede or redirect flood flows?	☐	☐	☐	☐	☒
d) In flood hazard, tsunami, or seiche zones, risk release of pollutants due a project inundation?	☐	☐	☒	☐	☐
e) Conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan?	☐	☐	☒	☐	☐

Implementation of the project would involve reconfiguration of roadways and intersections, and construction of a buried wall, multi-use trail, parking lot, and restrooms, but overall would not substantially alter the area of impervious surfaces such that it would noticeably interfere with groundwater recharge, nor would the project require the use of any groundwater. The project could require dewatering of excavation areas near the beach, but this would be temporary, limited to the construction period. Thus, the project would cause no measurable reduction in groundwater recharge or adverse effect on groundwater supplies. For these reasons, topic E.17(b) is ***not applicable***.

The landward or upland portions of the project area (outside of the beach and bluff areas) are not in a special flood hazard area as identified on the Federal Emergency Management Agency's flood hazard map for the project area.[227] The project includes one new aboveground structure (restroom), but because the structure would not be located in the floodplain[228] it would not impede or redirect flood flows. Therefore, topic E.17(c.iv) is ***not applicable***.

Impact HY-1: The project would not violate water quality standards or otherwise substantially degrade water quality. (*Less than Significant*)

The South Ocean Beach project site[229] is located along the Pacific Coast within the Lake Merced watershed and includes the historical location of the Lake Merced outlet to the ocean which has since been filled. Runoff from the eastern paved portions of the South Ocean Beach project site, including portions of the Great Highway, is captured by existing drainage infrastructure on the east side of the highway and directed to the Oceanside Treatment Plant located adjacent to the Great Highway. Some runoff from western areas of the South Ocean Beach project site was collected by stormwater pipelines that have been eroded along with the bluffs; this stormwater now drains to the Pacific Ocean. Treated water from the Oceanside Treatment Plant is discharged to the Pacific Ocean via an offshore outfall, known as the Southwest Ocean Outfall, in accordance with state and federal permits.[230] Flows from the highway that are not captured by the combined wastewater system flow toward the bluff and have led to the formation and expansion of erosion gullies along the shore over the last several years.[231]

Winter storms, modifications to dredging and placement practices, changes in the location of the offshore sand bar, placement of fill for landward development, and sea level rise (discussed further below) are all possible factors that are contributing to significant erosion along Ocean Beach.[232] Because of its location and orientation along the open Pacific Ocean coast, Ocean Beach is directly exposed to approaching waves and wave energy. Large waves, especially during times of high tides, have caused bluff recession along the southern portions of the beach.

Construction

Stormwater Discharges

Construction of improvements landward of the beach and bluff face, including roadway and intersection modifications, a multi-use trail, parking lot, and new restroom, could result in temporary soil disturbance and accidental release of chemicals that could adversely affect water quality if sediments or chemicals are carried off-site to receiving waterbodies via stormwater runoff. Sediments disturbed by construction activities could flow into the combined wastewater system, if not managed appropriately. Accidental

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227 Federal Emergency Management Agency, 2021. National Flood Insurance Program, Flood Insurance Rate Map, City and County of San Francisco, Panel 207 of 304. Available: https://sfplanninggis.s3.amazonaws.com/FEMAFloodMapping/0602980207A.pdf, accessed December 6, 2021.

228 Sea level rise is anticipated to change flood zones as well as to potentially increase the frequency, severity, and extent of flooding. However, the aboveground improvements associated with the project are not substantive and would not impede or redirect flood flows even if sea level rise leads to them being considered in the flood hazard zone in the future.

229 Note that the project also includes harvesting sand from North Ocean Beach for small sand placements at South Ocean Beach. Since the on-beach construction activities for North Ocean Beach and South Ocean Beach are similar in nature, the use of the term "project area" in this section refers mainly to South Ocean Beach.

230 U.S. Environmental Protection Agency, National Pollutant Discharge Elimination System Permit (NPDES No. CA0037681); California Regional Water Quality Control Board San Francisco Bay Region, Waste Discharge Requirements (Order No. R2-2019-0028)

231 Environmental Science Associates, 2020. Ocean Beach Short Term Erosion Protection Measures Project, 2019-2020 Monitoring Report, June 2020.

232 SPUR et al., 2012. Ocean Beach Master Plan. May.

chemical releases from the project work areas and staging areas could also occur due to the use of paints, solvents, fuels, lubricants, and other hazardous materials associated with construction and heavy equipment use. Once released, these chemicals could similarly be transported into receiving waters through stormwater runoff, wash water, and dust control water.

Due to the location and size of the area of ground disturbance, the project would be subject to the construction site runoff requirements of San Francisco Public Works Code article 4.2, section 146 and the State Water Resources Control Board's General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities (construction general permit), as applicable.[233] The purpose of section 146 and the city's construction site runoff control program is to protect water quality by controlling the discharge of sediment and other pollutants from construction sites. The construction site runoff measures specified in section 146 are consistent with federal water quality permit requirements. Pursuant to the Public Works code, all construction projects must implement standard construction water quality best management practices (BMPs) to prevent contaminated stormwater discharges into the combined wastewater system, and projects that are 5,000 square feet or greater must also submit an application and an erosion and sediment control plan to the SFPUC Wastewater Enterprise in order to obtain a construction site runoff control permit prior to the start of construction. The project would disturb more than 5,000 square feet and thus would be subject to the city's additional permit, BMPs, and inspection requirements. Inspections are required weekly during the dry season (April 16 through September 30) and daily during the rainy season (October 1 through April 15) if performing clearing, grading, and excavating activities (weekly if not).

Because the project would result in more than 1 acre of ground disturbance and result in construction storm water runoff in areas outside of the city's combined wastewater system, it would also be subject to the State's construction general permit, as stated above. Construction activities subject to this permit include ground disturbances such as clearing, grading, and excavating, as well as soil stockpiling and storage of hazardous materials. Under the construction general permit, construction projects are characterized by their level of risk to water quality. This is determined using a combination of the sediment risk of the project related to soil type, rainfall, and slopes and the receiving waterbody's water quality risk related to its beneficial uses. Following the method in the construction general permit, projects are characterized as being Risk Level 1, Level 2, or Level 3, and the minimum BMPs and monitoring that must be implemented during construction as prescribed in the construction general permit are based on the risk level. The BMPs are designed to prevent pollutants from coming in contact with stormwater and to keep all products of erosion and stormwater pollutants from moving off-site into receiving waters. The BMPs are to be specified in a site-specific stormwater pollution prevention plan (SWPPP) that must be prepared by a qualified SWPPP developer and submitted to the San Francisco Regional Water Quality Control Board before construction begins.

In addition, as described in EIR Chapter 2, Project Description, Section 2.7, Intended Uses of this EIR and Required Actions and Approvals, for construction activities on the beach the SFPUC would be required to implement water quality protection measures as requirements of permits or authorizations from the Corps under section 404 of the Clean Water Act and section 10 of the Rivers and Harbors Act, the Regional Water Quality Control Board under section 401 of the Clean Water Act, and the California Coastal Commission under the Coastal Act, as applicable. Similar to existing authorizations from these agencies for ongoing erosion management and shoreline maintenance activities along Ocean Beach, these permits and

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[233] State Water Resources Control Board, National Pollutant Discharge Elimination System General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities *(*Order 2009-0009-DWQ, NPDES No. CAS000002; as amended by Orders 2010-0014-DWQ and 2012-006-DWQ)

authorizations would include requirements for implementation of standard and project-specific construction measures to protect water quality.[234] These measures could include, although would not be limited to: scheduling work to avoid high tides; avoiding or minimizing any contact of equipment, debris, or excavated materials with ocean water; and conducting any refueling or maintenance activities in a controlled and contained area with drainage and spill control features.

Many of the required construction measures that would prevent pollutants from being discharged in stormwater would also be consistent with existing SFPUC standard construction measures implemented for all construction activities. At a minimum the BMPs would address good housekeeping practices, including those for managing hazardous materials used during construction, non-stormwater management, erosion and sediment control, and run-on and runoff control (e.g., fiber rolls, and/or gravel bags around storm drain inlets, silt fencing, etc.). These BMPs would be implemented during all phases of construction. A qualified professional must inspect the required BMPs at a regular frequency as determined based on the risk level.

Implementation of the city's construction site runoff control requirements, construction general permit SWPPP BMPs, water quality protection measures included in resource agency permits, and SFPUC standard construction measures would ensure that project construction activities would not result in substantial amounts of erosion or sedimentation in stormwater runoff, and that hazardous materials used during construction would be managed in accordance with good housekeeping practices to prevent a release that could contaminate stormwater. Therefore, water quality impacts related to violation of water quality standards or degradation of water quality due to discharge of polluted stormwater runoff during landward or upland construction-related activities would be ***less than significant***.

Groundwater Dewatering

As discussed in EIR Chapter 2, Project Description, Section 2.5.1.2, Phase 2 – Construct Buried Wall, excavation for the grade beam and tieback anchors associated with the buried wall may extend below groundwater, necessitating temporary groundwater dewatering. Active dewatering systems such as use of a sump pump may be required to maintain a dry working space in these excavations. The excavation may extend into the Colma Formation. Groundwater from dewatering activities could contain sediment and suspended solids.

Groundwater pumped from the excavated areas would be discharged to the combined wastewater system via existing manholes on the Great Highway. Discharge of groundwater produced during construction-related dewatering would be subject to a batch wastewater discharge permit from the SFPUC Wastewater Enterprise issued in accordance with article 4.1 of the Public Works code, as supplemented by Public Works Order No. 158170, which regulates the quantity and quality of discharges to the combined wastewater system. Accordingly, groundwater produced during the limited dewatering would be pumped to baker tanks or other containment, tested, and treated to ensure compliance with the discharge limitations of article 4.1 of the Public Works code and Public Works Order No. 158170. Treatment could include methods such as using settling tanks to remove sediments, filters to remove suspended solids, and other methods to meet chemical-specific discharge limitations. The chemical-specific treatment method used would depend on the chemicals that exceed the specified discharge limitation but could include methods such as filtration or

[234] U.S. Army Corps of Engineers, 2017. Department of Army Nationwide Permit approval letter, September 9, 2017. San Francisco Regional Water Quality Control Board, 2017. Water Quality Certification for the South Ocean Beach Short-Term Coastal Erosion Protection Measures Project in the City of San Francisco, June 14, 2017. California Coastal Commission, 2015. Coastal Development Permit, June 9, 2015.

activated carbon treatment to reduce chemical concentrations as necessary to meet permit requirements prior to discharge. Installation of meters to measure the volume of the discharge may also be required.

With discharge to the combined wastewater system in accordance with the city's requirements, water quality impacts related to a violation of water quality standards or degradation of water quality due to discharge of groundwater produced during construction-related dewatering would be ***less than significant***.

Operation

Stormwater Drainage

Following construction, drainage patterns would largely be comparable to existing conditions, with stormwater that is not infiltrated onsite being collected and directed to the Oceanside Treatment Plant for treatment via a stormwater pipeline or other stormwater management infrastructure. The final design of the project would be required to comply with the San Francisco Stormwater Management Ordinance included in San Francisco Public Works Code article 4.2, section 147. The stormwater management ordinance requires projects that would add or replace 5,000 square feet or more of impervious surface to manage stormwater using green infrastructure (i.e., stormwater controls or BMPs considered to be of low-impact design) and to maintain that green infrastructure for the lifetime of the project. Compliance with the ordinance would require that the project prepare a stormwater control plan describing the BMPs that would be implemented, including a plan for post-construction operation and maintenance of the BMPs. Specifically, the plan would include the following elements:

- Site characterization
- Design and development goals
- Site plan
- Site design
- Source controls
- Treatment BMPs
- Comparison of design to established goals
- Operations and maintenance plan

The selection of treatment BMPs to reduce pollutant loads in stormwater runoff is guided by existing site conditions and the pollutants of concern at the site. Treatment BMPs would reduce the pollutant loads in stormwater via infiltration (for example, permeable pavement or infiltration basins or trenches), detention (in constructed wetlands, detention ponds or vaults, or wet ponds), bioretention (such as flow through planter or rain garden), or biofiltration (for example, vegetated areas; media, sand, or vegetated rock filters; swirl separators, water quality inlets, or drain inserts). One or more treatment BMPs could be required to address each of the potential stormwater pollutants of concern.

The stormwater control plan must be reviewed and stamped by a licensed landscape architect, architect, or engineer. The SFPUC Wastewater Enterprise reviews the plan and certifies compliance with the guidelines and inspects stormwater BMPs once they are constructed; any issues noted during the inspection must be corrected. Compliance with the Stormwater Management Requirements and Design Guidelines (stormwater design guidelines) would require completing an annual self-certification inspection, and preparing completed checklists and maintenance logs for the year. In addition, the SFPUC would inspect all stormwater BMPs every third year, and any issues identified by either inspection must be resolved before the SFPUC could renew the certificate of compliance. With these standard requirements in place, impacts from stormwater discharges during project operation would be ***less than significant***.

Beach Nourishment

The project includes ongoing periodic maintenance of the beach through a beach nourishment program to replenish sand lost to sediment transport from coastal processes.

Small sand placements generally would be conducted during the dry season and during low tides. Small sand placement activities, including staging and onsite refueling, would be subject to SFPUC standard construction measure 3, water quality, which requires the use of erosion and sedimentation controls tailored to the project site. Corresponding large sand placement activities would comply with the Corps' standard contract specifications governing water quality protection, which require preparation of an environmental protection plan that includes best management practices to minimize the potential for leaks, spills, and prompt containment and cleanup in the event of a release, among other measures.[235]

Large sand placements would use sand dredged from the main ship channel. Dredged sediment proposed for placement in upland or beneficial use sites requires sediment characterization to determine whether such placement can occur without adversely affecting human health and the marine environment. Sampling and testing of the main ship channel sediments occurs every eight years according to a schedule agreed upon by the Corpsand the San Francisco Bay Dredge Material Management Office (DMMO), which reviews sediment testing plans and results, and issues suitability determinations in accordance with applicable federal and state regulations.[236] The United States Environmental Protection Agency (USEPA)/ Corps dredge material testing manuals[237] and Code of Federal Regulations, Title 40, Part 227.13(b)(1) provide an allowance for predominantly sandy material found in areas of high current or wave energy with low organic carbon content to be exempt from further chemical and biological testing since sandy sediments are not known to be carriers of elevated contaminants. The most recent sediment testing was in 2018 and included grain size, total organic carbon, and total solids.[238] The results of this testing confirmed that the 2018 main ship channel sediments average approximately 95 percent sand. Therefore, the sand continues to be excluded from additional testing requirements in the intervening years and the sediments are considered to be suitable for beneficial use at South Ocean Beach. Large sand placements would be conducted in accordance with applicable authorization from the DMMO, which would review the sediment quality for conformance with applicable quality standards.

During the large sand placement, slurried sand would be placed in an area contained by an appropriately sized toe berm. The berm would isolate the placement activities from the ocean surface waters, and allow for settlement of most sediment before the water from the slurry reaches the ocean. As a result, placement activities would be expected to result in minor and temporary increases in turbidity, or elevated levels of suspended sediments, generally limited to the area where the decant water returns to the surf. Due to the nature of the material (i.e., sand), the sediments would be expected to settle out of the water column

[235] U.S. Army Corps of Engineers, 2021. West Coast Hopper Maintenance Dredging 2021 Project Manual, Section 01 57 20.00 82, Environmental Protection, Part 3.1 Implementation, Part 3.5 Protecting Water Resources, Part 3.6 Environmental Monitoring, and Part 3.11 Ocean Beach Pump Ashore Beach Fill Environmental Controls. February 19, 2021.

[236] The Dredged Materials and Management Office is a joint program of the Corps, USEPA, San Francisco Bay Regional Water Quality Control Board, San Francisco Bay Conservation and Development Commission, and the State Lands Commission. Its primary function is to review sediment quality sampling plans, analyze the results of sediment quality sampling and make suitability determinations for material proposed for disposal in and around the San Francisco Bay, including within proposed and designated placement sites offshore of Ocean Beach.

[237] For dredging projects involving ocean disposal, local sediment testing guidance is provided on a case by case basis, using the 1991 Evaluation of Dredged Material Proposed for Ocean Disposal Testing Manual (also referred to generally as "The Green Book") a joint publication of the USEPA and US Army Corps of Engineers.

[238] USACE, San Francisco District. Sampling and Analysis Report, San Francisco Main Ship Channel 2018 Maintenance Dredging, April 2018.

quickly. In any event, the Corps would require as part of its standard contract specifications the implementation of turbidity controls and monitoring.[239]

Similarly, the placement and removal of the anchors and pipeline for the large sand placements may briefly elevate turbidity in the immediate vicinity of this equipment; however, as with the decant water this would be temporary and would not result in substantial water quality degradation.

Under either the large or small placement scenario, the sand would eventually erode from the beach by wave action and would be moved offshore and alongshore along with the ambient sediment load. Due to the nature of the material, and considering the small volume of sand from the project relative to the substantially greater volume in the littoral drift, the resulting turbidity levels would remain within the ambient range.

Therefore, with implementation of the monitoring program described above to evaluate runoff quality from the proposed improvements, and compliance with the stormwater design guidelines to infiltrate stormwater runoff, as well as adherence to water quality regulations, regulatory permits and authorizations, the impacts related to additional sources of polluted runoff and other project discharges would be ***less than significant***.

Impact HY-2: The project would not alter the existing drainage pattern of the area in a manner that would result in substantial erosion, siltation, or flooding onsite or offsite. *(Less than Significant)*

Construction

As noted above, all earthwork activities during construction would be conducted in accordance with San Francisco Public Works Code article 4.2, section 146 and the construction general permit, which include BMP requirements to minimize erosion and siltation as well as other drainage control measures. Construction activities would adhere to the required SWPPP prepared for the project, which would be consistent with existing SFPUC standard construction measures and include measures for erosion and sediment control (e.g., fiber rolls, and/or gravel bags around storm drain inlets, silt fencing, etc.), as well as stormwater runoff control to avoid any flooding. These BMPs would be implemented during all phases of construction. Implementation of the construction general permit requirements would ensure that project construction activities would not alter existing drainage patterns in a manner that would subsequently result in erosion, siltation, or flooding.

Operation

The landside improvements (proposed service road and multi-use trail) would alter the existing drainage patterns with the inclusion of a new stormwater drainage system. Stormwater runoff from the impervious areas would be collected and directed to the Oceanside Treatment Plant for treatment prior to offshore discharge. The beachside improvements including reshaping the bluff, installation of the slope stabilization, and placement of sand after revetment and rubble removal are intended to reduce erosion compared to existing conditions but could also result in erosion due to interactions between the placed sand or buried wall and coastal processes.

[239] U.S. Army Corps of Engineers, 2021. West Coast Hopper Maintenance Dredging 2021 Project Manual, Section 01 57 20.00 82, Environmental Protection, Part 3.1 Implementation and Part 3.6 Environmental Monitoring. February 19, 2021.

As with any San Francisco development that creates or replaces more than 5,000 square feet of impervious surfaces, the project would be required to implement post-construction stormwater controls in accordance with the city's stormwater management ordinance and comply with the SFPUC's stormwater design guidelines. The project would include stormwater management features as detailed in a stormwater control plan that would comply with the stormwater management ordinance (discussed in greater detail in Impact HY-1). The project includes stormwater management infrastructure that would be installed alongside new or replaced impervious areas. The stormwater management infrastructure would incorporate operational BMPs and low-impact design concepts as required by the stormwater management ordinance to the extent that is applicable to the site conditions and project specifics. These required drainage control features would minimize the potential for erosion or siltation, and would adequately control stormwater volumes such that the potential for flooding onsite or offsite would also be minimized.

As discussed in Impact HY-1, after sand placement the sand would erode from the beach by wave action and would enter the littoral drift along with the ambient sediment load; this is not expected to significantly increase turbidity and would remain within the ambient sediment load range. As discussed in Impact GE-3, the project is designed to reduce or avoid erosion at South Ocean Beach, and would not result in substantial erosion or sedimentation either north or south of the buried wall.

In addition to the reasons presented above, the project would not cause or result in new flooding, because it would remove and replace at inland locations assets that could at some point in the future be subject to coastal flood hazards (NPS restroom and parking), and would not change the elevation of other inland assets. The top of the buried wall would be between 15 and 20 feet above mean sea level and is designed to withstand coastal hazards, including wave runup. While the buried wall would be lower than the height of the existing revetments, the revetments do not perform a flood control function.

Therefore, although the project would alter drainage patterns, it would be done in a way that would not result in adverse on-site or off-site effects, such as flooding, erosion, or siltation. Therefore, this impact would be ***less than significant***.

Impact HY-3: The project would not substantially increase the rate or amount of surface runoff in a manner which would result in flooding on or offsite, or create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff. (*Less than Significant*)

The proposed service road, multi-use trail, Skyline coastal parking lot, and restroom would include construction of impervious surfaces. Most of the areas where impervious surfaces are proposed are currently already covered in impervious surfaces with the exception of portions of the Skyline coastal parking lot location, which would include pavement covering a currently unpaved vegetated median. The project would also remove the southbound lanes of the Great Highway, which would reduce the overall area of impervious surface within the South Ocean Beach project site. Overall, the project would result in a net decrease in impervious surface coverage relative to existing conditions. Therefore, the project would not substantially increase the amount of stormwater runoff from the South Ocean Beach project site. Regardless, as noted above, replacement of impervious surfaces requires compliance with the city's stormwater management ordinance, in addition to the stormwater design guidelines. These requirements and guidelines include stormwater management measures that would require the project to reduce the existing stormwater runoff flow rate and volume by 25 percent for a two-year, 24-hour design storm, thereby reducing the volume and rate of runoff water in the area and draining to existing stormwater drainage systems. Runoff from proposed improvements that would be in compliance with existing stormwater requirements would ensure that flows from the project would not exceed the current amount of runoff and there would no exceedance related to the capacity of the drainage infrastructure. Further, the construction general permit requires that post-construction runoff shall not exceed preconstruction runoff and includes a water balance calculation that must be used to demonstrate how this will be achieved. The stormwater management measures that would be part of the project to comply with the city's stormwater management ordinance would be expected to meet these requirements. In addition, the project does not include any new sources that could contribute polluted runoff. For these reasons, the project impact would be ***less than significant***.

Impact HY-4: The project would not risk release of pollutants due to inundation by flooding, tsunami waves, or seiche waves. (*Less than Significant*)

Construction

As noted above, the locations of the project's landward elements (multi-use trail, parking lot, restroom) are not currently in a special flood hazard area identified on the Federal Emergency Management Agency's flood hazard map for the project area. However, sea levels are continuing to rise globally at an accelerated rate due to climate change and will continue to do so for the foreseeable future. According to tide gauge data for San Francisco, the calculated trend of sea levels is rising 0.08 inch per year based on monthly mean sea level data from 1897 to 2019, which is equivalent to a change of 0.65 foot in the past 100 years.[240] According to the Sea Level Rise Vulnerability and Consequence Assessment report, the amount of sea level rise anticipated to occur by the end of the century for San Francisco could be as much as 108 inches (66 inches of sea level rise plus 42 inches of tidal and storm surge).[241]

Tsunamis (seismic sea waves) are long period waves typically caused by underwater seismic disturbances, volcanic eruptions, or submerged landslides. A tsunami, which travels at speeds up to 700 miles per hour, is typically only 1 to 3 feet high in open ocean water, but it may increase in height to up to 90 feet as it reaches coastal areas and cause large amounts of damage.[242] The San Francisco tide gauge has recorded numerous tsunamis throughout its history of operation, with the 1964 Alaska tsunami causing the greatest impact on the west coast of the United States. The project area is located within a tsunami hazard zone, as identified in the Community Safety Element of the San Francisco General Plan.[243] The inundation hazard zone extends into the existing zoo parking lot at the northern end of the South Ocean Beach project site and then becomes protected by the bluffs toward the southern end of the South Ocean Beach project site. As described for Impact HY-1, hazardous materials would be used for construction. In the event that a tsunami were to occur during construction, it is conceivable that a release of pollutants could occur if construction equipment and materials were not securely stored and appropriately managed. As also discussed for Impact HY-1, project construction would require implementation of a SWPPP, which would include measures for handling and storage of hazardous materials to minimize the potential for any inadvertent releases. To reduce the potential for a release of hazardous materials, the SWPPP would specify BMPs for hazardous materials storage, such as use of dedicated storage areas and secure storage containers.

240 National Oceanic and Atmospheric Administration (NOAA), 2020. Sea Level Trend Tracker for San Francisco 9414290, *https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=9414290*, accessed September 29, 2020.

241 City and County of San Francisco, 2020. Sea Level Rise Vulnerability and Consequence Assessment, 2020.

242 URS Corporation, 2008. City and County of San Francisco Hazard Mitigation Plan, December 2008.

243 San Francisco Planning Department, 2012. Community Safety, an Element of the General Plan of the City and County of San Francisco. October 2012.

Implementation of appropriate BMPs would aid in preventing a release of substantive quantities of pollutants but may not avoid a release in the event that a tsunami occurred during construction when activities would be taking place in the inundation zone.

The historical record of tsunami waves along the San Francisco coast, with approximately 71 events occurring since 1854 and none causing notable damage since 1964, suggests that the likelihood of occurrence is low. Moreover, existing warning systems now allow for early detection and public alert of tsunami events from faraway sources. These systems can provide advance notice which, depending upon the time available, would allow construction workers to evacuate and remove hazardous materials and heavy equipment from the inundation zone. Therefore, despite the South Ocean Beach project site being located within a tsunami inundation hazard area, with implementation of a SWPPP with hazardous materials storage requirements, and considering the low probability of a tsunami occurring during the construction period and tsunami warning systems, the risk of pollutant release due to inundation by tsunami waves is considered less than significant.

A seiche is caused by oscillation of the surface of an enclosed body of water, such as Lake Merced, due to an earthquake, changes in atmospheric pressure, or strong winds. The city has not mapped areas of potential inundation by seiches, but seiche waves could be experienced along the shoreline of the lake. The intersection of the Great Highway and Skyline Boulevard is located within approximately 100 feet of Lake Merced. While it would be speculative to estimate whether this area could become inundated by seiche waves, hazardous materials or other pollutants would not be stored in this portion of the project area during construction. For the same reasons identified for flooding and tsunamis, required BMPs for the handling of construction-related hazardous materials would ensure that the potential for their release during construction that coincided with a seiche event would be less than significant.

Operation

While sea level rise is anticipated to expand flood-prone areas in the future, and portions of the project site are within the tsunami hazard zone or near Lake Merced, the proposed improvements would not include the storage of hazardous materials or other pollutant sources in an area that could be subject to flood, tsunami, or seiche hazards. During sand placements, equipment would operate on the beach and near the intersection of Great Highway and Skyline Boulevard, among other areas, for a period of six to eight weeks, approximately once every four to ten years. As discussed in Impact HY-1, during sand placements vehicle staging and fueling would occur in the Skyline coastal parking lot and along the beach near the work areas. As also discussed in Impact HY-1, such work would occur during the dry season and would be subject to hazardous materials handling, storage, and water quality protection measures similar to those described for construction. For the same reasons set forth for construction, the risk of pollutant release from project operations due to inundation by tsunami waves is considered less than significant.

Therefore, project construction and operations impacts related to the risk of release of pollutants involving inundation by flooding, seiche, or tsunami waves would be ***less than significant***.

Impact HY-5: The project would not conflict with or obstruct implementation of a water quality control plan or sustainable groundwater management plan. (*Less than Significant*)

The project area is located within San Francisco Bay Regional Water Quality Control Board jurisdiction. The regional board has adopted a water quality control plan (basin plan) that covers the project area and includes water quality policies and guidelines. Both construction and operation of the project would be required to adhere to all applicable local and state water quality regulations including policies and objectives of the basin plan. As discussed above for Impact HY-1, project construction and operation would require compliance with the construction general permit and the city's stormwater management ordinance, as well as permits and authorizations for the beachside construction that would include measures to minimize transport of pollutants to receiving waters. Compliance with these mandatory regulatory requirements would ensure that all discharges to waterbodies meet water quality objectives and policies of the basin plan such that the potential impact would be ***less than significant***.

The project area is located in the Westside Groundwater Basin, which is divided into the North Westside Basin (basin area north of San Mateo/San Francisco county boundary) and the South Westside Basin (area south of the county boundary). A groundwater management plan has been drafted for the North Westside Basin but has not been formally adopted. Regardless, while the project may require temporary dewatering for construction purposes, this need would be short-term and the project would not otherwise involve the use of groundwater resources or substantively interfere with groundwater recharge. Therefore, the impact related to consistency with either a water quality control plan or sustainable groundwater management plan would be ***less than significant***.

Impact C-HY-1: The project, in combination with the cumulative projects, would not result in significant impacts on hydrology and water quality. (*Less than Significant*)

The South Ocean Beach project site includes shoreline areas of Ocean Beach and landward improvements that drain to the Pacific Ocean and to the combined wastewater system, where flows are treated by the Oceanside Treatment Plant before discharge to the Pacific Ocean. Therefore, the geographic scope of potential cumulative water quality effects encompasses portions of the city's Lake Merced and Sunset drainage basins where the project is located, and the Pacific Ocean, which receives stormwater runoff and Oceanside Treatment Plant effluent discharges from these areas.

The project would have less-than-significant water quality impacts related to violation of water quality standards, alteration of existing drainage patterns, exceedance of stormwater drainage capacity, and risk of release of pollutants due to inundation by tsunami or seiche waves.

As discussed under Impact HY-1, the project would include the use of heavy equipment and soil disturbances that could result in increased erosion or release of hazardous materials and, in turn, affect water quality in the coastal waters. Cumulative projects involving considerable ground disturbance and use of heavy equipment whose construction periods could overlap that of the project include the Westside Pump Station Reliability Improvements Project, Oceanside Treatment Plant Improvements Project, San Francisco Zoo Recycled Water Pipeline, Westside Force Main Reliability Project, 2700 Sloat Boulevard, and Vista Grande Drainage Basin Improvement Project.

Each of the cumulative projects would be required to comply with the construction general permit or the construction site runoff requirements of San Francisco Public Works Code article 4.2, section 146, which require measures to avoid adverse water quality effects during construction. These projects would also be required to adhere to stormwater drainage control requirements similar to what would be required of the project as discussed in Impacts HY-2 and HY-3. Just as with the project, these drainage control requirements would be applicable to cumulative projects and would ensure that both runoff water quality and runoff volumes are managed in a way that does not adversely affect water quality, create flooding, or exceed infrastructure capacity, both on an individual basis and cumulatively since these regulations inherently consider cumulative effects.

Of the cumulative projects identified, most (i.e., Westside Pump Station Reliability Improvements, Oceanside Treatment Plant Improvements, San Francisco Zoo Recycled Water Pipeline, Westside Force Main Reliability, and 2700 Sloat Boulevard) are located in the vicinity of the project; however, most are proposed for sites outside of the tsunami inundation zone. Sea level rise would be expected to expand the inundation zone; however, as discussed in Impact HY-4, the project would not store hazardous materials or provide other sources of pollutants such that the project effects could combine with those of other cumulative projects to increase risk of pollutant releases. As discussed, the cumulative projects would also be subject to the same existing regulatory requirements, including good housekeeping and BMPs. Therefore, cumulative impacts on water quality due to erosion, changes to drainage patterns, flooding, inundation, or other risk of release of pollutants would be ***less than significant***.

E.18 HAZARDS AND HAZARDOUS MATERIALS

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
18. HAZARDS AND HAZARDOUS MATERIALS. Would the project:					
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☒	☐	☐
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☒	☐	☐
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☒	☐	☐
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☐	☒
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard or excessive noise for people residing or working in the project area?	☐	☐	☐	☐	☒
f) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☒	☐	☐
g) Expose people or structures, either directly or indirectly, to a significant risk of loss, injury or death involving wildland fires?	☐	☐	☐	☐	☒

The project would not be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code section 65962.5, and would not be located within an airport land use plan or within 2 miles of a public or public use airport.[244,245] The project area does not include and is not adjacent to

244 The nearest airport, San Francisco International Airport, is located over 6 miles from the project area.

245 State Water Resources Control Board (SWRCB), Geotracker Database search, *https://geotracker.waterboards.ca.gov/map/?CMD=runreport&myaddress=2958+Sloat+Boulevard%2C+San+Francisco+CA*, accessed on December 12, 2019. Department of Toxic Substances Control (DTSC), EnviroStor database search, Available online at: *https://www.envirostor.dtsc.ca.gov/public/profile_report?global_id=80000607*, accessed on December 12, 2019.

areas at risk of wildland fire, and therefore the project would not alter exposure to wildland fires.[246] The project would not result in safety hazards related to these topics; therefore, topics E.17(d), E.17(e), and E.17(g) are ***not applicable*** to the project.

Impact HZ-1: Construction and operation of the project would not create a significant hazard through the routine transport, use, or disposal of hazardous materials, or through reasonably foreseeable upset and accident conditions involving the release of hazardous materials. (*Less than Significant*)

A *hazardous material* is defined as any material that, because of quantity, concentration, or physical or chemical characteristics, poses a significant present or potential hazard to human health and safety or to the environment if released into the workplace or the environment (California Health and Safety Code chapter 6.95, section 25501(o)). The term hazardous materials refers to both hazardous substances and hazardous wastes. Under federal and state laws, any material, including wastes, may be considered hazardous if it is specifically listed by statute as such or if it is toxic (causes adverse human health effects), ignitable (has the ability to burn), corrosive (causes severe burns or damage to materials), or reactive (causes explosions or generates toxic gases).

Hazardous wastes are hazardous substances that no longer have practical use, such as materials that have been spent, discarded, discharged, spilled, contaminated, or are being stored until they can be disposed of properly (California Code of Regulations [CCR] title 22, section 66261.10). Soil that is excavated from a site containing hazardous materials is a hazardous waste if it exceeds specific criteria established in sections 66261.20 through 66261.24 of the CCR title 22. Hazardous substances are regulated by multiple agencies, and cleanup requirements for hazardous releases are determined on a case-by-case basis according to the agency (e.g., Department of Toxic Substances Control, State Water Resources Control Board, or San Francisco Department of Public Health) with lead jurisdiction over a contaminated site.

Ultramafic bedrock materials, including serpentine rocks, are present in some areas of San Francisco and have the potential to contain naturally occurring asbestos fibers. According to statewide mapping and mapping compiled by the SFPUC, the project area is not located within any mapped ultramafic bedrock units or where asbestos occurrences have been mapped.[247] The San Francisco Property Information Map Viewer also shows that the project area is not underlain by serpentine rocks.[248]

Construction

Accidental Releases

Construction activities would require the use of limited quantities of hazardous materials such as fuels, oils, solvents, paints, and other common construction materials. As discussed in Section E.17, Hydrology and Water Quality, stormwater drainage from the South Ocean Beach project site flows either to the city's combined wastewater collection system or to Ocean Beach and the Pacific Ocean. Due to the location and size of the area of ground disturbance, construction activities would be subject to the requirements of

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246 California Department of Forestry and Fire Protection (CAL FIRE), Fire Hazard Severity Zone (FHSZ) Map by County, November 2008, *https://frap.fire.ca.gov/frap-projects/fhsz-in-sra-county-maps/* and *https://frap.fire.ca.gov/media/6404/fhszl06_1_map38.pdf*, accessed December 3, 2019.

247 California Division of Mines and Geology (CDMG), A General Location Guide for Ultramafic Rocks in California, Areas More Likely to Contain Natural Occurrences of Asbestos, Open-File Report 2000-19, compiled by Ronald K. Churchill and Robert L. Hill, August 2000; San Francisco Public Utilities Commission (SFPUC), Supplemental Detailed Local NOA –Map Sets for the City of San Francisco and SFPUC Lands in San Mateo, Alameda, Santa Clara, and Tuolumne Counties, December 23, 2013.

248 City and County of San Francisco, Property Information Map – Map Viewer, *https://sfplanninggis.org/pim/map.html?layers=Serpentine%20Rocks*, accessed December 17, 2019.

San Francisco Public Works Code article 4.2, section 146 and the State Water Resources Control Board's General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities (construction general permit),[249] as applicable (discussed in greater detail in Section E.17, Hydrology and Water Quality). In accordance with this article and the construction general permit, and consistent with the SFPUC's Water Pollution Prevention Program, the contractor would be required to develop and implement an erosion and sediment control plan or SWPPP specifying measures to prevent stormwater pollution and control runoff at each site, in conformance with any applicable stormwater management controls adopted by the SFPUC.[250] The plan would specify minimum BMPs related to housekeeping (storage of construction materials, waste management, vehicle storage and maintenance, landscape materials, pollutant control); and run-on and runoff control. Article 4.2 provides that for projects subject to both an erosion and sediment control plan and the construction general permit, the SWPPP may be prepared in lieu of the erosion and sediment control plan. Construction activities subject to these permit requirements include ground disturbances and hazardous materials storage.

In addition, the SFPUC would implement BMPs as part of its standard construction measures (see EIR Appendix C) which include hazardous materials management, spill prevention, and spill response measures. Examples include protocols for any unidentified hazardous materials encountered during construction to be characterized and appropriately treated, contained, or removed to avoid any adverse exposure. Measures would also be implemented to prevent the release of hazardous materials used during construction, such as storing them pursuant to manufacturer recommendation, maintaining spill kits onsite, and containing any spills that occur to the extent safe and feasible, followed by collection and disposal in accordance with applicable laws.

Implementation of these measures would reduce short-term construction-related transport, use, and disposal of hazardous materials to less-than-significant levels. In addition, earthwork activities would be located outside of known areas of serpentine, which would indicate an unlikely potential to encounter any naturally occurring asbestos.

Potential Exposure to Contaminated Soil or Groundwater

According to mapping compiled by the city (Maher Ordinance Layer), there are two individual sites near the South Ocean Beach project site that are likely associated with a past presence of underground storage tanks.[251] These sites appear to coincide with the former Chevron service station at 2940 Sloat Boulevard (cleanup completed in 1996), and the former San Francisco Armory lands south of the zoo and east of the Great Highway (cleanup completed in 2012). Both of these sites are in the presumed upgradient direction from the proposed ground disturbances; for both of these sites, however, either remediation activities have been completed and/or the state has otherwise determined that no further action is required, indicating that there is a low risk of exposure to hazardous materials.[252] Encountering hazardous materials in excavated soil at the project site would thus be unlikely. In addition, the primary areas of subsurface

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249 National Pollutant Discharge Elimination System General Permit for Stormwater Discharges Associated with Construction and Land Disturbance *Activities* (Order 2009-0009-DWQ, NPDES No. CAS000002; as amended by Orders 2010-0014-DWQ and 2012-006-DWQ).

250 San Francisco Public Utilities Commission (SFPUC), Construction Site Runoff Pollution Prevention Procedures. Available online at: *http://www.sfwater.org/index.aspx?page=235*. Accessed January 19, 2021.

251 City and County of San Francisco, Property Information Map – Map Viewer, Maher Ordinance Layer, *https://sfplanninggis.org/pim/map.html?layers=Maher%20Ordinance*, accessed December 13, 2019.

252 State Water Resources Control Board (SWRCB), Geotracker Database search, *https://geotracker.waterboards.ca.gov/map/?CMD=runreport&myaddress=2958+Sloat+Boulevard%2C+San+Francisco+CA*, accessed on December 12, 2019. Department of Toxic Substances Control (DTSC), EnviroStor database search, Available online at: *https://www.envirostor.dtsc.ca.gov/public/profile_report?global_id=80000607*, accessed on December 12, 2019.

disturbance would be west of the Great Highway, a minimum of 400 feet from these two sites, further reducing the probability of encountering contaminated soil or groundwater. Furthermore, any unidentified hazardous materials encountered during construction would be characterized and appropriately treated, contained, or removed, in accordance with SFPUC standard construction measure 6, Hazardous Materials. Therefore, based on the absence of any identified release sites within the proposed areas of disturbance, the regulatory status of nearby sites including the time since case closure and the distance from proposed activities, the potential impact resulting from encountering subsurface contamination in soil or groundwater is considered less than significant.

Operation

Once constructed, the project would not, outside of the beach nourishment activities, require the use, transport, or disposal of hazardous materials. The beach nourishment program, under the small or large sand placements, would require use of heavy equipment to place the sand and the use of limited quantities of hazardous materials, such as fuels, oils, and lubricants. The small sand placements would be undertaken by the city, while the large sand placements would be undertaken by the Corps. As described above for the construction period, the SFPUC would be required to implement BMPs for the small sand placements according to the construction general permit or article 4.2 of the Public Works code, as applicable, including hazardous materials management measures. The Corps would similarly require its contractor to undertake environmental protection measures during large sand placements; these measures address hazardous materials and include applicable requirements contained in the Code of Federal Regulations (40 CFR Part 112, Oil Pollution Prevention; 49 CFR Parts 171-178, Hazardous Materials Regulations; and 49 CFR Parts 260-262 related to management of hazardous waste).[253] Under both placement options, the project would be subject to and required to comply with Clean Water Act section 401 water quality permits, which include spill prevention and response measures to limit the potential adverse effects from any upset or accident conditions.

North Ocean Beach, the source of the small sand placements, is already used as a source of sand replenishment for South Ocean Beach and thus would not have any adverse effects related to sand quality or human health and safety from sediment quality. As explained for Impact HY-1, dredged sand proposed for placement within upland/beneficial use sites requires sediment characterization to determine whether placement can occur without adversely affecting human health and the marine environment. As discussed previously, the DMMO reviews sediment testing plans and results, and issues suitability determinations in accordance with applicable federal and state regulations. The most recent sediment testing in 2018 included grain size, total organic carbon, and total solids. The results of this testing confirmed that the 2018 main ship channel sediments average approximately 98 percent sand and, therefore, are considered suitable for beneficial use at South Ocean Beach. Large sand placements would be conducted in accordance with applicable authorization from the DMMO, which would review the sediment quality for conformance with applicable quality standards.

For the reasons presented, through compliance with mandatory regulatory requirements, project construction and operation would have a ***less-than-significant*** impact related to hazards associated with routine transport, use, or disposal, or through upset or accident conditions involving hazardous materials releases.

[253] U.S. Army Corps of Engineers, 2021. West Coast Hopper Maintenance Dredging 2021 Project Manual, Section 01 57 20.00 82, Environmental Protection. February 19, 2021.

Impact HZ-2: Construction and operation of the project would not emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school. (*Less than Significant*)

The nearest school to the South Ocean Beach portion of the project area is the Ark Christian Pre-School, which is located approximately 0.35 mile to the northeast. In addition, the Ulloa Elementary School is located approximately 0.38 mile to the northeast. The closest daycare facility is the Little Bananas Daycare, located approximately 0.33 mile to the north. The Pomeroy Recreation and Rehabilitation Center is located approximately 0.25 mile to the east; the center is considered a sensitive receptor because it offers programs and resources to children. The nearest school to the North Ocean Beach portion of the project area is Munchkinland Family and Daycare Center, located approximately 0.11 mile to the east.

Hazardous air emissions include the TACs that are listed in California Code of Regulations title 17, section 93000 (refer to Section E.8, Air Quality). Impacts associated with TAC emissions are addressed in Impact AQ-4 in Section E.8. As discussed in that section, the existing plus project excess cancer risk for residential and school child receptors would be below the APEZ excess cancer risk criteria of 100 per one million persons exposed. As a result, the health risks associated with project-related TAC exposure were determined to be less than significant.

Construction

The State of California defines acutely hazardous materials as extremely hazardous materials in Health and Safety Code section 25532(i)(2). As explained in Impact HZ-1, the project would use common hazardous materials such as paints, solvents, cements, adhesives, and petroleum products (such as asphalt, oil, and fuel). None of these materials is considered extremely hazardous. Project construction would not involve substantial quantities of hazardous material, and would be subject to mandatory regulatory requirements, including the implementation of BMPs. In particular, hazardous materials used during construction would be stored, and spill prevention and response measures would be established, in accordance with the requirements of the Public Works code and construction general permit, as applicable. Adherence to these requirements would minimize the potential for releases that could create a hazard to the public or the environment. Therefore, project construction would have a ***less-than-significant*** impact with respect to emitting or handling hazardous materials within 0.25 mile of a school.

Operation

With the exception of the beach nourishment program, project operation would not require handling or using hazardous materials, nor would it produce hazardous emissions. Sand placements, both small and large, would use heavy equipment that would require limited quantities of common hazardous materials such as fuel and lubricants. Project operations would not require use of extremely hazardous materials. The sand placement activities would be temporary and, as described in Impact HZ-1, the city and Corps would be required to comply with mandatory regulatory requirements, including implementing BMPs and other environmental protection measures, to limit the release of any hazardous materials. As explained for construction, adherence to these requirements would minimize the potential for releases that could create a hazard to the public or the environment. Therefore, project operations would have a ***less-than-significant*** impact with respect to emitting or handling hazardous materials within 0.25 mile of a school.

Impact HZ-3: Construction and operation of the project would not impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan. (*Less than Significant*)

The San Francisco Department of Emergency Management maintains city-wide emergency plans as part of a comprehensive emergency management program to ensure that the city is ready to respond to a variety of threats and hazards (e.g., earthquakes, tsunamis, fires, and floods). These plans include the 2010 All-Hazards Strategic Plan, the 2014 Hazard Mitigation Plan, and the 2017 Emergency Response Plan. The project would include permanent closure of the Great Highway between Sloat and Skyline boulevards (see also discussion of circulation in EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, Section 4.3, Transportation and Circulation). Closure would begin during project construction. This section of the Great Highway is listed as a primary emergency priority route in the transportation annex of the Emergency Response Plan.[254] Emergency access and public egress to and from the project area are provided by the Great Highway to the north; Sloat Boulevard, along with Zoo and Herbst roads (emergency access only), to the east; and the Great Highway and Skyline Boulevard to the south. The Sloat Boulevard and Great Highway intersection provides direct access to the sand ramp that is used by emergency personnel for access to Ocean Beach.

Construction

During construction, the project area, including portions of Ocean Beach south of Sloat Boulevard, would be closed to the public. Within this area, the existing sand ramp near the Sloat Boulevard/Great Highway intersection provides emergency access between the beach and city roadways. During construction, emergency vehicle access to Ocean Beach via the existing sand ramp would be maintained.

The intersection of Sloat Boulevard and Great Highway would not be closed during construction and, as discussed in greater detail in Impact TR-1 (in EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, Section 4.3, Transportation and Circulation), temporary travel lane closures on Sloat Boulevard would be of limited duration. Emergency vehicle access to the project area would also be maintained via Herbst and Zoo roads. While the section of the Great Highway extending between Sloat and Skyline boulevards would be closed to the public during construction, the service road would remain accessible to authorized personnel, including first responders. Skyline Boulevard would not be affected. Therefore, egress routes to evacuate the area would remain, as would emergency access to the project area and to the beach via the sand ramp.

In addition, as discussed further in EIR Chapter 4, Environmental Setting, Impacts, and Mitigation Measures, Section 4.3 Transportation and Circulation, project construction would include development and implementation of a traffic control plan consistent with the San Francisco Regulations for Working in San Francisco Streets (also known as the “blue book”) which would require coordination with emergency response providers prior to construction. The blue book establishes rules and guidance so that work can be done safely and with the least possible interference with pedestrians, bicycle, transit, and vehicular traffic. In addition, the SFPUC’s standard construction measure 4 requires implementation of traffic control measures sufficient to maintain traffic circulation on streets affected by project construction. Traffic control measures include coordination with local emergency responders to maintain emergency access. Therefore, while the adopted emergency route would be altered during construction, emergency response and evacuation routes

[254] City and County of San Francisco, Transportation Annex, Emergency Response Plan, May 2017, Appendix B.

would continue to serve this area in the event of an emergency and the impact would be ***less than significant***.

Operation

As discussed in more detail in EIR Chapter 2, Project Description, the intersections, service road, and multi-use trail would all be designed in accordance with applicable regulatory requirements, including review by the San Francisco Fire Department to allow for continued emergency vehicle access. Once construction is complete, emergency access to and egress from the project area and beach would be available along the service road and multi-use path; and via Great Highway to the north, Sloat Boulevard and Zoo and Herbst roads to the east, and Skyline Boulevard to the south. Therefore, while the adopted emergency route would be altered by the project, emergency response and evacuation routes would continue to serve this area in the event of an emergency and the potential impact would be ***less than significant***.

Impact C-HZ-1: The project, in combination with the cumulative projects, would not result in significant impacts related to hazards and hazardous materials. (*Less than Significant*)

The geographic scope of potential hazards and hazardous materials impacts is limited to the project area and immediately adjacent sites. This is because the impacts from hazards and hazardous materials are generally site-specific, due to the need to quickly contain spills and the site-specific nature of contamination at hazardous materials sites. As a result, cumulative impacts typically do not occur unless the cumulative projects are in close proximity to one another.

Routine Use, Transport, Disposal, and Accidental Release

Construction and operation of cumulative projects would involve the use of hazardous materials, similar to those identified for the project. The effects of such uses are generally site-specific and depend on controls and precautions that are employed during construction activities. As discussed for the project in Impact HZ-1, the cumulative projects would be required to comply with applicable water quality protection requirements of article 4.2 of the Public Works code; the construction general permit; and SFPUC standard construction measures (for SFPUC-sponsored projects). Consistent with these requirements, the cumulative projects would implement an erosion and sediment control plan or a SWPPP that would specify appropriate methods for storing hazardous materials, preventing spills, inspecting for hazardous conditions, responding to any releases, and reporting. Once constructed, cumulative projects would be required to comply with federal, state, and local regulations applicable to the use, storage, and disposal of any hazardous materials and wastes.

Accidental spills of small quantities of hazardous materials during construction (i.e., motor fuels, oils, solvents, lubricants) could expose the public or the environment to such substances. Similar to the project, all cumulative projects would be required to adhere to the applicable regulations regarding hazardous materials storage and handling, as well as to implement all construction BMPs to prevent such a release and provide the means to promptly contain and clean up any spills, if one did occur. Typically, such incidental spills are localized and occur at varying times such that they do not combine with other projects to become cumulatively considerable.

Similarly, the storage and handling of hazardous materials for project operations would be subject to regulations that would minimize the potential for harmful exposures. Although the potential exists for releases to result during the other cumulative projects, there is no way of predicting whether any such releases would occur, where they would be located, or whether they could occur contemporaneously. Compliance with existing regulations would serve to ensure that cumulative impacts related to these topics would be ***less than significant***.

Emissions Near Schools

During construction and operation, the project would generate TAC emissions, which are considered hazardous emissions. Construction of cumulative projects could also release similar emissions. Cumulative impacts related to these emissions would be less than significant as discussed in Section E.8, Air Quality (Impact C-AQ-1).

As noted in Impact HZ-3, the only schools, daycares, or other sensitive receptors within 0.25 mile of the project area are the Pomeroy Center and Munchkinland Family and Daycare Center. The Oceanside Treatment Plant Improvements Project, Signalization of State Route 35 (Skyline) and Sloat Boulevard, San Francisco Zoo Recycled Water Pipeline, and Westside Force Main Reliability Project are also within 0.25 mile of the Pomeroy Center. These projects are not industrial in nature and would not generate substantial hazardous emissions during operation. Similar to the project, during construction these projects would also use common hazardous materials in limited quantities for the operation of equipment and machinery, and would be subject to federal, state, and local regulations. The combined effects of these projects would not result in a significant cumulative impact related to a release of hazardous materials, including releases that could affect the Pomeroy Center or Munchkinland Family and Daycare Center, given that none of the projects would use large quantities of hazardous materials, and all would be required to comply with laws and regulations intended to minimize hazardous materials emissions and associated public exposure. As discussed in Impact HZ-3, the project would not use extremely hazardous materials, so it would not contribute to any cumulative impacts related to the use of these materials. For these reasons, the project in combination with other projects would have a ***less-than-significant*** cumulative impact related to emissions near schools.

Emergency Response

Construction of other planned projects in the vicinity during the same time period could cause a cumulative emergency response impact if these projects were to cause closures of additional emergency response/evacuation routes. The following cumulative projects could require temporary partial and/or full lane closures along Sloat Boulevard, or Skyline Boulevard, in the project vicinity: Westside Pump Station Reliability Improvements, Reconfiguration of the Sloat and Skyline Boulevard Intersection, San Francisco Zoo Recycled Water Pipeline, Westside Force Main Reliability, and 2700 Sloat Boulevard. While these projects may require temporary closure of lanes along Sloat Boulevard, or Skyline Boulevard, these projects would be required to implement construction traffic management plans that would require coordination with emergency response providers prior to construction. Coordination with emergency response providers for the project and cumulative projects in compliance with emergency access requirements in the San Francisco Fire Code and traffic control requirements for road closures would minimize the potential for a cumulative emergency response effect. As such, the project, in combination with the other planned projects, would have a ***less-than-significant*** impact on emergency response.

E.19 MINERAL RESOURCES

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
19. MINERAL RESOURCES. Would the project:					
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☒	☐	☐
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	☐	☒

For purposes of this analysis, mineral resources include sand, clay, gravel and rock deposits that could be located within the project area and that would be of value to the region and residents of the state. The project area is classified by the California Geological Survey as MRZ-1 and MRZ-3 under the Surface Mining and Reclamation Act of 1975.[255] The MRZ-1 classification of lands south and west of the Great Highway, including Ocean Beach south of Sloat Boulevard, indicates that adequate information exists to conclude that no significant mineral deposits are present or little likelihood exists for their presence. The MRZ-3 classification of lands south of Sloat Boulevard and east of the Great Highway, and all of the portion of North Ocean Beach from which sand would be excavated for the small sand placements, indicates that these areas contain mineral deposits, the significance of which cannot be evaluated from available data (including whether these deposits can be considered mineral resources). The California Department of Conservation's Mineral Land Classification: Aggregate Materials in the San Francisco-Monterey Bay Area, Special Report 146 notes that these (MRZ-3) areas contain dune sand, and similar material has been mined in the past, but a lack of data precludes classifying these locations as areas where significant mineral resources are present.[256] None of these areas has been designated by the state as containing mineral deposits of statewide or regional significance.[257]

There are no mines, mineral plants, oil, gas, or geothermal wells located within the project area.[258,259] The San Francisco General Plan states that, as a very urban place, San Francisco does not contain mineral resources to any appreciable extent and, as a result, consideration of mineral resources is omitted from the

255 *Classification* of mineral resource zones is based on geologic and economic factors without regard to existing land use and land ownership. *Designation* is the formal recognition by the state, after consultation with lead agencies and other interested parties, of areas containing mineral deposits of regional or statewide significance.

256 California Department of Conservation, Division of Mines and Geology (CDMG), Mineral Land Classification: Aggregate Materials in the San Francisco-Monterey Bay Area, Special Report 146, Part II, Plate 2.41 San Francisco North Quadrangle and Plate 2.42 San Francisco South Quadrangle, 1987.

257 Ibid.

258 California Department of Conservation, Division of Oil, Gas, and Geothermal Resources (DOGGR), Online Mapping System, available online at *http://www.conservation.ca.gov/dog/Pages/WellFinder.aspx*, accessed December 16, 2019.

259 U.S. Geological Survey (USGS), Active Mines and Mineral Plants in the U.S., 2003, available online at *http://mrdata.usgs.gov/mineral-resources/active-mines.html*, accessed December 16, 2019.

general plan.[260] The general plan does not identify any areas of important mineral resource recovery sites in San Francisco. For these reasons, topic E.19(b) is ***not applicable*** to the project.

Impact MN-1: Construction and operation of the project would not result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state. (*Less than Significant*)

The project would involve a beach nourishment program. Sand used for beach nourishment could come from multiple sources. Sand would be excavated from a portion of North Ocean Beach and placed along a portion of South Ocean Beach. Both the excavation and placement sites would be on NPS lands within the Golden Gate National Recreation Area (GGNRA). Because the project would relocate sand from North Ocean Beach to South Ocean Beach, it would remain on federal land and continue to serve a federal purpose, and therefore is allowed.[261] Sand also would be sourced from the San Francisco Harbor – Main Ship Channel, which is regularly dredged by the U.S. Army Corps of Engineers (Corps) as part of that agency's ongoing federal navigation channels maintenance program.[262] Dredging would occur regardless of whether dredged sand is placed for beneficial use as part of the project's beach nourishment.

The purpose of the beach nourishment program would be to provide continued beach access and recreational opportunities within GGNRA lands. The program would include annual monitoring of North Ocean Beach sand levels to confirm sufficient sand supply exists to support the nourishment program prior to excavation. In the event monitoring identified insufficient supply, the program would be modified to avoid diminishing North Ocean Beach access and recreational opportunities. Thus, the nourishment program would not result in the loss of availability of a known mineral resource that would be of other, non-commercial value (e.g., beach access and recreation) to the region and residents of the state. For these reasons, the effect would be ***less than significant***.

Impact C-MN-1: The project, in combination with the cumulative projects, would not result in a significant impact related to mineral resources. (*No Impact*)

None of the projects in the cumulative scenario would involve work that would affect sand supply along North Ocean Beach. As a result, the effects of the project would not combine with those of other projects to result in a cumulative effect on mineral resources.

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260 City and County of San Francisco, San Francisco General Plan, Environmental Protection Element, available online at *https://generalplan.sfplanning.org/I6_Environmental_Protection.htm*, accessed December 16, 2019.

261 Unless otherwise authorized by law, utilizing, mining, extracting, removing sand or other resources directly from Ocean Beach for non-federal purposes is prohibited by the NPS Management Policies (2006; refer to Chapter 3, Plans and Policies, for additional information about these policies), Sections 8.7 Mineral Exploration and Development and 9.1.3.3 Borrow Pits and Spoil Areas, and Codes of Federal Regulations, Title 36 Chapter 1. NPS, Department of the Interior, Sections 2.1 – 2.62 Resource Protection, Public Use, and Recreation.

262 To provide deep-draft marine vessel access between the Pacific Ocean and San Francisco Bay, the Corps regularly dredges a sandbar located approximately 2 miles offshore of the Golden Gate. Commonly known as the main ship channel, the passage measures approximately 2,000 feet wide and 26,000 feet long, and is maintained at a depth of approximately 55 feet mean lower low water.

E.20 ENERGY

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
20. ENERGY. Would the project:					
a) Result in potentially significant environmental impact due to wasteful, inefficient, or unnecessary consumption of energy resources, during project construction or operation?	☐	☐	☒	☐	☐
b) Conflict with or obstruct a state or local plan for renewable energy or energy efficiency?	☐	☐	☒	☐	☐

Impact EN-1: The project would not result in the use of large amounts of fuel, water, or energy, or use these in a wasteful manner. (*Less than Significant*)

Construction Energy

Construction of the project would require the use of fuel-powered equipment and vehicles for construction activities, and electricity for construction trailers. Most construction activities would rely on fuel-powered equipment and vehicles and would consume gasoline or diesel fuel. Heavy construction equipment (e.g., cranes, dump trucks, backhoes, loaders) and generators would be diesel powered, while smaller construction vehicles, such as pick-up trucks would be gasoline powered. The precise amount of fuel required for project construction is uncertain; however, it is expected that the quantity of gasoline and diesel use for construction equipment, as well as workers' vehicles and haul vehicles, would be comparable to the quantity used for large construction projects within the city. The majority of electric power usage would result from service to the construction trailers. In addition, indirect electricity usage would occur associated with the supply, distribution, and treatment of water used for construction. While a direct connection to the electrical grid might be available, the analysis conservatively assumes all electrical power would be obtained from generators. The construction contractor would have financial incentive to use fuel and energy efficiently, because excess usage would reduce profits. Fuel and energy usage during construction would not be wasteful or inefficient, and the impact from construction fuel and energy usage would be less than significant.

Operation Energy and Water Resources

Fuels. The project would result in an increase in vehicular mileage associated with permanently closing the Great Highway between Sloat and Skyline boulevards. Based on the traffic analysis conducted for the project, there would be approximately 14,600 re-routed daily trips along Sloat and Skyline boulevards, which would result in an additional vehicular mileage of 0.46 mile per trip compared to the vehicular mileage for existing trips along Great Highway. The additional vehicular mileage would increase the use of transportation fuels of gasoline, diesel, and natural gas. Using on-road vehicle emission factors from the EMFAC2017 model, the increase in fuel use estimates are based on carbon dioxide emissions calculated for 2027, the first year the project would be operational. The estimated annual increase in fuels that would be associated with the increased vehicular mileage due to the Great Highway closure are presented in **Table 8**.

Table 8 Summary of Operational Annual Fuel Energy Resource Use

Project Element	Source	Resource Use	
		Total gallons	Average annual gallons
Increased Vehicular Mileage Associated with Great Highway Closure between Sloat and Skyline boulevards	Gasoline	67,152	67,152
	Diesel	572	572
Small Sand Placement	Gasoline	241	60
	Diesel	6,101	1,525
Large Sand Placement	Gasoline	317	45
	Diesel	92,384	11,738

NOTES:

* Off-road equipment fuel use was estimated with consumption rates estimated using California Air Resources Board Off-road emissions model and the CalEEMod equipment use assumptions used for the air quality emissions modeling. On-road vehicle fuel volumes were estimated using trip and mileage assumptions with carbon dioxide generation rates per gallon of fuel for the applicable vehicle types for calendar years 2027 (for the increased vehicular mileage associated with closure of Great Highway) and 2031 (for beach nourishment activities) using the EMFAC2017 model emission factors, then backing into the fuel usage amounts for the three fuel types. Dredge and tugboat fuel volumes were estimated based on calculated greenhouse gas emission estimates under the assumption that combustion of one gallon of diesel produces 22 pounds of carbon dioxide.

The project's proposed beach nourishment program would also periodically require the use of diesel and gasoline. Under the program, the city would undertake the small sand placements (approximately 85,000 cubic yards) about once every four years, and the Corps would undertake the large sand placements (up to 575,000 cubic yards) about once every 10 years. Energy use for the small sand placements would be limited to diesel for operation of off-road equipment and haul trucks, and gasoline for operation of commuting worker vehicles. Energy use for the large sand placements would require similar diesel- and gasoline-fueled equipment and vehicles, but would also require diesel for dredge pump ashore and tug operations. While nourishment events could occur less frequently, the analysis conservatively assumes that small sand placement events would occur about once every four years, and large sand placement events would occur roughly every 10 years; therefore, the total gallons per small sand beach nourishment event were divided by four years and the total gallons per large sand beach nourishment event were divided by 10 years to obtain the average annual gallons per year. The estimated operational energy use volumes for each are shown in Table 8, and discussed below.

The gasoline, diesel, and natural gas usage that would be associated with the increased vehicular mileage due to the closure of the Great Highway, and commuting worker and haul truck vehicles during beach nourishment events has been calculated based on total vehicle miles traveled from the air quality analysis for the project, and average fuel efficiency calculated from the EMFAC2017 model. Diesel volumes associated with the large sand placement's dredge equipment and tug boat activity are based on greenhouse gas emissions estimated for the Corps' 2021 Ocean Beach Nourishment Project,[263] with adjustments that increase the sand placement volume from 265,000 cubic yards to 575,000 cubic yards,[264] applying the factor of approximately 22 pounds of carbon dioxide per gallon of diesel combusted.

263 ESA, 2020. Memorandum from Sarah Patterson and Elijah Davidian (ESA) to Julie Moore (SF Planning Department), Subject: Air Pollutant Emissions Analysis for South Ocean Beach Nourishment Project, San Francisco, California. December 2, 2020.

264 The analysis assumes a 15 percent loss of material in handling of the dredge material during placement, and so assumes a haul volume that is 15 percent greater than the proposed placement volume.

As summarized in Table 8, the annual fuel consumption that would be associated with the increased vehicular mileage due to the closure of the Great Highway would be approximately 67,152 gallons of gasoline and 572 gallons of diesel per year. These annual transportation-related gasoline and diesel consumption rates would represent approximately 0.06 percent and 0.01 percent, respectively, of the city-wide totals for use of these transportation fuels.[265] The average annual fuel consumption associated with small sand placement activities would be approximately 60 gallons of gasoline and 1,525 gallons of diesel per year. The small beach nourishment's average annual transportation-related gasoline and diesel consumption would represent less than 0.01 percent and approximately 0.02 percent, respectively, of the city-wide totals for use of these fuels. The average annual fuel consumption associated with large sand placement activities would be approximately 45 gallons of gasoline and 11,738 gallons of diesel per year. The large sand placement's average annual transportation-related gasoline and diesel consumption would represent less than 0.01 percent and approximately 0.12 percent, respectively, of the city-wide totals for use of these fuels.

Therefore, the project would not result in the use of unusually large amounts of transportation fuels during operation, nor would it result in the inefficient, wasteful, or unnecessary use of these fuels. The project's operational impact related to the use of transportation fuels would be ***less than significant***.

Energy. The annual electric vehicle electricity consumption that would be associated with the increased vehicular mileage from re-routed traffic due to the closure of the Great Highway would be approximately 31,435 kilowatt-hours (kWh) based on the estimated increase in electric vehicle miles travelled calculated using the air board's 2017 EMFAC2017 model and a conservative electric vehicle energy consumption rate of three miles travelled per kwh charged (see Appendix H, Air Quality Technical Memorandum and Health Risk Assessment [Appendix A, part A5]).[266] This annual transportation-related electricity consumption would represent less than 0.001 percent of the city-wide total electricity use.

The project would require electricity for lighting at the new restroom facilities and along the new multi-use trail and service road. The new restroom lighting would replace lighting at the existing NPS restroom that would be removed, but the electricity used at the proposed restroom would be less because the design of the proposed restroom building, path lighting, and service road would need to meet or exceed the current energy efficiency requirements, including the 2019 San Francisco Green Building Code energy performance requirements, which requires: all energy supplied for the project to be electric; and installation of wiring for electric vehicles at the proposed new parking lot.[267,268] In addition, the SFPUC would explore renewable energy opportunities for the project, including photovoltaics and solar hot water.[269] The project would comply with the state's Title 24 and San Francisco Green Building Code requirements for energy efficiency. Compliance with Title 24 regulations and the San Francisco Building Code would reduce potential for the

265 California Energy Commission, 2019. 2018 California Annual Retail Fuel Outlet Report Results (CEC-A15) Energy Assessments Division, 07-1-19. Available at: https://www.energy.ca.gov/data-reports/energy-almanac/transportation-energy/california-retail-fuel-outlet-annual-reporting.

266 Kelley Blue Book, 2020. How Much Does It Cost to Charge an EV? By Nick Kurczewski, September 2, 2020. Available at: *https://www.kbb.com/car-news/how-much-does-it-cost-to-charge-an-ev/*

267 San Francisco Planning Department. Compliance Checklist Table for Greenhouse Gas Analysis: Table 2. Municipal Projects, for the Ocean Beach Climate Change Adaptation Project, Case Number 2019-020115ENV.

268 San Francisco Department of Building Inspection Administrative Bulletin 093, Attachment H. Available at: *https://sfdbi.org/sites/default/files/AB-093.pdf*.

269 San Francisco Planning Department. Compliance Checklist Table for Greenhouse Gas Analysis: Table 2. Municipal Projects, for the Ocean Beach Climate Change Adaptation Project, Case Number 2019-020115ENV.

project to use energy in a wasteful manner. Therefore, the project's operational impact on energy resources would be ***less than significant***.

Water. The new restroom facilities would be served by the city's water and wastewater systems and could include an outdoor wash station. It is anticipated that the new facilities would result in similar usage as the existing NPS restroom at the western terminus of Sloat Boulevard that would be removed (i.e., number of visitors accessing the facilities per day); but the water use and wastewater flow through would be less (or less per use) because the project would be required to comply with the current water conservation measures specified in the 2016 California Green Building Code. For these reasons, there would be no net increase, and possibly reductions, in water use and sewer service associated with the project, and therefore no substantial change in the project operational energy use related to water and sewer service.

For the reasons described above, neither construction nor operation of the project would result in the wasteful use of fuel, water, or electricity, and this impact would be ***less than significant***.

Impact EN-2: The project would not conflict with or obstruct a state or local plan for renewable energy or energy efficiency. (*Less and Significant*)

California's renewable energy and energy efficiency plans include the Renewables Portfolio Standard Program (as revised by SB X1-2), which requires utilities to increase their renewable energy generation to 33 percent by 2020, and the California Energy Efficiency Strategy Plan, which was developed to provide a roadmap for energy efficiency in California through the year 2020 and beyond. As a local level, the majority of the city's energy-efficiency requirements are geared toward commercial and residential development and do not apply to the project. The project would involve a four-year construction period as well as a long-term beach nourishment program approximately once every four to 10 years. The project would also use energy-efficient fixtures and equipment, in compliance with the program and plan. The project would not conflict with or obstruct a state or local plan for renewable energy or energy efficiency. Therefore, impacts would be ***less than significant***.

Impact C-E-1: The project, in combination with the cumulative projects, would not result in significant impacts on energy resources. *(Less than Significant)*

The geographic scope for potential cumulative impacts on energy resources consists of the project vicinity as well as the broader Bay Area region. There is no existing significant adverse condition with regard to energy resources in the project vicinity or broader region that would be worsened or intensified by the project. The project would result in increased electricity, diesel, gasoline, and water consumption as discussed in Impact EN-1. All current and proposed projects in the region require the use of fuel and energy for construction and potentially operation. However, the projects are required to promote energy efficiency to the extent possible, consistent with applicable building codes, standards, and regulations. In addition, project contractors have a financial incentive to use fuel and energy efficiently during construction. Therefore, the project, in combination with the cumulative projects, would have a ***less-than-significant*** cumulative impact on energy and energy resources.

E.21 AGRICULTURE AND FORESTRY RESOURCES

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
21. AGRICULTURE AND FORESTRY RESOURCES: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project; and forest carbon measurement methodology provided in Forest Protocols adopted by the California Air Resources Board. **Would the project:**					
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance, as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☐	☒
c) Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?	☐	☐	☐	☐	☒
d) Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☐	☒
e) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of farmland to non-agricultural use or forest land to non-forest use?	☐	☐	☐	☐	☒

The project area is classified as zoning district P (Public) and is not used for farming or agricultural activities. No land in San Francisco has been designated by the California Department of Conservation's Farmland Mapping and Monitoring Program as agricultural land. Because the project area does not contain agricultural uses and is not zoned or designated for such uses by the city or the state, the project would not involve the conversion of farmland to non-agricultural use. The project also would not conflict with any existing agricultural zoning or Williamson Act contracts.[270,271] Similarly, the project area does not contain forest or timberlands, does not support timber uses, and is not zoned for timber uses. Therefore, the project

[270] California Department of Conservation, Farmland Mapping and Monitoring Program, 1984-2018, available online at *https://maps.conservation.ca.gov/DLRP/CIFF/*.

[271] The Williamson Act is a State of California law enacted in 1965 that provides property tax relief to owners of farmland and open space land in exchange for a 10-year agreement that the land will not be developed or converted into another use.

would not conflict with zoning for forest land, cause a loss of forest land, or convert forest land to a different use. For these reasons, topics E.21(a) through E.21(e) are ***not applicable*** to the project, and these topics are not discussed further in the EIR, including this initial study.

E.22 WILDFIRE

Topics:	Potentially Significant Impact	Less Than Significant with Mitigation Incorporated	Less Than Significant Impact	No Impact	Not Applicable
22. WILDFIRE. If located in or near state responsibility areas or lands classified as very high fire hazard severity zones, would the project:					
a) Substantially impair an adopted emergency response plan or emergency evacuation plans?	☐	☐	☐	☐	☒
b) Due to slope, prevailing winds, and other factors, exacerbate wildfire risks, and thereby expose project occupants to, pollutant concentrations from a wildfire or the uncontrolled spread of a wildfire?	☐	☐	☐	☐	☒
c) Require the installation or maintenance of associated infrastructure (such as roads, fuel breaks, emergency water sources, power lines or other utilities) that may exacerbate fire risk or that may result in temporary or ongoing impacts to the environment?	☐	☐	☐	☐	☒
d) Expose people or structure to significant risks including downslope or downstream flooding or landslides, as a result of runoff, post-fire slope instability, or drainage changes?	☐	☐	☐	☐	☒

San Francisco and bordering areas within San Mateo County do not have any state responsibility areas for fire prevention or lands that have been classified as very high fire hazard severity zones.[272]

Therefore, topics E.22(a) through E.22(d) are ***not applicable*** to the project and are not discussed further in the EIR, including this initial study. Refer to Section E.18, Hazards and Hazardous Materials, for a discussion of wildland fire risks and emergency response or evacuation plans.

272 California Department of Forestry and Fire Protection, Fire and Resource Assessment Program, San Francisco County Draft Fire Hazard Severity Zones in Local Responsibility Areas Map, October 5, 2007; San Mateo County Fire Hazard Severity Zones in State Responsibility Areas Map, November 7, 2007; and San Mateo County Very High Fire Hazard Severity Zones in Local Responsibility Areas Map, November 24, 2008, *http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_zones_maps*.

E.23 MANDATORY FINDINGS OF SIGNIFICANCE

Topic	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact	Not Applicable
23. MANDATORY FINDINGS OF SIGNIFICANCE. Does the project:					
a) Have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory?	☒	☐	☐	☐	☐
b) Have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)	☒	☐	☐	☐	☐
c) Have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly?	☒	☐	☐	☐	☐

NOTE: Authority cited: Public Resources Code sections 21083 and 21083.05, 21083.09. Reference: Section 65088.4, Gov. Code; Public Resources Code sections 21073, 21074, 21080(c), 21080.1, 21080.3, 21083, 21083.05, 21083.3, 21080.3.1, 21080.3.2,21082.3, 21084.2, 21084.3, 21093, 21094, 21095, and 21151; *Sundstrom v. County of Mendocino* (1988) 202 Cal.App.3d 296; *Leonoff v. Monterey Board of Supervisors* (1990) 222 Cal.App.3d 1337; *Eureka Citizens for Responsible Govt. v. City of Eureka* (2007) 147 Cal.App.4th 357; *Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th at 1109; *San Franciscans Upholding the Downtown Plan v. City and County of San Francisco* (2002) 102 Cal.App.4th 656.

a) This initial study and the EIR together provide a comprehensive discussion of the potential for the project to affect the quality of the environment. Specifically, EIR Section 4.6, Biological Resources, discusses the potential for the project to substantially affect habitats, fish/wildlife populations, and sensitive natural communities. Section E.4, Cultural Resources, discusses the potential for the project to affect important examples of California history.

b) The project could result in significant cumulative impacts related to transportation and circulation and noise, as analyzed further in EIR Sections 4.3, Transportation and Circulation, and 4.4, Noise and Vibration.

c) This initial study and the EIR together provide a comprehensive discussion of the potential for the project to cause substantial adverse effects on human beings, either directly or indirectly.

F. Mitigation Measures

This section lists the mitigation measures identified in this initial study to reduce potentially significant impacts resulting from the project to less-than-significant levels. Other potentially significant impacts are fully analyzed in EIR Chapter 4, Environmental Setting and Impacts, and mitigation measures are identified for significant impacts.

Mitigation Measure M-AQ-2: Construction Emissions Minimization

A. Engine Requirements.

All off-road equipment greater than 125 horsepower and operating for more than 20 total hours over the entire duration of construction activities shall have engines that meet the USEPA or California Air Resources Board Tier 4 Final off-road emission standards in construction years 2, 3 and 4 (2024 through 2026).

B. Waivers.

The Environmental Review Officer (ERO) may waive the equipment requirements of section A if: (1) engines that comply with Tier 4 Final off-road emission standards are not available, (2) use of a particular piece of off-road equipment is technically not feasible; (3) the equipment would not produce desired emissions reduction due to expected operating modes; or (4) there is a compelling emergency need to use other off-road equipment.

If the SFPUC seeks a waiver from the requirements of section A, it shall submit documentation to the ERO of the following: 1) evidence that a waiver from the section A requirements meets the criteria set forth in section B; 2) identification of the compliance alternative in **Table M-AQ-2-1** to be implemented (or other compliance alternative that yield sufficient emissions reductions); and 3) analysis demonstrating that with the compliance alternative the project would not exceed the significance threshold for NOx of an average of 54 pounds/day. The SFPUC shall maintain records concerning its efforts to comply with this requirement.

Table M-AQ-2-1 Off-Road Equipment Compliance Step-Down Schedule

Compliance Alternative	Engine Emission Standard
1	Tier 4 Interim
2	Tier 3
3	Tier 2

How to use the table: If the Tier 4 Final emissions standards cannot be met for a specific piece of off-road equipment, then the SFPUC would need to meet Compliance Alternative 1. Should the SFPUC not be able to supply off-road equipment meeting Compliance Alternative 1, then Compliance Alternative 2 would need to be met. Should the SFPUC not be able to supply off-road equipment meeting Compliance Alternative 2, then Compliance Alternative 3 would need to be met.

Mitigation Measure M-GE-5: Paleontological Resources Monitoring and Mitigation Program

The SFPUC shall engage a qualified paleontologist meeting standards recommended by the Society for Vertebrate Paleontology (SVP) to develop a site-specific monitoring plan prior to commencing soil-disturbing activities at the project site. The Paleontological Monitoring Plan would determine project construction activities requiring paleontological monitoring based on those activities that may affect sediments with moderate or greater sensitivity for paleontological resources. Prior to any ground disturbing activities, the SFPUC shall submit the Paleontological Monitoring Plan to the Environmental Review Officer (ERO) for approval.

At a minimum, the plan shall include:

a. Project Description

b. Regulatory Environment – outline applicable federal, state, and local regulations

c. Summary of Sensitivity Classification(s)

d. Research Methods, including but not limited to:

    - Field studies conducted by the qualified paleontologist to check for fossils at the surface and assess the exposed sediments.
    - Literature Review to include an examination of geologic maps and a review of relevant geological and paleontological literature to determine the nature of geologic units in the project area.
    - Locality Search to include outreach to the University of California Museum of Paleontology in Berkeley.

e. Results: to include a summary of literature review and finding of potential site sensitivity for paleontological resources; and depth of potential resources if known.

f. Recommendations for any additional measures that could be necessary to avoid or reduce any adverse impacts to recorded and/or inadvertently discovered paleontological resources of scientific importance. Such measures could include:

    - Avoidance: If a known fossil locality appears to contain critical scientific information that should be left undisturbed for subsequent scientific evaluation.
    - Fossil Recovery: If isolated small, medium- or large-sized fossils are discovered during field surveys or construction monitoring, and they are determined to be scientifically significant, they should be recovered. Fossil recovery may involve collecting a fully exposed fossil from the ground surface, or may involve a systematic excavation, depending upon the size and complexity of the fossil discovery.
    - Monitoring: Monitoring involves systematic inspections of graded cut slopes, trench sidewalls, spoils piles, and other types of construction excavations for the presence of fossils, and the fossil recovery and documentation of these fossils before they are destroyed by further ground disturbing actions. Monitoring could identify the need for test sampling.
    - Data recovery and reporting: Fossil and associated data discovered during ground disturbing activities should be treated according to professional paleontological standards and documented in a data recovery report. The plan should define the scope of the data recovery report.

g. The paleontologist shall document the monitoring conducted according to the monitoring plan and any data recovery completed for significant paleontological resource finds discovered, if any. Plans and reports prepared by the paleontologist shall be considered draft reports subject to revision until final approval by the ERO.

G. Public Notice and Comment

Publication of the Notice of Preparation (NOP) of an EIR initiated a 30-day public review and comment period that began on September 9, 2020 and ended on October 9, 2020. The planning department held a public scoping meeting on September 30, 2020 to receive input on the scope of the environmental review for this project. During the scoping period, the planning department received 29 pieces of correspondence (e.g., letters, e-mails, oral comments). Among the correspondence received, 23 were from individuals, 2 from public agencies, and 4 from community organizations. The topics raised in the comment letters are addressed in this initial study and in the EIR to which this initial study is appended, as appropriate (refer to EIR Chapter 1, Introduction, for additional detail on the public noticing and comments). The NOP is included as Appendix A in the EIR.

H. Determination

On the basis of this Initial study:

☐ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☒ I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, no further environmental documentation is required.

December 8, 2021
DATE

Lisa Gibson
Environmental Review Officer
for Richard Hillis
Director of Planning

I. Initial Study Preparers

Refer to EIR Chapter 7, EIR Report Preparers.

APPENDIX C
STANDARD CONSTRUCTION MEASURES

SFPUC Standard Construction Measures

1. SEISMIC AND GEOTECHNICAL STUDIES: All projects will prepare a characterization of the soil types and potential for liquefaction, subsidence, landslide, fault displacement, and other geological hazards at the project site and will be engineered and designed as necessary to minimize risks to safety and reliability due to such hazards. As necessary, geotechnical investigations will be performed.

2. AIR QUALITY: All projects within San Francisco City (the City) limits will comply with the Construction Dust Control Ordinance. All projects outside the City will comply with applicable local and State dust control regulations. All projects within City limits will comply with the Clean Construction Ordinance. Projects outside City limits will comply with San Francisco or other applicable thresholds for health risks. All projects, both within and outside of City limits, will comply with either San Francisco or other applicable thresholds for construction criteria air pollutants.

To meet air quality thresholds, all projects (as necessary) will implement air quality controls to be tailored to the project, such as using high tier engines, Verified Diesel Emissions Control Strategies (VDECS) such as diesel particulate filters, customized construction schedules and procedures, and low emissions fuel.

3. WATER QUALITY: All projects will implement erosion and sedimentation controls to be tailored to the project site such as, fiber rolls and/or gravel bags around stormdrain inlets, installation of silt fences, and other such measures sufficient to prevent discharges of sediment and other pollutants to storm drains and all surface waterways, such as San Francisco Bay, the Pacific Ocean, water supply reservoirs, wetlands, swales, and streams. As required based on project location and size, a Stormwater Control Plan (in most areas of San Francisco) or a Stormwater Pollution Prevention Plan (SWPPP) (outside of San Francisco and in certain areas of San Francisco) will be prepared. If uncontaminated groundwater is encountered during excavation activities, it will be discharged in compliance with applicable water quality standards and discharge permit requirements.

4. TRAFFIC: All projects will implement traffic control measures sufficient to maintain traffic and pedestrian circulation on streets affected by construction of the project. Traffic control measures may include, but not be limited to, flaggers and/or construction warning signage of work ahead; scheduling truck trips during non-peak hours to the extent feasible; maintaining access to driveways, private roads, and off-street commercial loading facilities by using steel trench plates or other such method; and coordination with local emergency responders to maintain emergency access. For projects in San Francisco, the measures will also, at a minimum, be consistent with the requirements of San Francisco Municipal Transportation Agency (SFMTA)'s Blue Book. Any temporary rerouting of transit vehicles or relocation of transit facilities would be coordinated with the applicable transit agency, such as SFMTA Muni Operations in San Francisco. All Projects will obtain encroachment permits from the applicable jurisdiction for work in public roadways.

5. NOISE: All projects will comply with local noise ordinances regulating construction noise. The SFPUC shall undertake measures to minimize noise disruption to nearby neighbors and sensitive receptors during construction. These efforts could include using best available noise control technologies on equipment (i.e., mufflers, ducts, and acoustically attenuating shields),

locating stationary noise sources (i.e., pumps and generators) away from sensitive receptors, erecting temporary noise barriers, and other such measures.

6. HAZARDOUS MATERIALS: Where there is reason to believe that site soil or groundwater that will be disturbed may contain hazardous materials, the SFPUC shall undertake an assessment of the site in accordance with any applicable local requirements (e.g., Maher Ordinance) or using reasonable commercial standards (e.g., Phase I and Phase II assessments, as needed). If hazardous materials will be disturbed, the SFPUC shall prepare a plan and implement the plan for treating, containing or removing the hazardous materials in accordance with any applicable local, State and federal regulations so as to avoid any adverse exposure to the material during and after construction. In addition, any unidentified hazardous materials encountered during construction likewise will be characterized and appropriately treated, contained or removed to avoid any adverse exposure. Measures will also be implemented to prevent the release of hazardous materials used during construction, such as storing them pursuant to manufacturer recommendation, maintaining spill kits onsite, and containing any spills that occur to the extent safe and feasible followed by collection and disposal in accordance with applicable laws. SFPUC will report spills of reportable quantity to applicable agencies (e.g., the Governor's Office of Emergency Services).

7. BIOLOGICAL RESOURCES: All project sites and the immediately surrounding area will be screened to determine whether biological resources may be affected by construction. A qualified biologist will also carry out a survey of the project site, as appropriate, to note the general resources and identify whether habitat for special-status species and/or migratory birds, are present. In the event further investigation is necessary, the SFPUC will comply with all local, State, and federal requirements for surveys, analysis, and protection of biological resources (e.g., Migratory Bird Treaty Act, federal and State Endangered Species Acts, etc.). If necessary, measures will be implemented to protect biological resources, such as installing wildlife exclusion fencing, establishing work buffer zones, installing bird deterrents, monitoring by a qualified biologist, and other such measures. If tree removal is required, the SFPUC would comply with any applicable tree protection ordinance.

8. VISUAL AND AESTHETIC CONSIDERATIONS, PROJECT SITE: All project sites will be maintained in a clean and orderly state. Construction staging areas will be sited away from public view where possible. Nighttime lighting will be directed away from residential areas and have shields to prevent light spillover effects. Upon project completion, project sites on SFPUC-owned lands will be returned to their general pre-project condition, including re-grading of the site and re-vegetation or re-paving of disturbed areas to the extent this is consistent with SFPUC's Integrated Vegetation Management Policy. However, where encroachment has occurred on SFPUC-owned lands, the encroaching features may not be restored if inconsistent with the SFPUC policies applicable to management of its property. Project sites on non-SFPUC land will be restored to their general pre-project condition so that the owner may return them to their prior use, unless otherwise arranged with the property owner.

9. CULTURAL RESOURCES: All projects that will alter a building or structure, produce vibrations, or include soil disturbance will be screened to assess whether cultural resources are or may be present and could be affected, as detailed below.

Archeological Resources. No archeological review is required for a project that will not entail ground disturbance. Projects involving ground disturbance will undergo screening for archeological sensitivity as described below and implement, as applicable, SFPUC's Standard Archeological Measures I (Discovery), II (Monitoring) and III (Testing/Data Recovery) per the Cultural Resources Attachments. Standard Construction Measure I will be implemented on all projects involving ground disturbance and Standard Archeological Measures II and III will be implemented based on the screening process described below for projects assessed as having the potential to encounter archeological sites and/or if an archeological discovery occurs during construction.

Projects involving ground disturbance will initially be screened to identify whether there is demonstrable evidence of prior ground disturbance in the project site to the maximum vertical and horizontal extent of the current project's planned disturbance. For projects where prior complete ground disturbance has occurred throughout areas of planned work, SFPUC will provide evidence of the previous disturbance in the Categorical Exemption application and no further archeological screening will be required.

For projects that are on previously undisturbed sites or where the depth/extent of prior ground disturbance cannot be documented, or where the planned project-related ground disturbance will extend beyond the depth/extent of prior ground disturbance, additional screening will be carried out as detailed below and shown on the attached flow chart titled "SFPUC Standard Construction Measure #9 Archeological Assessment Process". The additional screening will be conducted by the SFPUC's qualified archeologist (defined as meeting the Secretary of the Interior's Professional Qualifications Standards [36 CFR 61]) and, if a consultant, selected in consultation with the San Francisco Planning Department's Environmental Review Officer (ERO) and meeting criteria or specialization required for the resource type as identified by the ERO.

1) The SFPUC qualified archeologist will conduct an archival review for the project site, including review of Environmental Planning's (EP's) archeological GIS data and/or a records search of the California Historical Resources Information System (CHRIS) and other archival sources as appropriate. The qualified archeologist will also conduct an archeological field survey of the project site if, in the archeologist's judgment, this is warranted by site conditions. Based on the results, the archeologist will complete and submit to EP a Preliminary Archeological Checklist (PAC) (version dated 4/2015, to be amended in consultation with the ERO as needed). The PAC will include recommendations for the need for archeological testing, additional research and/or treatment measures consistent with Archeological Measures I, II, and III, to be implemented by the project to protect and/or treat significant archeological resources identified as being present within the site and potentially affected by the project.

2) The EP Archeologist (for projects within the City) or the ERO's archeological designee (for projects outside the City) will then conduct a Preliminary Archeological Review (PAR) of the PAC and other sources as warranted; concur with the PAC recommendations; and/or amend the PAC in consultation with the SFPUC archeologist or archeological consultant to require additional research, reports, or treatment measures as warranted based on his/her professional opinion.

3) The SFPUC shall implement the PAC/PAR recommendations prior to and/or during project construction consistent with Standard Archeological Measures I, II, and III, and

shall consult with the EP Archeologist in selecting an archeological consultant, as needed, to implement these measures.

4) Ground disturbing activities in archeologically sensitive areas, as identified through the above screening, will not begin until required preconstruction archeological measures of the PAC/PAR (e.g., preparation of an Archeological Monitoring Plan, Archeological Treatment Plan, and/or an Archeological Research Design and Data Recovery Plan) have been implemented.

Historic (Built Environment) Resources. For projects within the City that include activities with the potential for direct or indirect effects to historic buildings or structures, initial CEQA screening will include a review, for the project footprint and up to one parcel surrounding the footprint of CCSF's online planning map, all relevant survey data, preservation address files, and other pertinent sources for previously-identified, historically significant buildings and building and structures more than 45 years old that have not been previously evaluated. For projects outside of the City, initial CEQA screening will include a records search of EP's CCSF historical resources data, CHRIS, and other pertinent sources for historically significant or potentially significant buildings and structures older than 45 years.

For projects that would modify an existing building or structure that has been determined by EP as being a significant historical resource (i.e., appears eligible to qualify for the CRHR), or that would introduce new aboveground facilities in the vicinity of a significant historical resource, or that would affect previously unevaluated buildings or structures more than 45 years old, the SFPUC will retain a qualified architectural historian (defined as meeting the Secretary of the Interior's Professional Qualification standards and, if a consultant, also selected in consultation with the ERO) to conduct a historical resource evaluation (HRE). SFPUC will submit the project description and the HRE to the CCSF Planning Department Preservation Planner or to the ERO's-designated qualified architectural historian to assess potential effects. Where the potential for the project to have adverse effects on historic buildings or structures is identified, the CCSF Planning Department Preservation Planner or the ERO's designee will consult with SFPUC to determine if the project can be conducted as planned or if the project design can be revised to avoid the significant impact, and will comply with applicable procedures set forth in Historic Architectural Resource Measure I. If these options are not feasible, the project will need to undergo further review with EP and mitigation may be required. If so, the project would not qualify for a Categorical Exemption from CEQA review.

Where construction will take place in proximity to a building or structure identified as a significant historical resource but would not otherwise directly affect it, the SFPUC will implement protective measures, such as but not limited to, the erection of temporary construction barriers to ensure that inadvertent impacts to such buildings or structures are avoided.

APPENDIX D
TRANSPORTATION ANALYSIS SUPPORTING DOCUMENTATION

TRAFFIC VOLUMES AND TRAVEL DEMAND CALCULATIONS

Ocean Beach Climate Change Adaptation Project
Traffic Volume Summary Tables – Updated
October 5, 2020, modified 11-13-2020

The following tables summarize the information used in the quantitative and qualitative impact analysis for the proposed project.

Table 1, Project Total and Average Daily Construction Trucks and Average Daily Construction Workers by Phase, summarizes the total trucks required for hauling materials by construction phase by purpose (i.e., export hauls, import hauls, vendor deliveries) as provided by SFPUC in "Ocean_Beach_LTP_RFI_56 resource Allocation Responses–MN EDR 6 09+KEF", referred as the "RFI spreadsheet". The daily trucks were calculated using the total number of truck loads (spreadsheet tab MN Trucking Details) and the number of production days (spreadsheet tab MN Equipment Trip Info). The truck data was adjusted based on comments made to Table 2-2 in the project description dated July 20, 2020. For purposes of the transportation analysis, only the offsite truck data was used (i.e., the 5,429 onsite truck hauls are not included as they would travel within the construction work area and not adjacent city streets).

Table 2, Project Average Daily Construction Trucks and Workers During Period of Maximum Overlap of Construction Phases November 2025 through April 2026 (Six Months), presents the number of daily trucks and workers for the six months when construction phases 2, 3 and 4 would overlap. Based on the daily trucks in Table 1 and the construction schedule for the phases provided in the RFI, the construction periods of these three phases would overlap between November 2025 and April 2026. See the attached overlap spreadsheet table which presents this overlap analysis.

Table 3, Project Construction Trucks Origin/Destination Assumptions, summarizes the assumption for the origin and destination for the construction trucks. This information is based on data provided by SFPUC in the RFI spreadsheet and updated information provided after initial review of these tables.

Table 4, Project Construction Worker Origin/Destination Assumptions, summarizes the origin and destination assumptions for construction workers. The RFI information on "local" versus other workers was used to distribute the workers between the non-San Francisco locations.

The assignment of construction vehicles assumed that both the north and south ends of the construction work area would be accessible during construction. The vehicles were assigned to the roadway as follows:

- **SF North of Site or North Bay –** For construction trucks, 100% <u>exit the site to the north</u> and 100% continue east on Sloat Boulevard towards 19th Avenue. For construction workers, 100% exit the site to the north, 50% continue north on the Great Highway and 50% continue east on Sloat Boulevard.
- **SF East of the Site**
    a. <u>50% exit the site to the north</u> and take Sloat Blvd to Ocean Avenue to their destination
    b. <u>50% exit the site to the south</u> and take Skyline Blvd to John Daly Blvd to I-280 northbound to their destination
- **South Bay**
    a. <u>25% exit the site to the north</u> and take Sloat Blvd to Ocean Ave to I-280 southbound to continue south

    b. 75% exit the site to the south and take Skyline Blvd to I-280 southbound to continue south

- **East Bay**
    a. 25% exit the site to the north and take Sloat Boulevard to Ocean Avenue to I-280 northbound or southbound to continue to the East Bay
    b. 75% exit the site to the south and take Skyline Blvd to John Daly Blvd to I-280 northbound or southbound to continue to the East Bay

The attached draft figure presents the travel paths assumed for vehicles in the vicinity of the project site.

Table 5, Project Weekday Daily Traffic Volumes During Period of Maximum Overlap of Construction Phases November 2025 through April 2026 (Six Months), presents the daily traffic volumes for the peak construction period for six roadway segments (i.e., each leg of the key study intersections of Great Highway/Sloat Boulevard, Skyline Drive/Sloat Boulevard, and Skyline Drive/Great Highway), and presents the following:

- Existing daily traffic volumes on the segment. This is based on 12-hour counts that were included in the Ocean Beach Climate Adaptation Project Traffic Operations Analysis, Technical Memorandum Draft #2 (October 2, 2020) prepared by the CHS Consulting Group, expanded to 24-hour volumes.
- Adjusted daily volumes on the segment assuming closure of the Great Highway between Sloat Boulevard and Skyline Drive. This is based on the p.m. peak hour diversions presented on Figure 7 of the Ocean Beach Climate Adaptation Project Traffic Operations Analysis, Technical Memorandum Draft #1. The p.m. peak hour diversions were used to estimate daily diversions and the existing daily traffic volume were adjusted.
- Construction volumes for inbound and outbound trips. The number of trucks and workers in Table 1 were multiplied by 2 to reflect both inbound and outbound trips for each truck or worker
- Total daily volumes during the peak construction period – i.e., the six months of overlap. For the remainder of the 49-month construction period, the daily construction vehicles would be less.

Table 6, Weekday P.M. Peak Hour Traffic Volumes During Period of Maximum Overlap of Construction Phases November 2025 through April 2026 (Six Months), presents the same information as in Table 5, but for the p.m. peak hour.

- The existing p.m. peak hour volumes and adjusted volumes were obtained from Figure 4 in the Ocean Beach Climate Adaptation Project Traffic Operations Analysis, Technical Memorandum Draft #2, October 2, 2020.
- Per information from the SFPUC, construction truck trips would generally occur over a four-hour period during the morning and would generally not overlap with the p.m. peak hour. However, as a conservative assumption, the construction truck trips were added to the p.m. peak hour volumes.
- Per information on construction worker schedule from the SFPUC, construction workers would generally arrive prior to the a.m. peak hour of adjacent street traffic and leave prior to the p.m. peak hour of adjacent street traffic. Therefore, construction worker travel would generally not overlap with the p.m. peak hour. However, as a conservative assumption, we added the construction worker trips ***leaving*** the project site to the p.m. peak hour volumes.

Table 7, Existing plus Project Weekday P.M. Peak Hour Traffic Volumes During Operations for the Proposed Project, presents the weekday p.m. peak hour volumes at the six study locations for conditions after completion of the project construction. This is based on Figure 10 in the Ocean Beach Climate Adaptation Project Traffic Operations Analysis, Technical Memorandum Draft #2, and reflect the Great Highway roadway closure and changes to the zoo access configuration. The proposed project is Variant 1 in the CHS Consulting report. Note that this report is still under review and there might be slight changes in the volumes. Also note that these volumes do not include trips associated with sand replacement. This is will be discussed qualitatively.

TABLE 1
PROJECT TOTAL AND AVERAGE DAILY CONSTRUCTION TRUCKS AND AVERAGE DAILY CONSTRUCTION WORKERS BY PHASE[a]

Construction Trucks/Workers	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Total
Total Truck Loads						
Export Trucks [b]	444	6,500	2,500	484	0	9,928
Import Trucks [c]	3,240	0	0	89	89	3,418
Vendor Trucks [d]	245	4,310	0	890	860	6,305
Total trucks	**3,929**	**10,810**	**2,500**	**1,463**	**949**	**19,651**
Average Daily Truck Loads						
Export Trucks	3	15	14	4	0	--
Import Trucks	17	0	0	1	1	--
Vendor Trucks	2	13	0	6	9	--
Total average daily trucks	**22**	**28**	**14**	**11**	**10**	--
Average Daily Construction Workers						
Workers	**50**	**60**	**20**	**50**	**50**	--

NOTES:
[a] Due to rounding, numbers in columns may not add to totals.
[b] Export trucks include removal of excavated materials (e.g., bus stop, restrooms, wall, rock, roadway)
[c] Import trucks include deliveries of clean fill for slope protection and grading.
[d] Vendor trucks include deliveries of construction materials (e.g. concrete piles, steel, asphalt)

SOURCES: San Francisco Public Utilities Commission (SFPUC), spreadsheets entitled "Ocean_Beach_LTP_RFI_56 resource Allocation Responses–MN EDR 6 09+KEF", October 2020; LCW Consulting analysis for Ocean Beach Climate Change Adaptation Project.

TABLE 2
PROJECT AVERAGE DAILY CONSTRUCTION TRUCKS AND WORKERS DURING PERIOD OF MAXIMUM OVERLAP OF CONSRUCTION PHASES NOVEMBER 2025 THROUGH APRIL 2026 (SIX MONTHS) [a]

Phase (Schedule)	Trucks	Workers [b]	Total
Phase 2 (3/2024 – 4/2026)			
Export Trucks	15	--	15
Import Trucks	0	--	0
Vendor Trucks	13	--	13
Subtotal	28	60	88
Phase 3 (11/2024 – 4/2026)			
Export Trucks	14	--	14
Import Trucks	0	--	0
Vendor Trucks	0	--	0
Subtotal	14	20	34
Phase 4 (11/025 – 7/2026)			
Export Trucks	4	--	4
Import Trucks	1	--	1
Vendor Trucks	6	--	6
Subtotal	11	50	61
Total			
Export Trucks	33	--	33
Import Trucks	1	--	1
Vendor Trucks	19	--	19
Subtotal	53	130	183

NOTES:
[a] Daily number of trucks and construction workers traveling to or from the site (i.e., one-way trips).
[b] The number of construction workers assumes a single shift and that all construction workers travel to site by auto (single occupancy).

SOURCES: San Francisco Public Utilities Commission (SFPUC), spreadsheets entitled "Ocean_Beach_LTP_RFI_56 resource Allocation Responses–MN EDR 6 09+KEF", October 2020; LCW Consulting analysis for Ocean Beach Climate Change Adaptation Project.

TABLE 3
PROJECT CONSTRUCTION TRUCK ORIGIN/DESTINATION ASSUMPTIONS

Construction Truck Type	SF North of Site or North Bay	SF East of Site	South Bay	East Bay	Total
Export Trucks					
Disposal of bus station restroom (444 loads)	0%	40%	50%	10%	100%
Wall Excavation (6,909 loads)	0%	20%	75%	5%	100%
Rock Excavation (2,500 loads)	0%	0%	100%	0%	100%
Sloat/Skyline Roadway Removal (76 loads)	0%	25%	75%	0%	100%
Import Trucks					
Slope Protection (3,000 loads)	30%	30%	0%	40%	100%
Grading (418 loads)	0%	60%	40%	0%	100%
Vendor Trucks					
Concrete Pile & Caps (3,050 loads)	80%	20%	0%	0%	100%
Tiebacks (971 loads)	75%	25%	0%	0%	100%
Resteel & Bridge (227 loads)	80%	20%	0%	0%	100%
Abandon Ped Tunnels (33 loads)	0%	0%	100%	0%	100%
Roadway (2,025 loads)	0%	60%	40%	0%	100%

SOURCES: San Francisco Public Utilities Commission (SFPUC), spreadsheets entitled "Ocean_Beach_LTP_RFI_56 resource Allocation Responses–MN EDR 6 09+KEF", October 2020; LCW Consulting analysis for Ocean Beach Climate Change Adaptation Project.

TABLE 4
PROJECT CONSTRUCTION WORKER ORIGIN/DESTINATION ASSUMPTIONS

Phase (daily workers)	SF North of Site or North Bay	SF East of Site	South Bay	East Bay	Total
Phase 1 (50 workers)	20%	40%	20%	20%	100%
Phase 2 (60 workers)	20%	50%	20%	10%	100%
Phase 3 (20 workers)	20%	50%	20%	10%	100%
Phase 4 (50 workers)	10%	60%	20%	10%	100%
Phase 5 (50 workers)	20%	50%	20%	10%	100%

SOURCES: San Francisco Public Utilities Commission (SFPUC), spreadsheet entitled "Ocean_Beach_LTP_RFI_56 resource Allocation Responses–MN EDR 6 09+KEF", October 2020; LCW Consulting analysis for Ocean Beach Climate Change Adaptation Project.

TABLE 5
PROJECT WEEKDAY DAILY TRAFFIC VOLUMES
DURING PERIOD OF MAXIMUM OVERLAP OF CONSRUCTION PHASES
NOVEMBER 2025 THROUGH APRIL 2026 (SIX MONTHS)

Roadway Segment and Direction of Travel	Existing Volumes	Existing plus Project Construction Conditions			
		Great Highway Closure[a]	Construction Truck Trips [b]	Construction Worker Trips [c]	GH Closure + Construction Trips
1. Great Highway north of Sloat Blvd					
Northbound	11,961	9,121	0	11	9,132
Southbound	11,579	9,144	0	11	9,155
2. Great Highway south of Sloat Blvd					
Northbound	12,218	0	22	66	88
Southbound	11,923	0	22	66	88
3. Sloat Blvd east of Great Highway					
Eastbound	4,215	8,780	22	55	8,857
Westbound	4,228	9,303	22	55	9,380
4. Sloat Blvd west of Skyline Blvd					
Eastbound	6,536	14,011	22	55	14,088
Westbound	9,163	16,408	22	55	16,485
5. Sloat Blvd east of Skyline Blvd					
Eastbound	10,619	12,239	22	55	12,316
Westbound	9,449	10,959	22	55	11,036
6. Skyline Blvd south of Sloat Blvd					
Northbound	11,508	20,263	0	0	20,263
Southbound	7,166	16,041	0	0	16,041
7. Great Highway west of Skyline					
Eastbound	11,879	0	30	64	94
Westbound	12,108	0	30	64	94
8. Skyline north of Great Highway					
Northbound	10,839	19,294	0	0	19,294
Southbound	7,213	15,783	0	0	15,783
9. Skyline south of Great Highway					
Northbound	22,016	19,641	30	64	19,735
Southbound	18,053	15,943	30	64	16,038

NOTES:
[a] Reflects closure of the Great Highway between Sloat and Skyline boulevards, and associated rerouting of traffic volumes due to the closure.
[b] Includes inbound and outbound construction vehicle trips.
[c] The number of construction workers assumes a single shift and that all construction workers travel to site by auto (single occupancy).

TABLE 6
PROJECT WEEKDAY P.M. PEAK HOUR TRAFFIC VOLUMES
DURING PERIOD OF MAXIMUM OVERLAP OF CONSRUCTION PHASES
NOVEMBER 2025 THROUGH APRIL 2026 (SIX MONTHS)

Roadway Segment and Direction of Travel	Existing Volumes	Existing plus Project Construction Conditions			
		Great Highway Closure[a]	Construction Truck Trips[b]	Construction Worker Trips[c]	GH Closure + Construction Trips
1. Great Highway north of Sloat Blvd					
Northbound	880	693	0	11	**704**
Southbound	1,295	1,001	0	0	**1,001**
2. Great Highway south of Sloat Blvd					
Northbound	1,071	0	6	66	**71**
Southbound	1,314	0	6	0	**6**
3. Sloat Blvd east of Great Highway					
Eastbound	443	1,062	6	55	**1,123**
Westbound	275	754	6	0	**760**
4. Sloat Blvd west of Skyline Blvd					
Eastbound	513	1,438	6	55	**1,499**
Westbound	795	1,436	6	0	**1,442**
5. Sloat Blvd east of Skyline Blvd					
Eastbound	876	1,109	6	55	**1,170**
Westbound	825	955	6	0	**961**
6. Skyline Blvd south of Sloat Blvd					
Northbound	957	1,800	0	0	**1,800**
Southbound	575	1,598	0	0	**1,598**
7. Great Highway west of Skyline					
Eastbound	1,273	0	8	64	**72**
Westbound	990	0	8	0	**8**
8. Skyline north of Great Highway					
Northbound	884	1,694	**0**	0	**1,694**
Southbound	673	1,638	0	0	**1,638**
9. Skyline south of Great Highway					
Northbound	1,813	1,694	8	0	**1,702**
Southbound	1,880	1,638	8	64	**1,710**

NOTES:
[a] Reflects closure of the Great Highway between Sloat and Skyline boulevards, and associated rerouting of traffic volumes due to the closure.
[b] Construction trucks would typically travel to and from the site during a 4-hour period in the morning. As a conservative assumption, the transportation analysis assumed that 25 percent of the daily construction trucks would travel to and from the site during the p.m. peak hour.
[c] Construction activities are expected to generally occur on a single shift primarily during daytime hours (7 a.m. to 3:30 p.m.). It was conservatively assumed that all construction workers would depart during the p.m. peak hour.

TABLE 7
EXISTING PLUS PROJECT WEEKDAY P.M. PEAK HOUR TRAFFIC VOLUMES DURING OPERATIONS FOR THE PROPOSED PROJECT AND ZOO PARKING ACCESS VARIANTS

Roadway Segment/Direction of Travel	Existing Conditions	Existing plus Project Conditions			
			Proposed Project (CHS Variant 1) [b]		
1. Great Highway north of Sloat Blvd					
Northbound	880		693		
Southbound	1,295		1,001		
2. Great Highway south of Sloat Blvd					
Northbound	1,071		0		
Southbound	1,314		0		
3. Sloat Blvd east of Great Highway					
Eastbound	443		1,062		
Westbound	275		754		
4. Sloat Blvd west of Skyline Blvd					
Eastbound	513		1,438		
Westbound	795		1,436		
5. Sloat Blvd east of Skyline Blvd					
Eastbound	876		1,109		
Westbound	825		955		
6. Skyline Blvd south of Sloat Blvd					
Northbound	957		1,800		
Southbound	575		1,598		
7. Great Highway west of Skyline					
Eastbound	1,273		26		
Westbound	990		34		
8. Skyline north of Great Highway					
Northbound	884		1,707		
Southbound	673		1,655		
9. Skyline south of Great Highway					
Northbound	1,813		1,711		
Southbound	1,880		1,651		
10. Herbst wb w. of Skyline (signal)	49		49		
11. Herbst eb w. of Skyline	142		142		

NOTES:

[a] Proposed Project volumes do not include vehicle trips associated with sand placement associated for beach nourishment. Beach nourishment would occur about once every four to seven years, on average, with additional ad-hoc placements about once every 12 years, on average.

[c] The Proposed Project (CHS Variant 1) would modify the zoo's Sloat Boulevard entrance to provide both entrance and exit.

SOURCE: Ocean Beach Climate Adaptation Project Traffic Operations Analysis, Technical Memorandum Draft #2, October 2, 2020.

SOUTH BEACH COASTAL PROTECTION PROJECT

TRUCKING STUDY

10/4/2020 edit see below

UPDATED EDR 4/13/2020

TRANSPORTATION Qantities

	Description	unit	quantity	ADJUSTED QUANTITY CY	CY/LOAD	NO LOADS		EXPORT	IMPORT	ON SITE	VENDOR		PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5
1	Demoition of bus and restrooms and turnaround	LS															
	disposal	CY		4000	9	444		444					444				
2	Wall Excavation	cy	152000														
	off haul	cy	76000	76000	11	6462		6462						6462			
	on site haul	cy	76000	76000	14	5429				5429				5429			
3	pile concrete	lf	46400														
		cy		22000	8	2750					2750			2750			
	pile cap	cy	2400	2400	8	300					300			300			
	tiebacks	lf	22400														
		cy		6800	7	971					971			971			
	resteel	lbs	6564600		30000	219					219			219			
	bridge over ppe	cy	60	60	8	8					8			8			
	abandon ped tunnels	ea															
		cy		300	9	33					33			33			
	slope protection layer	cy	29997	29997	10	3000			3000				3000				
	rock excavation	cy	20000	20000	8	2500		2500							2500		
	grade access rd	cy	2400	2400	10	240			240				240				
	agg base	cy	1200	1200	10	120					120		120				
	ac pavement	tons	1500	1500	12	125					125		125				
	walkway material																
	SLOAT BLVD																
	PAVEMENT REMOVAL	SY	2000														
		cy		300	8	38		38						38			
	RECONSTRUCT ROADWAY	SY	2500														
				300	10	30					30			30			
	SKYLINE BLVD INTERSECTION																
	PAVEMENT REMOVAL	SY	2000														
		cy		300	8	484		484								484	
	RECONSTRUCT ROADWAY	SY	2500														
		cy		300	10	30					30					30	
	PARKING LOT AT GREAT HIGHWAY																
	grading & fill	sf	8000														
		cy		800	9	89			89							89	
	reconstruct roadway	cy	8600	8600	10	860					860					860	
	HERBST ACCESS RD																
	GRADING	SF	8600														
				800	9	89			89								89
	RECONSTRUCT RDWAY	CY	8600	8600	10	860					860						860
	total loads					25080	0	9928	3417	5429	6306	25080	3929	16239	2500	1462	949
	NO OF WORKING DAYS												200	480	180	160	100
	AVERAGE TRIPS /DAY												19.6	33.8	13.9	9.1	9.5

														Daily Construction Volumes
Existing Conditions					Diverted	Proposed	Project	Project	Project		Daily Diverted	Adjusted	Daily	Daily
		Weekday			Trips	Project	Var. 1	Var. 2	Var. 3		Base	Daily	Project	Project
		12-hour	24-hour	PM Pk Hr	PM Pk Hr								Trucks	Workers
				CHS Fig. 4	CHS Fig. 7	CHS Var. 3	CHS Var. 1	CHS Var. 2	CHS Var. 4					
1. Great Highway N. of Sloat							CHS Figure 10							
	northbound	9,569	11,961	880	-262	693	693	693	778		-2,840	9,121	0	11
	southbound	9,263	11,579	1,295	-300	1,001	1,001	1,001	1,001		-2,435	9,144	0	11
	total	18,832	23,540	2,175	-562	1,694	1,694	1,694	1,779		-5,275	18,265		
2. Great Highway S. of Sloat														
	northbound	9,774	12,218	1,071	-1,254	0	0	0	206		-12,840	0	22	66
	southbound	9,539	11,923	1,314	-1,314	0	0	0	0		-11,925	0	22	66
	total	19,313	24,141	2,385	-2,568	0	0	0	206		-24,765	0		
3. Sloat E. of Great Highway														
	eastbound	3,372	4,215	443	482	1,015	1,062	1,015	1,136		4,565	8,780	22	55
	westbound	3,382	4,228	275	456	707	754	707	707		5,075	9,303	22	55
	total	6,754	8,443	718	938	1,722	1,816	1,722	1,843		9,640	18,083		
4. Sloat W. of Skyine Blvd														
	eastbound	5,229	6,536	513	903	1,438	1,438	1,317	1,353		7,475	14,011	22	55
	westbound	7,331	9,163	795	622	1,388	1,436	1,388	1,388		7,245	16,408	22	55
	total	12,559	15,699	1,308	1,525	2,826	2,874	2,705	2,741		14,720	30,419		
5. Sloat E. of Skyline Blvd														
	eastbound	8,495	10,619	876	212	1,109	1,109	1,109	1,024		1,620	12,239	22	55
	westbound	7,559	9,449	825	112	955	955	955	955		1,510	10,959	22	55
	total	16,054	20,068	1,701	324	2,064	2,064	2,064	1,979		3,130	23,198		
6. Skyline S. of Sloat Blvd														
	northbound	9,207	11,508	957	812	1,752	1,800	1,752	1,752		8,755	20,263	0	0
	southbound	5,733	7,166	575	993	1,598	1,598	1,477	1,598		8,875	16,041	0	0
	total	14,939	18,674	1,532	1,805	3,350	3,398	3,229	3,350		17,630	36,304		
7. Great Highway W. of Skyline														
	eastbound	9,503	11,879	1,273	-1,273	26	26	26	26		-11,340	0	30	64
	westbound	9,687	12,108	990	-1,020	34	34	34	82		-11,440	0	30	64
	total	19,190	23,987	2,263	-2,293	60	60	60	108		-22,780	0		
8. Skyline N. of Great Highway														
	northbound	8,671	10,839	884	793	1,707	1,707	1,707	1,660		8,455	19,294	0	0
	southbound	5,770	7,213	673	951	1,655	1,655	1,655	1,655		8,570	15,783	0	0
	total	14,441	18,051	1,557	1,744	3,362	3,362	3,362	3,315		17,025	35,076		
9. Skyline S. of Great Highway														
	northbound	17,613	22,016	1,813	-166	1,711	1,711	1,711	1,712		-2,375	19,641	30	64
	southbound	14,443	18,053	1,880	-256	1,651	1,651	1,651	1,651		-2,110	15,943	30	64
	total	32,055	40,069	3,693	-422	3,362	3,362	3,362	3,363		-4,485	35,584		
10. Herbst wb w. of Skyline (signal)				49										
11. Herbst eb w. of Skyline				142		97	49	97	49					
						142	142	263	142					

		P.M. Peak Hour Constr. Volumes					
Total Project Daily	Adjusted + Project Daily	Project Trucks	Project Workers	**Var. 1 + Construction**			
11	9,132	0	11	704			
11	9,154	0	0	1,001			
21	18,286			1,694			
88	88	6	66	71			
88	88	6		6			
176	176			0			
78	8,858	6	55	1,123			
78	9,380	6		760			
155	18,238			1,816			
78	14,088	6	55	1,499			
78	16,486	6		1,442			
155	30,574			2,874			
78	12,316	6	55	1,170			
78	11,036	6		961			
155	23,353			2,064			
0	20,263	0		1,800			
0	16,041	0		1,598			
0	36,304			3,398			
94	94	8	64	72	removed Skyline coastal lot trips		
94	94	8		8	removed Skyline coastal lot trips		
189	189			60			
0	19,294	0		1,694	removed Skyline coastal lot trips		
0	15,783	0		1,638	removed Skyline coastal lot trips		
0	35,076			3,362			
94	19,735	8		1,702	removed Skyline coastal lot trips		
94	16,038	8	64	1,710	removed Skyline coastal lot trips		
189	35,773			3,362			

Ocean Beach Climate Change Adaption Project EIR
Average Daily Construction Trucks and Workers
October 5, 2020

		Jan 23		Feb 23		Mar 23		Apr 23		May 23		June 23		July 23		Aug 23		Sept 23		Oct 23		Nov 23		Dec 23		Jan 24		Feb 24		Mar 24		Apr 24		May 24		June 24	
		1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	12	13	13	14	14	15	15	16	16	17	17	18	18
Prokect Schedule																																					
Mobilizatior	1/2/23 to 3/18/23																																				
Phase 1	3/18/23 to 3/26/24																																				
Phase 2	3/27/24 to 4/21/26																																				
Phase 3	11/6/24 to 4/21/26																																				
Phase 4	11/5/25 to 7/28/26																																				
Phase 5	8/1/26 to 1/12/27																																				
Truck Hauls																																					
Mobilizatior	1/2/23 to 3/18/23																																				
	Delivery of Equipment																																				
Phase 1	3/18/23 to 3/26/24																																				
	Hauling Export						3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3						
	Hauling Import						17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17						
	Vendor						2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
Phase 2	3/27/24 to 4/21/26																																				
	Hauling Export																															15	15	15	15	15	15
	Hauling Import																															0	0	0	0	0	0
	Vendor																															13	13	13	13	13	13
Phase 3	11/6/24 to 4/21/26																																				
	Hauling Export																																				
	Hauling Import																																				
	Vendor																																				
Phase 4	11/5/25 to 7/28/26																																				
	Hauling Export																																				
	Hauling Import																																				
	Vendor																																				
Phase 5	8/1/26 to 1/12/27																																				
	Hauling Export																																				
	Hauling Import																																				
	Vendor																																				
Total Construction Trucks																																					
	Hauling Export	0	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	15	15	15	15	15	15
	Hauling Import	0	0	0	0	0	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	0	0	0	0	0	0
	Vendor	0	0	0	0	0	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	13	13	13	13	13	13
Construction Workers																																					
Mobilizatior	1/2/23 to 3/18/23	10	10	10	10	10																															
Phase 1	3/18/23 to 3/26/24						50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50						
Phase 2	3/27/24 to 4/21/26																															60	60	60	60	60	60
Phase 3	11/6/24 to 4/21/26																																				
Phase 4	11/5/25 to 7/28/26																																				
Phase 5	8/1/26 to 1/12/27																																				

Ocean Beach Climate Change Ada
Average Daily Construction Truck
October 5, 2020

		July 24		Aug 24		Sept 24		Oct 24		Nov 24		Dec 24		Jan 25		Feb 25		Mar 25	
		19	19	20	20	21	21	22	22	23	23	24	24	25	25	26	26	27	27
Prokect Schedule																			
Mobilizatior	1/2/23 to 3/18/23																		
Phase 1	3/18/23 to 3/26/24																		
Phase 2	3/27/24 to 4/21/26																		
Phase 3	11/6/24 to 4/21/26																		
Phase 4	11/5/25 to 7/28/26																		
Phase 5	8/1/26 to 1/12/27																		
Truck Hauls																			
Mobilizatior	1/2/23 to 3/18/23																		
	Delivery of Equipmen																		
Phase 1	3/18/23 to 3/26/24																		
	Hauling Export																		
	Hauling Import																		
	Vendor																		
Phase 2	3/27/24 to 4/21/26																		
	Hauling Export	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
	Hauling Import	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vendor	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Phase 3	11/6/24 to 4/21/26																		
	Hauling Export									14	14	14	14	14	14	14	14	14	14
	Hauling Import									0	0	0	0	0	0	0	0	0	0
	Vendor									0	0	0	0	0	0	0	0	0	0
Phase 4	11/5/25 to 7/28/26																		
	Hauling Export																		
	Hauling Import																		
	Vendor																		
Phase 5	8/1/26 to 1/12/27																		
	Hauling Export																		
	Hauling Import																		
	Vendor																		
Total Construction Trucks																			
	Hauling Export	15	15	15	15	15	15	15	15	29	29	29	29	29	29	29	29	29	29
	Hauling Import	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vendor	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Construction Workers																			
Mobilizatior	1/2/23 to 3/18/23																		
Phase 1	3/18/23 to 3/26/24																		
Phase 2	3/27/24 to 4/21/26	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Phase 3	11/6/24 to 4/21/26									20	20	20	20	20	20	20	20	20	20
Phase 4	11/5/25 to 7/28/26																		
Phase 5	8/1/26 to 1/12/27																		

		Apr 25		May 25		June 25		July 25		Aug 25		Sept 25		Oct 25		Nov 25		Dec 25	
		28	28	29	29	30	30	31	31	32	32	33	33	34	34	35	35	36	36
Prokect Schedule																			
Mobilizatior	1/2/23 to 3/18/23																		
Phase 1	3/18/23 to 3/26/24																		
Phase 2	3/27/24 to 4/21/26																		
Phase 3	11/6/24 to 4/21/26																		
Phase 4	11/5/25 to 7/28/26																		
Phase 5	8/1/26 to 1/12/27																		
Truck Hauls																			
Mobilizatior	1/2/23 to 3/18/23																		
	Delivery of Equipmen																		
Phase 1	3/18/23 to 3/26/24																		
	Hauling Export																		
	Hauling Import																		
	Vendor																		
Phase 2	3/27/24 to 4/21/26																		
	Hauling Export	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
	Hauling Import	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vendor	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13
Phase 3	11/6/24 to 4/21/26																		
	Hauling Export	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
	Hauling Import	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Vendor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phase 4	11/5/25 to 7/28/26																		
	Hauling Export															4	4	4	4
	Hauling Import															1	1	1	1
	Vendor															6	6	6	6
Phase 5	8/1/26 to 1/12/27																		
	Hauling Export																		
	Hauling Import																		
	Vendor																		
Total Construction Trucks																			
	Hauling Export	29	29	29	29	29	29	29	29	29	29	29	29	29	29	33	33	33	33
	Hauling Import	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
	Vendor	13	13	13	13	13	13	13	13	13	13	13	13	13	13	19	19	19	19
Construction Workers																			
Mobilizatior	1/2/23 to 3/18/23																		
Phase 1	3/18/23 to 3/26/24																		
Phase 2	3/27/24 to 4/21/26	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Phase 3	11/6/24 to 4/21/26	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
Phase 4	11/5/25 to 7/28/26															50	50	50	50
Phase 5	8/1/26 to 1/12/27																		

Ocean Beach Climate Change Ada
Average Daily Construction Truck
October 5, 2020

		Jan 26		Feb 26		Mar 26		Apr 26		May 26		June 26		July 26		Aug 26		Sept 26		Oct 26		Nov 26		Dec 26		Jan 27	
		37	37	38	38	39	39	40	40	41	41	42	42	43	43	44	44	45	45	46	46	47	47	48	48	49	49
Prokect Schedule																											
Mobilizatior	1/2/23 to 3/18/23																										
Phase 1	3/18/23 to 3/26/24																										
Phase 2	3/27/24 to 4/21/26																										
Phase 3	11/6/24 to 4/21/26																										
Phase 4	11/5/25 to 7/28/26																										
Phase 5	8/1/26 to 1/12/27																										
Truck Hauls																											
Mobilizatior	1/2/23 to 3/18/23																										
	Delivery of Equipmen																										
Phase 1	3/18/23 to 3/26/24																										
	Hauling Export																										
	Hauling Import																										
	Vendor																										
Phase 2	3/27/24 to 4/21/26																										
	Hauling Export	15	15	15	15	15	15	15	15																		
	Hauling Import	0	0	0	0	0	0	0	0																		
	Vendor	13	13	13	13	13	13	13	13																		
Phase 3	11/6/24 to 4/21/26																										
	Hauling Export	14	14	14	14	14	14	14	14																		
	Hauling Import	0	0	0	0	0	0	0	0																		
	Vendor	0	0	0	0	0	0	0	0																		
Phase 4	11/5/25 to 7/28/26																										
	Hauling Export	4	4	4	4	4	4	4	4	4	4	4	4	4	4												
	Hauling Import	1	1	1	1	1	1	1	1	1	1	1	1	1	1												
	Vendor	6	6	6	6	6	6	6	6	6	6	6	6	6	6												
Phase 5	8/1/26 to 1/12/27																										
	Hauling Export															0	0	0	0	0	0	0	0	0	0	0	
	Hauling Import															1	1	1	1	1	1	1	1	1	1	1	
	Vendor															9	9	9	9	9	9	9	9	9	9	9	
Total Construction Trucks																											
	Hauling Export	33	33	33	33	33	33	33	33	4	4	4	4	4	4	0	0	0	0	0	0	0	0	0	0	0	
	Hauling Import	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Vendor	19	19	19	19	19	19	19	19	6	6	6	6	6	6	9	9	9	9	9	9	9	9	9	9	9	
Construction Workers																											
Mobilizatior	1/2/23 to 3/18/23																										
Phase 1	3/18/23 to 3/26/24																										
Phase 2	3/27/24 to 4/21/26	60	60	60	60	60	60	60	60																		
Phase 3	11/6/24 to 4/21/26	20	20	20	20	20	20	20	20																		
Phase 4	11/5/25 to 7/28/26	50	50	50	50	50	50	50	50	50	50	50	50	50	50												
Phase 5	8/1/26 to 1/12/27															50	50	50	50	50	50	50	50	50	50	50	

TRANSIT DELAY ANALYSIS CALCULATIONS

Ocean Beach Climate Change Adaptation Project EIR
Review of Project Impacts on Transit Delay - Weekday PM Peak Hour
For segment of Sloat Boulevard between Great Highway and Skyline,
and Skyline between Sloat and Great Highway

			Seconds of delay for approach			
			Existing	**Project (CHS Var 1)**		
18 46th Avenue						
Outbound to Stonestown						
EB on Sloat	#2 SB LT		25.1	25.3		
	45th Ave use #2		5.0	8.9		
	#3 EB RT		9.2	40.5	40.5	delay at Skyline/Sloat
SB on Skyline	#4 SB Thru		5.0	6.7		
	#5 SB Thru		0.0	0.0		
	#6 SB Thru		0.0	0.2		
	#7 SB Thru		14.6	6.7		
	Reentry		8.0	50.5		
		total	66.9	138.8	138.8	29% delay at Skyline/Sloat as % of total E+P delay
net change in transit delay				*71.9*	71.9	56% delay at Skyline/Sloat as % of net increase in delay
Inbound to Outer Richmond						
NB on Skyline	#7 NB Thru		0.0	7.0		
	#6 NB Thru		0.0	0.0		
	#5 NB Thru		0.0	1.7		
	#4 NB Thru		4.1	7.0		
	#3 NB LT		9.5	80.0	80.0	delay at Skyline/Sloat
WB on Sloat	--		0.0	0.0		
	45th Ave use #2		4.0	5.1		
	Reentry		2.0	16.0		
		total	19.6	116.8	116.8	68% delay at Skyline/Sloat as % of total E+P delay
net change in transit delay				*97.2*	97.2	82% delay at Skyline/Sloat as % of net increase in delay
23 Monterey						
Inbound to Bayview						
EB on Sloat	#2 SB LT		25.1	25.3		
	45th Ave use #2		5.0	8.9		
	#3 EB Thru		9.2	40.5	40.5	delay at Skyline/Sloat
	Reentry		4.0	44.0		
		total	43.3	118.7	118.7	34% delay at Skyline/Sloat as % of total E+P delay
net change in transit delay				*75.4*	75.4	54% delay at Skyline/Sloat as % of net increase in delay
Oubound to Zoo						
WB on Sloat	#3 WB Thru (free)		0.0	0.0		
	45th Ave use #2		4.0	5.1		
	#2 WB Thru		4.1	5.1		
	Reentry		2.0	16.0		
		total	10.1	26.2		
net change in transit delay				*16.1*		
57 Parkmerced						
Outbound to Outer Sunset						
NB on Skyline	#7 NB Thru		0.0	7.0		
	#6 NB Thru		0.0	0.0		
	#5 NB Thru		0.0	1.7		
	#4 NB Thru		4.1	7.0		
EB on Sloat	#3 NB RT		9.5	80.0	80.0	delay at Skyline/Sloat
	Reentry		8.0	20.5		
		total	21.6	116.2	116.2	69% delay at Skyline/Sloat as % of total E+P delay
net change in transit delay				*94.6*	94.6	85% delay at Skyline/Sloat as % of net increase in delay
Inbound to West Portal						
WB on Sloat	#3 WB LT		13.3	19.0	19.0	delay at Skyline/Sloat
SB on Skyline	#4 SB Thru		5.0	6.7		
	#5 SB Thru		0.0	0.0		
	#6 SB Thru		0.0	0.2		
	#7 SB Thru		14.6	6.7		
	Reentry		3.0	14.0		
		total	35.9	46.6	46.6	41% delay at Skyline/Sloat as % of total E+P delay
net change in transit delay				*10.7*	10.7	178% delay at Skyline/Sloat as % of net increase in delay

Source of Intersection approach delay: CHS Consulting, Ocean Beach Climate Adaptation Project Traffic Operations Report, October 2, 2020
Table 2, p. 14 for Existing Conditions and Table 13, p. 37 for Existing plus Project (Variant 1) conditions
Source of reentry delay: 2000 Highway Capacity Manual Figure V.A.3-4, p. V.A.3-8, as presented in SF Guidelines
Traffic volumes as presented in CHS Consulting, Traffic Operations Report
LCW Consulting, October 2020

Ocean Beach Climate Change Adaptation Project EIR
Intersection Volumes and Reentry Delay
For segment of Sloat Boulevard between Great Highway and Skyline,
and Skyline between Sloat and Great Highway

	Existing			Project (CHS Var 1)			Muni 18	Muni 23	Muni 57
	vol	per lane	delay	vol	per lane	delay			
Sloat Blvd - Eastbound									
Sloat/47th	338	203	1.0	1469	881	11.0	X	X	--
Sloat/45th	338	203	1.0	1469	881	11.0	X	X	--
Sloat/43	338	203	1.0	1469	881	11.0	X	X	--
Sloat/41	338	203	1.0	1469	881	11.0	X	X	--
Sloat/Skyline	863	518	4.0	1097	658	6.5	X	--	X
Sloat Blvd - Westbound									
Sloat/Skyline							X	--	X
Sloat/41st	248	149	0.5	888	533	4.0	X	X	--
Sloat/43	248	149	0.5	888	533	4.0	X	X	--
Sloat/45	248	149	0.5	888	533	4.0	X	X	--
Sloat/47	248	149	0.5	888	533	4.0	--	X	--
Skyline Blvd - Southbound									
Herbst/Armory	49	49	0.0	49	97	0.0	--	--	X
Herbst/Skyline			0.0			0.0	--	--	X
Skyline/Harding	635	381	3.0	1659	995	14.0	--	--	--
Skyline Blvd - Northbound									
Skyline/Harding	848	509	0.0	1718	1031	0.0	--	--	X
Skyline/Zoo	876	526	4.0	1690	1014	14.0	--	--	X
Skyline/Lake Merced Blvd	917	550	0.0	1759	1055	0.0	--	--	X

Source of Intersection approach volumes: CHS Consulting, Ocean Beach Climate Adaptation Project
Traffic Operations Report, October 2, 2020
Figure 4, p. 13 for Existing Conditions and Figure 10, p. 35 for Existing plus Project (Variant 1) conditions
Source of reentry delay: 2000 Highway Capacity Manual Figure V.A.3-4, p. V.A.3-8, as presented in SF Guidelines
LCW Consulting, October 2020

MEMORANDUM

Date: August 25, 2021

To: Ryan Shum, San Francisco Planning Department
Wade Wietgrefe, San Francisco Planning Department
Julie Moore, San Francisco Planning Department

From: Luba Wyznyckyj, LCW Consulting

Subject: Ocean Beach Climate Change Adaptation Project EIR – Transit Delay Assessment for Additional Cumulative Scenario (Planning Case Number 2019-020115NV)

This memorandum presents the steps taken to assess cumulative transit delay impacts for the additional cumulative scenario that includes the potential permanent closure of the Great Highway between Lincoln Way and Sloat Boulevard by SFMTA and San Francisco Recreation and Parks department. The SFCTA's District 4 Mobility Study explored four long-term alternative configurations of the Great Highway between Lincoln Way and Sloat Boulevard ranging from no closure, weekend closure, partial closure, and full closure. The potential full closure of the Great Highway between Lincoln Way and Sloat Boulevard is considered in the cumulative impact analysis in the Ocean Beach Climate Change Adaptation Project (OBCCAP) EIR as a separate additional cumulative scenario.

1. Based on the SFCTA presentation "D4 Mobility Study Open House (March 2021)", the full permanent closure of the Great Highway between Lincoln Way and Sloat Boulevard could delay the Muni 29 Sunset route, the 28 19th Avenue route, and the 18 46th Avenue route.

   The SFCTA D4 Mobility Study analysis is evaluates existing plus project conditions and doesn't include cumulative projects such as the 28 19th Avenue Rapid Project and the 19th Avenue (CA Route 1) Combined City Project. Because the Great Highway closure would not reroute a substantial number of vehicles to 19th Avenue and cumulative projects are pending on 19th Avenue, I concluded that the cumulative projects on 19th Avenue would mitigate the effects of the low amount of rerouted vehicles on 19th Avenue and that there would not be a significant cumulative transit delay impact on the 28 19th Avenue route.

   The OBCCAP would not combine with impacts of the potential permanent closure of the Great Highway between Lincoln Way and Sloat Boulevard because the OBCCAP Great Highway traffic reroutes are not projected to occur along the 18 46th Avenue route.

The SFCTA analysis for the 29 Sunset route is based on the macroscopic model runs and does not take into consideration that on Sunset Boulevard buses stop in the travel lane and therefore are not subject to re-entry delay. Also, the traffic signals are coordinated along Sunset Boulevard which would limit the effects of the additional traffic. Nevertheless, I concluded that:

- Significant cumulative transit delay impacts may occur on the 29 Sunset route.
- Improvements may be part of that project or a separate project that would reduce or eliminate the transit delay increases due to vehicle reroutes from the Great Highway, but that is not currently reasonably foreseeable.
- Conservatively assume that cumulative transit delay impacts under the additional cumulative scenario would be significant.

2. The contribution to significant cumulative transit delay impacts was based on traffic volumes and distance of Great Highway roadway closure. Daily traffic volumes on the Great Highway north and south of Sloat Boulevard are similar[1], and therefore the OBCCAP's Great Highway closure contribution was calculated as the distance between Sloat and Skyline boulevards (0.75 miles) over the entire closure distance (i.e., between Lincoln Way and Skyline Boulevard).

Great Highway between Lincoln Way and Skyline Blvd	**Distance (miles)**	**Percentage**
Lincoln Way to Sloat Boulevard	2.00	70%
Sloat Boulevard to Skyline Boulevard	0.75	30%
	2.75	100%

Therefore, the OBCCAP's contribution to cumulative impacts would be about 30 percent.

3. I considered a significant cumulative impact as four or more minutes of delay to the transit route and a "considerable contribution" from the project as two minutes (out of four or more minutes of additional transit delay).[2]

4. I assumed that the transit delay is only due to the additional rerouted vehicles and would be above the four-minute threshold due to additional traffic congestion. As noted above, on Sunset Boulevard, the bus stops are within the travel lane so there is no re-entry delay for buses. In addition, the reroute would not generate additional passengers, so there would be no additional boarding delay.

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[1] Ocean Beach Climate Change Adaptation Draft EIR, Appendix D.

[2] In the Balboa Reservoir Project EIR, a considerable contribution to significant transit delay impacts was defined as two minutes or more under cumulative conditions. City and County of San Francisco, Balboa Reservoir Project Final Supplemental EIR, Case No. 2018-007883ENV; certified May 2020, p. 4.C-51.

A four-minute increase in transit delay on Sunset Boulevard due solely to increased traffic congestion is conservative given the three travel lanes in each direction, the 30-mph speed limit and traffic signal progression, and the low existing volume-to-capacity(v/c) ratios[3] (e.g., v/c ratios of between 0.59 and 0.67 on Sunset Boulevard north of Sloat Boulevard during the p.m. peak hour using information from the SFCTA model analysis noted above) that indicates that additional vehicles could be accommodated in both directions of Sunset Boulevard.[4] Portions of Sunset Boulevard that could be substantially congested to the point where transit would be delayed would likely be localized and limited in length (e.g., in the segment of Sunset Boulevard directly north and south of Sloat Boulevard, Sunset Boulevard between Lincoln Way and Martin Luther King Jr. Drive[5]), which would also limit the magnitude of additional transit delay for the 29 Sunset route. However, without a more detailed traffic impact analysis this cannot be established for certain. Between four and six minutes of additional transit delay the OBCCAP project would contribute less than the two-minute considerable contribution threshold.

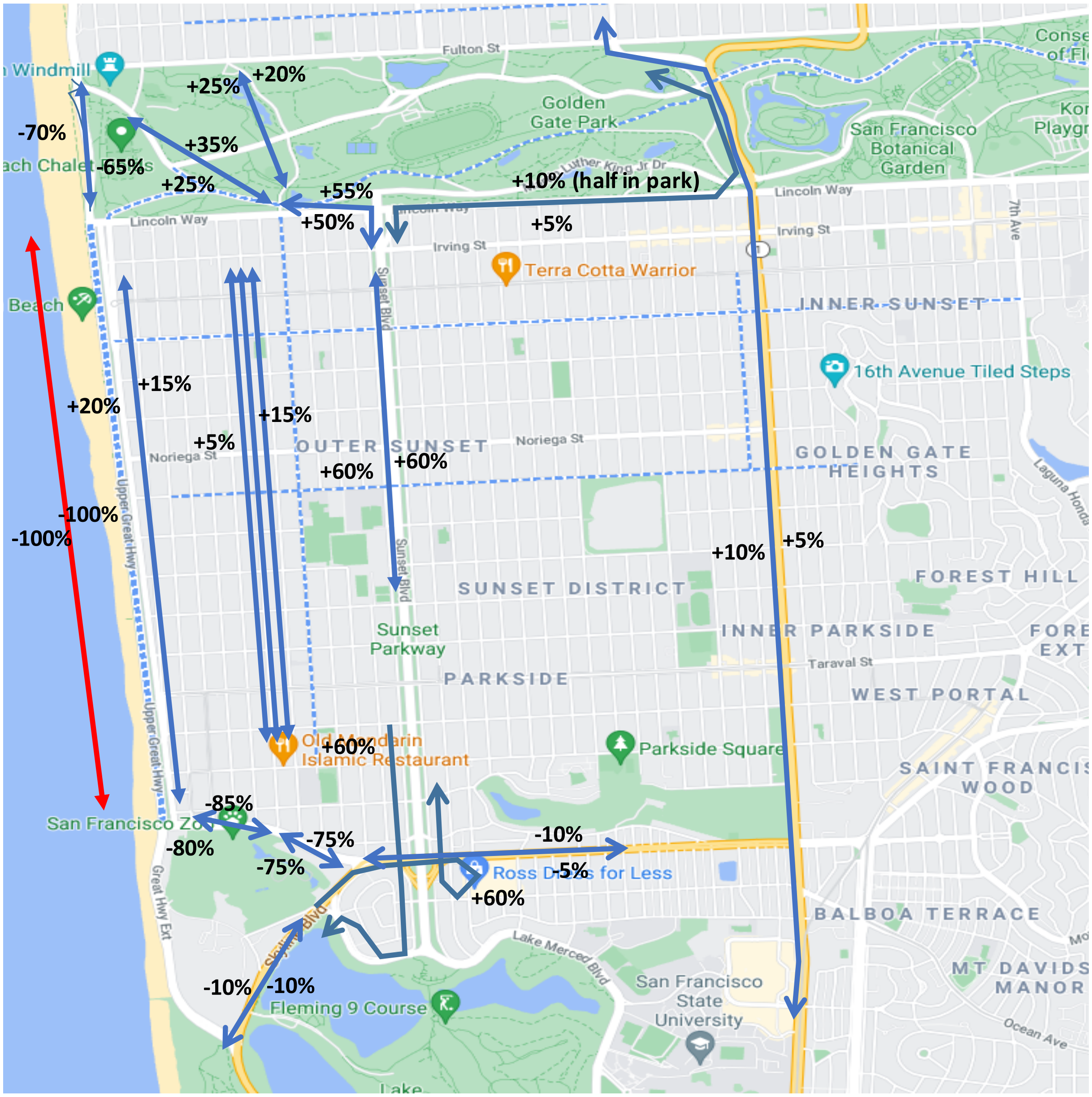
Level of Additional Transit Delay	**Project Contribution at 30 percent**	**Significant Contribution?**
4 minutes	1.2 minutes	No
5 minutes	1.5 minutes	No
6 minutes	1.8 minutes	No
7 minutes	2.1 minutes	Yes

5. Conclusion is that for the above reasons, the OBCCAP would not contribute considerably to any cumulative transit delay impacts that could occur under the additional cumulative scenario.

[3] The volume-to-capacity (v/c) ratio, also referred to as the degree of saturation, measures the level of congestion on a roadway by dividing the volume of traffic by the capacity of the roadway.
[4] SFCTA SF-CHAMP model data and LCW Consulting v/c ratio calculations for existing conditions attached to memo.
[5] SFCTA D4 Mobility Study Open House, March 2021 presentation, page 19 of 61 (attached to memo) and SFCTA, Great Highway Concepts Evaluation Report, Final Report, July 2021, page 21 (attached to memo).

Upper Great Highway Closure

PM PM Diversions



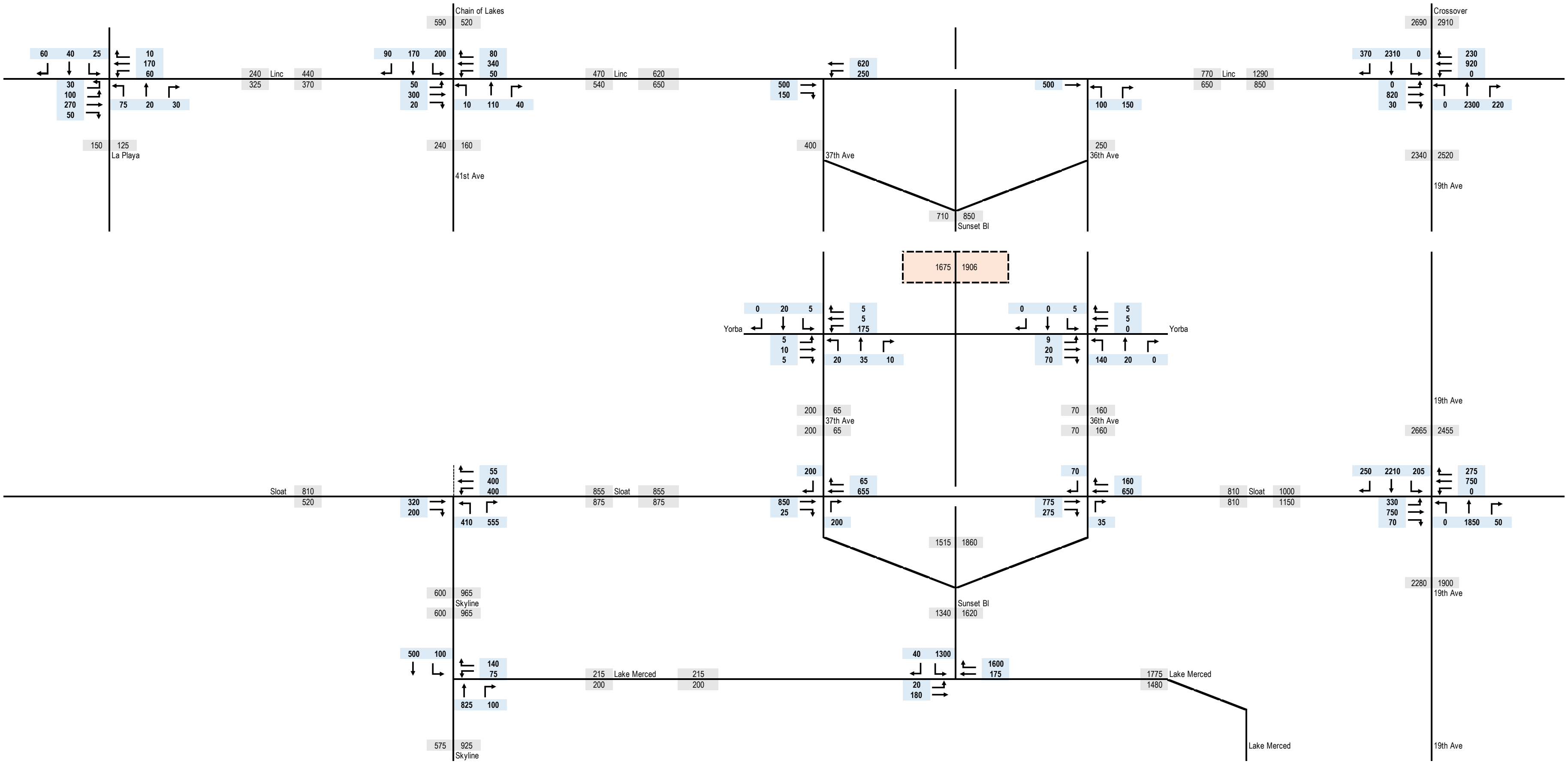
Ocean Beach Climate Change Adaptation Project EIR
Determining Existing Volume-to-Capacity (v/c) Ratios
Weekday PM Peak Hour Conditions
August 24, 2021

Existing v/c ratios on Sunset Boulevard

	SF-CHAMP Cumulative net_base	
		north of Sloat Boulevard
northbound		
volume	1,906	
capacity	2,850	
v/c ratio	**0.67**	
Southbound		
volume	1,675	
capacity	2,850	
v/c ratio	**0.59**	

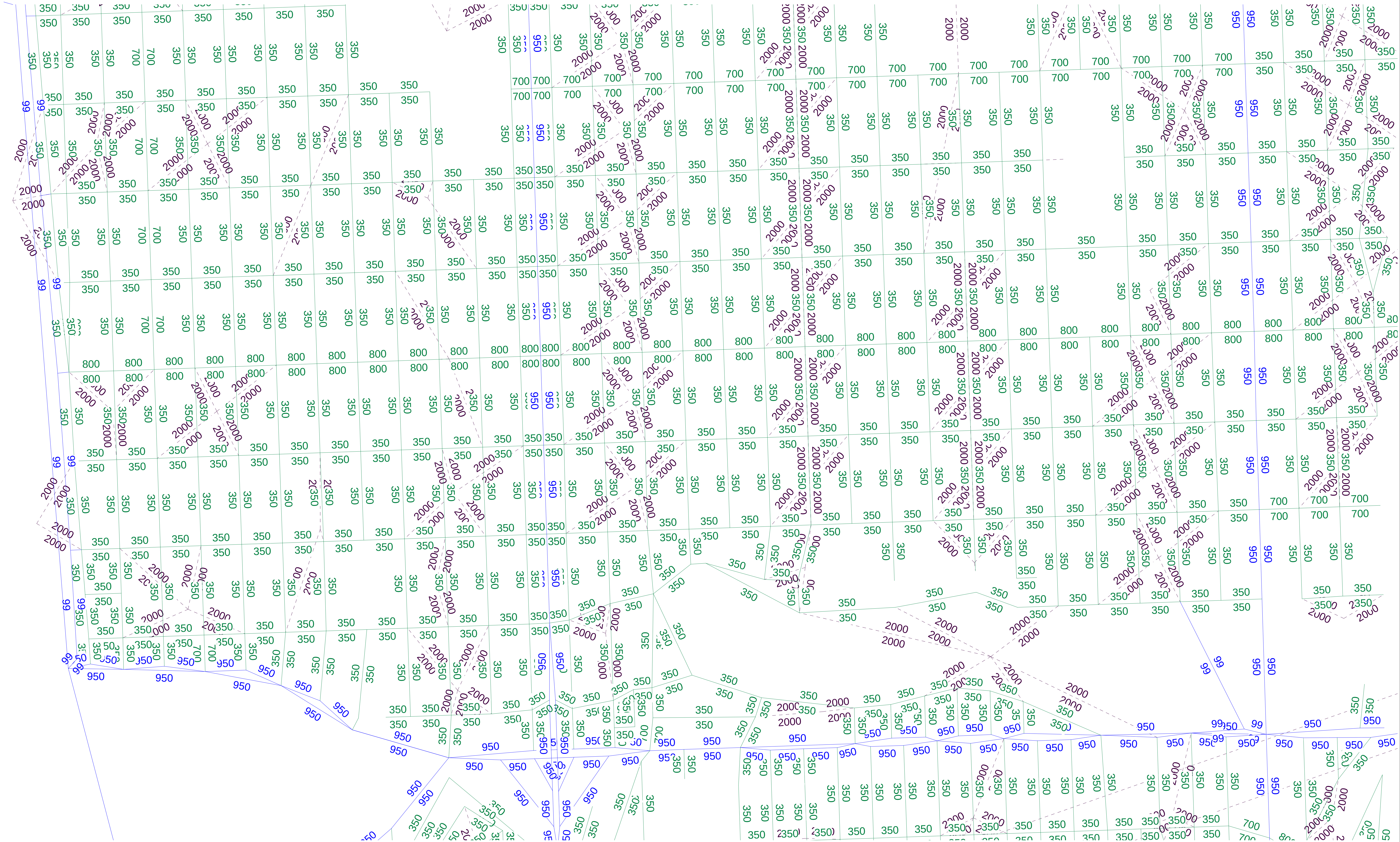
Net_Base: Existing Conditions
SF-CHAMP distribution from spreadsheet "GtHwy_TrafficVols_Diversions_20210521.xlsx" net_base tab
Sunset Boulevard north of Sloat Boulevard.

Capacity from SF-CHAMP roadway network inputs.
Sunset Boulevard 950 vehicles per hour x 3 travel lanes in each direction = 2,850 vph


Chain of Lakes
Crossover
Linc
La Playa
41st Ave
37th Ave
36th Ave
19th Ave
Sunset Bl
Yorba
Sloat
Skyline
Lake Merced

YEAR 2020 - BASELINE

PM PEAK HOUR



Potential Congested Locations

Concept 3:
Full Promenade/
Complete Vehicle
Closure

Concept 4: Timed
Promenade

Issue area observed under temporary closure

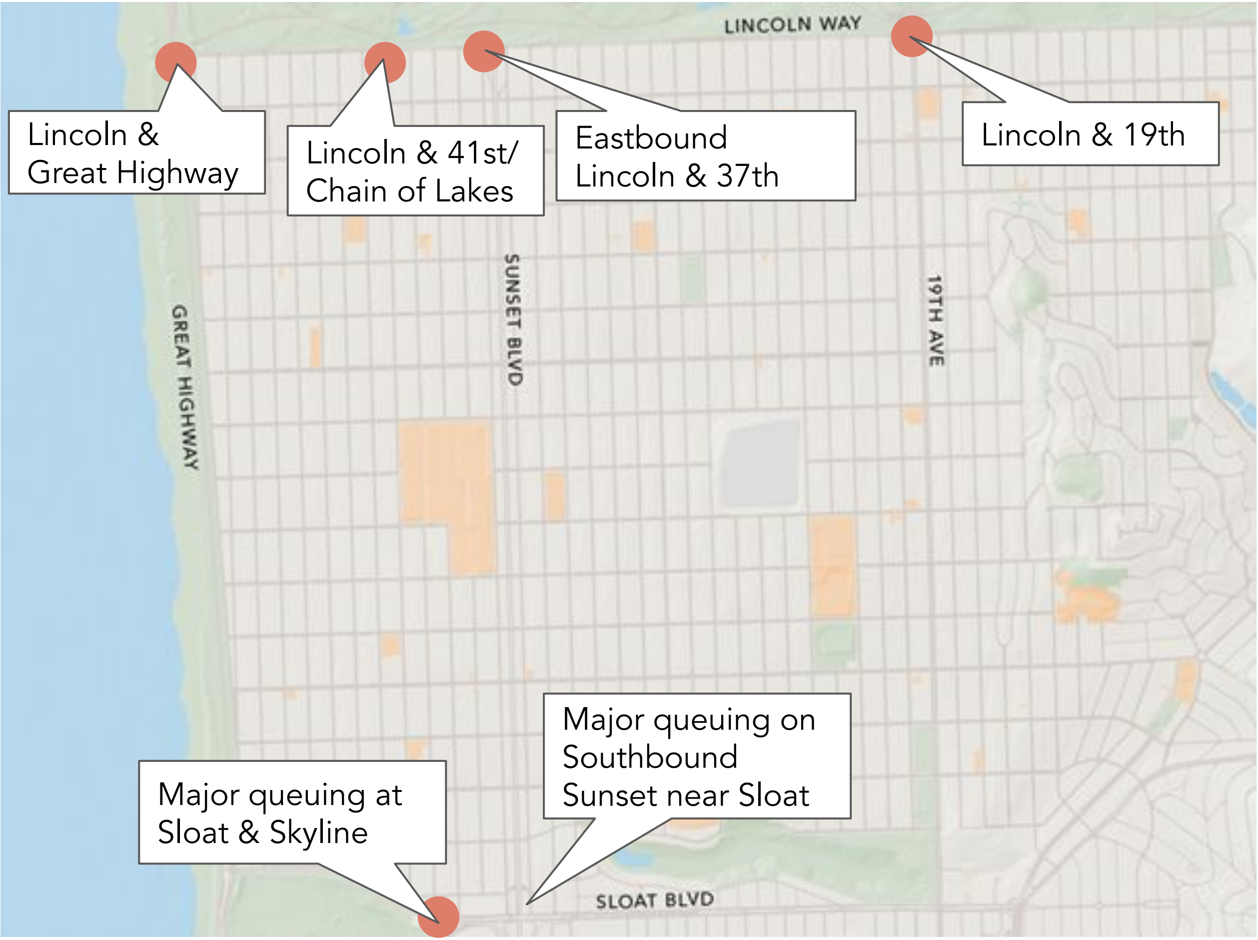
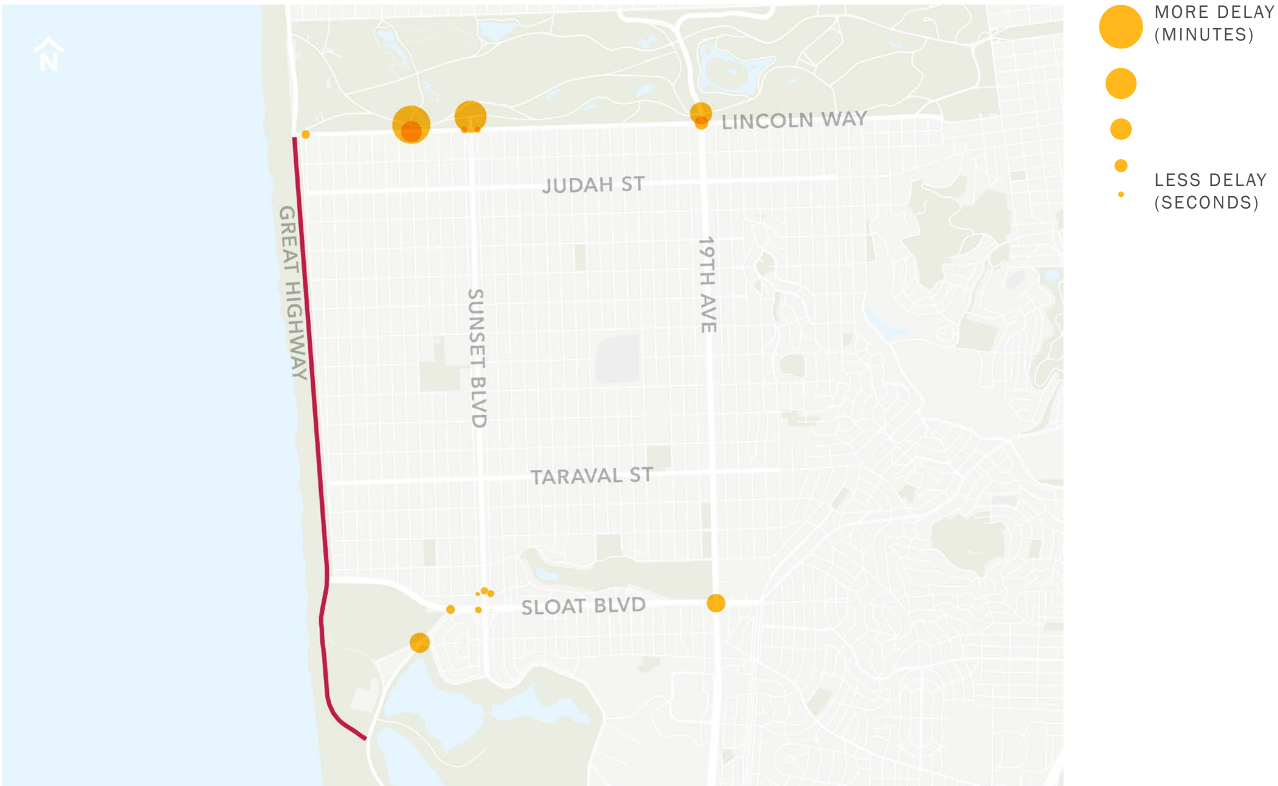


Figure 2-8. Intersection Delay – Upper Great Highway Closed



Using a combination of the initial analysis, staff observations, and feedback from the public, four key areas were identified for more detailed analysis:

- Northern end of study area, including Chain of Lakes intersections with Lincoln Way and Martin Luther King, Jr. Dr and Sunset intersection with Lincoln Way (including 36th/37th Ave access between Lincoln Way and Sunset) and Sunset Blvd & Martin Luther King, Jr. Dr
- Southern end of study area, including Sloat Blvd & Skyline Blvd, Lake Merced Blvd & Skyline Blvd, and Sunset Blvd & Sloat Boulevard
- Local streets between Upper Great Highway and Sunset Blvd
- 19th Avenue corridor, including intersections at Martin Luther King, Jr. Dr, Lincoln Way, and Sloat Blvd

SFMTA is also conducting area-wide operational analyses of north-south traffic across and around Golden Gate Park using micro-simulation traffic models to evaluate some of these effects in more detail. This work was in progress at the time this report was completed and all findings from this study were shared with the SFMTA team.

APPENDIX E
NOISE ANALYSIS SUPPORTING DOCUMENTATION

E1 PROPOSED CONSTRUCTION EQUIPMENT BY CONSTRUCTION PHASE

PROPOSED CONSTRUCTION EQUIPMENT BY CONSTRUCTION PHASE

Equipment	Intersection Modifications (12 months)		Install Buried Wall (25 months)		Revetment Removal/ Sand Application (18 months)		Construction (9 months)		Debris Removal/ Landscaping (6 months)	
	Max. Daily Amt.	Hrs/ Day	Max. Daily Amt.	Hrs/ Day	Max. Daily Amt.	Hrs/ Day	Max. Daily Amt.	Hrs/ Day	Max. Daily Amt.	Hrs/ Day
Air Compressors	2	8	2	8	2	8	2	8	2	8
Backhoes	3	7	3	7	3	7	3	7	3	7
Bore/Drill Rigs	0	0	3	7	0	0	0	0	0	0
Cement and Mortar Mixers	0	0	1	7	0	0	0	0	0	0
Concrete/ Industrial Saws	0	0	1	6	0	0	0	0	0	0
Cranes	0	0	2	4	1.5	4	1.5	4	1.5	4
Concrete Pump	0	0	2	4	0	0	2	4	0	0
Crawler Tractor	2	7	2	7	2	7	2	7	2	7
Excavator	2	7	2	7	2	7	2	7	2	7
Forklifts	1	4	1	4	1	4	1	4	1	4
Generator Sets	2	10	2	10	2	10	2	10	2	10
Hoe Ram	1	6	1	6	1	6	0	0	0	0
Grader	1	6	1	6	1	6	1	6	1	6
Loader	1	5	1	5	1	5	1	5	1	5
Paving Equipment	1	7	0	0	0	0	1	7	0	0
Vibratory Compactor	2	6	0	0	0	0	2	6	0	0
Roller	1	6	0	0	0	0	1	6	0	0
Pumps	3	24	3	24	3	24	3	24	0	0
Signal Boards	4	24	2	24	4	24	4	24	2	24
Water Trucks	2	6	2	6	2	6	2	6	2	6

E2 CONSTRUCTION NOISE MODELING OUTPUT

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 08/18/2020
Case Description: Intersection Work

**** Receptor #1 ****

		Baselines (dBA)		
Description	Land Use	Daytime	Evening	Night
2788 Great Highway	Residential	64.0	64.0	59.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Mounted Impact Hammer (hoe ram)	Yes	20		90.3	60.0	0.0
Tractor	No	40	84.0		60.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Mounted Impact Hammer (hoe ram)	88.7	81.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	82.4	78.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	88.7	83.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 01/26/2021
Case Description: Nighttime Work with

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
2788 Great Highway	Residential	64.0	64.0	59.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Generator (<25KVA, VMS signs)	No	50		72.8	190.0	0.0
Generator (<25KVA, VMS signs)	No	50		72.8	230.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Generator (<25KVA, VMS signs)	61.2	58.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator (<25KVA, VMS signs)	59.6	56.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	61.2	60.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 08/19/2020
Case Description: Beach Nourishment

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
2788 Great Highway	Residential	64.0	64.0	59.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dump Truck	No	40		76.5	365.0	0.0
Excavator	No	40		80.7	365.0	0.0
Dozer	No	40		81.7	365.0	0.0
Dozer	No	40		81.7	365.0	0.0
Front End Loader	No	40		79.1	365.0	0.0
Pumps	No	50		80.9	1000.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Dump Truck	59.2	55.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	63.4	59.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer	64.4	60.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer	64.4	60.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	61.8	57.9	N/A	N/A	N/A	N/A	N/A							

N/A	N/A	N/A	N/A	N/A	N/A	N/A					
Pumps			54.9	51.9		N/A	N/A	N/A	N/A	N/A	
N/A	N/A	N/A	N/A	N/A	N/A	N/A					
		Total	64.4	66.2		N/A	N/A	N/A	N/A	N/A	
N/A	N/A	N/A	N/A	N/A	N/A	N/A					

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/16/2021
Case Description: Revetment

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
2788 Great Highway	Residential	64.0	64.0	59.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Mounted Impact Hammer (hoe ram)	Yes	20		90.3	280.0	0.0
Tractor	No	40	84.0		280.0	0.0

Results

Equipment	Calculated (dBA) Lmax	Calculated (dBA) Leq	Noise Limits (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Mounted Impact Hammer (hoe ram)	75.3	68.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	69.0	65.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	75.3	70.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/16/2021
Case Description: Buried Wall

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
2788 Great Highway	Residential	64.0	64.0	59.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Mounted Impact Hammer (hoe ram)	Yes	20		90.3	280.0	0.0
Concrete Saw	No	20		89.6	280.0	0.0

Results

Equipment	Calculated (dBA) Lmax	Leq	Noise Limits (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Mounted Impact Hammer (hoe ram)	75.3	68.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Saw	74.6	67.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	75.3	71.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 02/16/2021
Case Description: Construction

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
2788 Great Highway	Residential	64.0	64.0	59.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Crane	No	16		80.6	280.0	0.0
Grader	No	40	85.0		280.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Crane	65.6	57.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	70.0	66.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	70.0	66.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

E3 TRAFFIC NOISE MODELING OUTPUT

Existing

ROAD SEGMENT (Calveno Peak)	from:	to:	TOTAL # VEHICLES	VEHICLE TYPE % Auto %	Auto	MT %	MT	HT %	HT	VEHICLE SPEED Auto	k/h	MT	k/h	HT	k/h	NOISE LEVEL (dBA) Auto	MT	HT	CALCULATED NOISE LEVEL (15 meters from roadway center)
Great Hwy	Vicente	Sloat	2172	97	2106.8	2	43.44	1	21.72	35	56	35	56	35	56	67.5	60.4	64.1	69.7
Sloat	Great Hwy	47th	709	97	687.73	2	14.18	1	7.09	35	56	35	56	35	56	62.7	55.5	59.3	64.9
Sloat	47th	Skyline	565	97	548.05	2	11.3	1	5.65	35	56	35	56	35	56	61.7	54.6	58.3	63.9
Sloat	Skyline	Sunset	1689	97	1638.3	2	33.78	1	16.89	35	56	35	56	35	56	66.5	59.3	63.0	68.6
Skyline	Sloat	Herbst	1532	97	1486	2	30.64	1	15.32	45	72	45	72	45	72	69.2	60.6	63.6	70.7
Skyline	Herbst	Harding	1530	97	1484.1	2	30.6	1	15.3	45	72	45	72	45	72	69.2	60.6	63.6	70.7
Skyline	Harding	J. Muir	3693	97	3582.2	2	73.86	1	36.93	45	72	45	72	45	72	73.0	64.4	67.4	74.5
N. Herbst	Skyline	Armory	37	95	35.15	2	0.74	3	1.11	25	40	25	40	25	40	45.6	40.4	49.9	51.6
S. Herbst	Skyline	Armory	142	95	134.9	2	2.84	3	4.26	25	40	25	40	25	40	51.4	46.3	55.7	57.4

Assumptions: PM peak hour traffic data from CHS Consulting Group

Existing + Project (CHS Variant #1 in 10/20 study)

ROAD SEGMENT (Calveno Peak)	from:	to:	TOTAL # VEHICLES	VEHICLE TYPE % Auto %	Auto	MT %	MT	HT %	HT	VEHICLE SPEED Auto	k/h	MT	k/h	HT	k/h	NOISE LEVEL (dBA) Auto	MT	HT	CALCULATED NOISE LEVEL (15 meters from roadway center)
Great Hwy	Vicente	Sloat	1691	97	1640.3	2	33.82	1	16.91	35	56	35	56	35	56	66.5	59.3	63.0	68.6
Sloat	Great Hwy	47th	1752	97	1699.4	2	35.04	1	17.52	35	56	35	56	35	56	66.6	59.5	63.2	68.8
Sloat	47th	Skyline	2336	97	2265.9	2	46.72	1	23.36	35	56	35	56	35	56	67.9	60.7	64.4	70.0
Sloat	Skyline	Sunset	2052	97	1990.4	2	41.04	1	20.52	35	56	35	56	35	56	67.3	60.2	63.9	69.5
Skyline	Sloat	Herbst	3398	97	3296.1	2	67.96	1	33.98	45	72	45	72	45	72	72.6	64.1	67.1	74.1
Skyline	Herbst	Harding	3396	97	3294.1	2	67.92	1	33.96	45	72	45	72	45	72	72.6	64.1	67.1	74.1
Skyline	Harding	J. Muir	3362	97	3261.1	2	67.24	1	33.62	45	72	45	72	45	72	72.6	64.0	67.0	74.1
N. Herbst	Skyline	Armory	37	95	35.15	2	0.74	3	1.11	25	40	25	40	25	40	45.6	40.4	49.9	51.6
S. Herbst	Skyline	Armory	142	95	134.9	2	2.84	3	4.26	25	40	25	40	25	40	51.4	46.3	55.7	57.4

Assumptions: PM peak hour traffic data from CHS Consulting Group

Existing + Project (CHS Variant #1 in 10/20 study) + Full GH Closure

ROAD SEGMENT			TOTAL # VEHICLES	VEHICLE TYPE % Auto		MT		HT		VEHICLE SPEED Auto	k/h	MT	k/h	HT	k/h	NOISE LEVEL (dBA) Auto	MT	HT	CALCULATED NOISE LEVEL 15 meters from roadway center)
Calveno Peak	from:			%	Auto	%	MT	%	HT										
Great Hwy	Vicente	Sloat	0	97	0	2	0	1	0	35	56	35	56	35	56	0.0	0.0	0.0	0.0
Sloat	Great Hwy	47th	840.96	97	815.73	2	16.82	1	8.41	35	56	35	56	35	56	63.4	56.3	60.0	65.6
Sloat	47th	Skyline	1121.28	97	1087.6	2	22.43	1	11.21	35	56	35	56	35	56	64.7	57.5	61.2	66.8
Sloat	Skyline	Sunset	2400.84	97	2328.8	2	48.02	1	24.01	35	56	35	56	35	56	68.0	60.8	64.5	70.1
Skyline	Sloat	Herbst	2480.54	97	2406.1	2	49.61	1	24.81	45	72	45	72	45	72	71.3	62.7	65.7	72.8
Skyline	Herbst	Harding	2479.08	97	2404.7	2	49.58	1	24.79	45	72	45	72	45	72	71.3	62.7	65.7	72.8
Skyline	Harding	J. Muir	2454.26	97	2380.6	2	49.09	1	24.54	45	72	45	72	45	72	71.2	62.6	65.6	72.7
N. Herbst	Skyline	Armory	37	95	35.15	2	0.74	3	1.11	25	40	25	40	25	40	45.6	40.4	49.9	51.6
S. Herbst	Skyline	Armory	142	95	134.9	2	2.84	3	4.26	25	40	25	40	25	40	51.4	46.3	55.7	57.4

Assumptions: PM peak hour traffic data from CHS Consulting Group

Project Contribution

ROAD SEGMENT			TOTAL # VEHICLES	VEHICLE TYPE % Auto		MT		HT		VEHICLE SPEED Auto	k/h	MT	k/h	HT	k/h	NOISE LEVEL (dBA) Auto	MT	HT	CALCULATED NOISE LEVEL 15 meters from roadway center)
Calveno Peak	from:			%	Auto	%	MT	%	HT										
Sloat	47th	Skyline	1771	97	1717.9	2	35.42	1	17.71	35	56	35	56	35	56	66.7	59.5	63.2	68.8

Existing

ROAD SEGMENT			TOTAL # VEHICLES	VEHICLE TYPE % Auto %	Auto	MT %	MT	HT %	HT	VEHICLE SPEED Auto	k/h	MT	k/h	HT	k/h	NOISE LEVEL (dBA) Auto	MT	HT	CALCULATED NOISE LEVEL (15 meters from roadway center)
Calveno Peak	from:	to:																	
Great Hwy	Vicente	Sloat	2172	97	2106.84	2	43.44	1	21.72	35	56	35	56	35	56	67.5	60.4	64.1	69.7
Sloat	Great Hwy	47th	709	97	687.73	2	14.18	1	7.09	35	56	35	56	35	56	62.7	55.5	59.3	64.9
Sloat	47th	Skyline	565	97	548.05	2	11.3	1	5.65	35	56	35	56	35	56	61.7	54.6	58.3	63.9
Sloat	Skyline	Sunset	1689	97	1638.33	2	33.78	1	16.89	35	56	35	56	35	56	66.5	59.3	63.0	68.6
Skyline	Sloat	Herbst	1532	97	1486.04	2	30.64	1	15.32	45	72	45	72	45	72	69.2	60.6	63.6	70.7
Skyline	Herbst	Harding	1530	97	1484.1	2	30.6	1	15.3	45	72	45	72	45	72	69.2	60.6	63.6	70.7
Skyline	Harding	J. Muir	3693	97	3582.21	2	73.86	1	36.93	45	72	45	72	45	72	73.0	64.4	67.4	74.5
N. Herbst	Skyline	Armory	37	95	35.15	2	0.74	3	1.11	25	40	25	40	25	40	45.6	40.4	49.9	51.6
S. Herbst	Skyline	Armory	142	95	134.9	2	2.84	3	4.26	25	40	25	40	25	40	51.4	46.3	55.7	57.4

Assumptions: PM peak hour traffic data from CHS Consulting Group

Existing +Construction Trucks

ROAD SEGMENT			TOTAL # VEHICLES	VEHICLE TYPE % Auto %	Auto	MT %	MT	HT %	HT	VEHICLE SPEED Auto	k/h	MT	k/h	HT	k/h	NOISE LEVEL (dBA) Auto	MT	HT	CALCULATED NOISE LEVEL (15 meters from roadway center)
Calveno Peak	from:																		
Great Hwy	Vicente	Sloat	2172	97	2106.84	2	43.44	1	24.72	35	56	35	56	35	56	67.5	60.4	64.7	69.9
Sloat	Great Hwy	47th	709	97	687.73	2	14.18	1	10.09	35	56	35	56	35	56	62.7	55.5	60.8	65.3
Sloat	47th	Skyline	565	97	548.05	2	11.3	1	8.65	35	56	35	56	35	56	61.7	54.6	60.1	64.5
Sloat	Skyline	Sunset	1689	97	1638.33	2	33.78	1	19.89	35	56	35	56	35	56	66.5	59.3	63.7	68.8
Skyline	Sloat	Herbst	1532	97	1486.04	2	30.64	1	18.32	45	72	45	72	45	72	69.2	60.6	64.4	70.8
Skyline	Herbst	Harding	1530	97	1484.1	2	30.6	1	18.3	45	72	45	72	45	72	69.2	60.6	64.4	70.8
Skyline	Harding	J. Muir	3693	97	3582.21	2	73.86	1	39.93	45	72	45	72	45	72	73.0	64.4	67.8	74.6
N. Herbst	Skyline	Armory	37	95	35.15	2	0.74	3	1.11	25	40	25	40	25	40	45.6	40.4	49.9	51.6
S. Herbst	Skyline	Armory	142	95	134.9	2	2.84	3	4.26	25	40	25	40	25	40	51.4	46.3	55.7	57.4

Assumptions: PM peak hour traffic data from CHS Consulting Group

E4 NOISE MONITORING SUMMARIES AND OUTPUT

Calculated Ldn from long-term noise monitoring data LT-1 Great Highway and Sloat Avenue

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/10/2019	Midnight	0 / 24	53.3	216219	2162186	683743
	am 1:00	100	53.8	240021	2400209	759013
	2:00	200	51.9	155156	1551558	490646
	3:00	300	49.9	97085	970850	307010
	4:00	400	51.5	139806	1398057	442105
	5:00	500	59.8	956005	9560046	3023152
	6:00	600	61.8	1529442	15294420	4836520
	7:00	700	65.7	3677012	36770116	11627732
	8:00	800	66.1	4039132	40391316	12772856
	9:00	900	65.0	3127469	31274689	9889925
	10:00	1000	65.2	3290963	32909630	10406939
	11:00	1100	65.3	3396675	33966750	10741230
	12:00	1200	68.3	6820277	68202768	21567609
	pm 1:00	1300	65.0	3187807	31878069	10080730
	2:00	1400	64.0	2497687	24976869	7898380
	3:00	1500	64.7	2977748	29777484	9416467
	4:00	1600	68.8	7508203	75082029	23743022
	5:00	1700	63.4	2179159	21791594	6891107
	6:00	1800	65.7	3757682	37576818	11882833
	7:00	1900	66.3	4313184	43131841	13639486
	8:00	2000	64.2	2627635	26276348	8309311
	9:00	2100	62.6	1801619	18016192	5697220
	10:00	2200	60.9	1224506	12245062	3872229
	pm 11:00	2300	59.2	826458	8264584	2613491

Leq Morning Peak Hour 7:00-10:00 a.m.
66 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
66 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
58 dBA

Leq Daytime 7:00 am-10:00 p.m.
66 dBA

Leq 24-Hour
64 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
67 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
67 dBA

CNEL - Ldr 0.69427224

Calculated Ldn from long-term noise monitoring data LT-1 Great Highway and Sloat Avenue

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/11/2019	Midnight	0 / 24	52.7	187312	1873122	592333
	am 1:00	100	53.5	225261	2252610	712338
	2:00	200	53.2	210365	2103652	665233
	3:00	300	56.5	448107	4481073	1417040
	4:00	400	53.9	245370	2453703	775929
	5:00	500	63.0	1979689	19796891	6260327
	6:00	600	65.5	3538197	35381969	11188761
	7:00	700	73.2	20697743	206977435	65452012
	8:00	800	68.6	7222458	72224576	22839416
	9:00	900	68.6	7162176	71621762	22648790
	10:00	1000	67.1	5164746	51647464	16332362
	11:00	1100	65.5	3585494	35854940	11338328
	12:00	1200	67.9	6211050	62110496	19641064
	pm 1:00	1300	65.1	3204594	32045939	10133816
	2:00	1400	68.4	6960846	69608456	22012127
	3:00	1500	80.6	114198921	1141989209	361128696
	4:00	1600	66.6	4558469	45584689	14415144
	5:00	1700	65.9	3892763	38927633	12309998
	6:00	1800	64.3	2704251	27042510	8551593
	7:00	1900	65.9	3908652	39086520	12360243
	8:00	2000	64.9	3104552	31045524	9817457
	9:00	2100	63.6	2293137	22931370	7251536
	10:00	2200	63.3	2131513	21315131	6740436
	pm 11:00	2300	61.8	1520075	15200749	4806899

Leq Morning Peak Hour 7:00-10:00 a.m.

71 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.

66 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)

61 dBA

Leq Daytime 7:00 am-10:00 p.m.

71 dBA

Leq 24-Hour

69 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.

71 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.

71 dBA

CNEL - Ldr 0.28220185

Calculated Ldn from long-term noise monitoring data LT-1 Great Highway and Sloat Avenue

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/12/2019	Midnight	0 / 24	60.0	993516	9935163	3141774
	am 1:00	100	58.8	752983	7529827	2381140
	2:00	200	59.3	846761	8467613	2677694
	3:00	300	58.3	676536	6765361	2139395
	4:00	400	59.9	984279	9842785	3112562
	5:00	500	67.4	5451111	54511107	17237926
	6:00	600	67.5	5620863	56208630	17774729
	7:00	700	67.1	5078729	50787285	16060350
	8:00	800	65.8	3778366	37783658	11948242
	9:00	900	65.4	3499065	34990649	11065015
	10:00	1000	73.7	23517329	235173293	74368325
	11:00	1100	66.6	4618150	46181496	14603871
	12:00	1200	66.8	4776964	47769643	15106088
	pm 1:00	1300	66.5	4465273	44652728	14120433
	2:00	1400	68.7	7403703	74037032	23412565
	3:00	1500	65.5	3587336	35873355	11344151
	4:00	1600	68.2	6656470	66564703	21049607
	5:00	1700	64.0	2527860	25278599	7993795
	6:00	1800	62.8	1921786	19217859	6077221
	7:00	1900	62.4	1733465	17334647	5481697
	8:00	2000	64.8	3013353	30133529	9529059
	9:00	2100	62.8	1916121	19161213	6059308
	10:00	2200	62.8	1903290	19032901	6018732
	pm 11:00	2300	59.0	787727	7877275	2491013

Leq Morning Peak Hour 7:00-10:00 a.m.
66 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
65 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
63 dBA

Leq Daytime 7:00 am-10:00 p.m.
67 dBA

Leq 24-Hour
66 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
70 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
71 dBA

CNEL - Ldr 0.23539733

Calculated Ldn from long-term noise monitoring data LT-1 Great Highway and Sloat Avenue

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/13/2019	Midnight	0 / 24	58.9	778644	7786441	2462289
	am 1:00	100	55.5	356085	3560853	1126040
	2:00	200	52.6	182890	1828900	578349
	3:00	300	52.9	193061	1930612	610513
	4:00	400	54.1	257919	2579188	815611
	5:00	500	61.4	1386140	13861397	4383359
	6:00	600	61.2	1315988	13159882	4161520
	7:00	700	64.1	2586706	25867056	8179881
	8:00	800	63.7	2353569	23535694	7442640
	9:00	900	63.5	2218365	22183650	7015086
	10:00	1000	63.9	2472020	24720201	7817214
	11:00	1100	63.2	2108706	21087058	6668313
	12:00	1200	63.4	2203276	22032765	6967372
	pm 1:00	1300	63.7	2367778	23677781	7487572
	2:00	1400	63.5	2264279	22642793	7160280
	3:00	1500	65.4	3453282	34532816	10920235
	4:00	1600	64.8	3053641	30536412	9656461
	5:00	1700	63.4	2170561	21705610	6863917
	6:00	1800	62.7	1877937	18779369	5938558
	7:00	1900	65.4	3474777	34747775	10988211
	8:00	2000	64.4	2739902	27399018	8664330
	9:00	2100	64.1	2594305	25943048	8203912
	10:00	2200	64.5	2813695	28136949	8897684
	pm 11:00	2300	63.2	2074832	20748323	6561196

Leq Morning Peak Hour 7:00-10:00 a.m.
64 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
64 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
60 dBA

Leq Daytime 7:00 am-10:00 p.m.
64 dBA

Leq 24-Hour
63 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
67 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
68 dBA

CNEL - Ldr 0.58734486

Calculated Ldn from long-term noise monitoring data LT-1 Great Highway and Sloat Avenue

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/14/2019	Midnight	0 / 24	62.4	1727007	17270066	5461274
	am 1:00	100	61.3	1355189	13551894	4285485
	2:00	200	61.0	1262237	12622373	3991545
	3:00	300	59.9	977683	9776829	3091705
	4:00	400	59.8	950423	9504231	3005502
	5:00	500	61.9	1550262	15502616	4902358
	6:00	600	60.3	1064261	10642606	3365488
	7:00	700	63.8	2389599	23895988	7556575
	8:00	800	64.4	2780987	27809873	8794254
	9:00	900	67.7	5904145	59041448	18670545
	10:00	1000	66.3	4265805	42658050	13489660
	11:00	1100	65.8	3802017	38020165	12023032
	12:00	1200	69.7	9414429	94144293	29771040
	pm 1:00	1300	66.3	4257268	42572681	13462664
	2:00	1400	66.1	4043775	40437752	12787540
	3:00	1500	64.9	3060624	30606241	9678543
	4:00	1600	65.1	3215622	32156221	10168690
	5:00	1700	64.9	3087131	30871306	9762364
	6:00	1800	65.8	3779427	37794273	11951599
	7:00	1900	65.2	3277917	32779174	10365685
	8:00	2000	63.5	2235141	22351414	7068138
	9:00	2100	63.0	1989862	19898622	6292497
	10:00	2200	62.2	1659384	16593844	5247434
	pm 11:00	2300	63.0	1980993	19809933	6264451

Leq Morning Peak Hour 7:00-10:00 a.m.
66 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
65 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
61 dBA

Leq Daytime 7:00 am-10:00 p.m.
66 dBA

Leq 24-Hour
65 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
69 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
69 dBA

CNEL - Ldr 0.3693218

Calculated Ldn from long-term noise monitoring data LT-1 Great Highway and Sloat Avenue

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/15/2019	Midnight	0 / 24	61.4	1367099	13670991	4323147
	am 1:00	100	61.8	1501288	15012880	4747489
	2:00	200	59.1	813999	8139992	2574092
	3:00	300	57.2	525764	5257642	1662612
	4:00	400	56.5	443123	4431227	1401277
	5:00	500	57.1	511402	5114015	1617194
	6:00	600	57.7	590973	5909735	1868822
	7:00	700	61.0	1252028	12520279	3959260
	8:00	800	62.1	1615348	16153476	5108178
	9:00	900	67.6	5820563	58205631	18406237
	10:00	1000	64.5	2794827	27948274	8838020
	11:00	1100	63.9	2429461	24294614	7682631
	12:00	1200	65.0	3190355	31903549	10088788
	pm 1:00	1300	65.3	3383888	33838882	10700794
	2:00	1400	65.4	3502418	35024182	11075619
	3:00	1500	66.5	4446651	44466505	14061544
	4:00	1600	63.9	2456292	24562920	7767477
	5:00	1700	65.4	3448292	34482917	10904456
	6:00	1800	62.4	1747511	17475113	5526116
	7:00	1900	62.0	1569333	15693326	4962665
	8:00	2000	60.4	1097582	10975821	3470859
	9:00	2100	60.7	1165835	11658348	3686693
	10:00	2200	58.7	734705	7347050	2323341
	pm 11:00	2300	57.6	568968	5689682	1799235

Leq Morning Peak Hour 7:00-10:00 a.m.
65 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
64 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
59 dBA

Leq Daytime 7:00 am-10:00 p.m.
64 dBA

Leq 24-Hour
63 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
67 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
67 dBA

CNEL - Ldr 0.31410105

Calculated Ldn from long-term noise monitoring data LT-2 41st Avenue and Sloat Avenue

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/10/2019	Midnight	0 / 24	58.5	704203	7042032	2226886
	am 1:00	100	54.1	254543	2545429	804935
	2:00	200	53.1	206209	2062092	652091
	3:00	300	53.8	238989	2389890	755750
	4:00	400	56.0	393553	3935528	1244523
	5:00	500	60.8	1197463	11974627	3786710
	6:00	600	63.7	2318350	23183500	7331266
	7:00	700	69.5	8831795	88317954	27928589
	8:00	800	68.8	7625126	76251256	24112764
	9:00	900	66.5	4468842	44688420	14131719
	10:00	1000	68.3	6693619	66936192	21167082
	11:00	1100	67.2	5219165	52191647	16504448
	12:00	1200	67.3	5318718	53187184	16819264
	pm 1:00	1300	66.6	4607380	46073797	14569814
	2:00	1400	67.5	5669555	56695554	17928708
	3:00	1500	67.6	5707724	57077245	18049410
	4:00	1600	68.0	6331608	63316077	20022302
	5:00	1700	67.4	5473045	54730448	17307287
	6:00	1800	67.6	5706187	57061870	18044548
	7:00	1900	68.0	6320639	63206392	19987616
	8:00	2000	67.4	5462180	54621799	17272929
	9:00	2100	65.5	3535420	35354199	11179979
	10:00	2200	62.7	1871927	18719274	5919554
	pm 11:00	2300	60.5	1131134	11311339	3576959

Leq Morning Peak Hour 7:00-10:00 a.m.
68 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
68 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
60 dBA

Leq Daytime 7:00 am-10:00 p.m.
68 dBA

Leq 24-Hour
66 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
69 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
69 dBA

CNEL - Ldr 0.77252576

Calculated Ldn from long-term noise monitoring data LT-2 41st Avenue and Sloat Avenue

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/11/2019	Midnight	0 / 24	58.9	779502	7795016	2465000
	am 1:00	100	55.3	339140	3391400	1072455
	2:00	200	55.2	333503	3335032	1054630
	3:00	300	53.9	244782	2447817	774068
	4:00	400	56.8	473514	4735142	1497383
	5:00	500	62.2	1676633	16766330	5301979
	6:00	600	65.4	3473890	34738895	10985403
	7:00	700	69.6	9050321	90503214	28619629
	8:00	800	69.6	9219620	92196195	29154997
	9:00	900	68.7	7476839	74768385	23643839
	10:00	1000	67.2	5226537	52265366	16527760
	11:00	1100	66.7	4640193	46401925	14673577
	12:00	1200	68.5	7118935	71189345	22512048
	pm 1:00	1300	67.1	5182950	51829498	16389926
	2:00	1400	67.4	5451751	54517509	17239950
	3:00	1500	68.4	6947891	69478911	21971161
	4:00	1600	68.1	6399499	63994994	20236994
	5:00	1700	67.6	5705425	57054250	18042138
	6:00	1800	66.8	4747959	47479594	15014366
	7:00	1900	67.6	5777354	57773543	18269598
	8:00	2000	66.0	3974898	39748981	12569731
	9:00	2100	65.3	3387459	33874586	10712085
	10:00	2200	64.4	2782518	27825181	8799095
	pm 11:00	2300	61.9	1554429	15544294	4915537

Leq Morning Peak Hour 7:00-10:00 a.m.
69 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
68 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
61 dBA

Leq Daytime 7:00 am-10:00 p.m.
68 dBA

Leq 24-Hour
66 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
69 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
70 dBA

CNEL - Ldr 0.55886399

Calculated Ldn from long-term noise monitoring data LT-2 41st Avenue and Sloat Avenue

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/12/2019	Midnight	0 / 24	58.6	724389	7243893	2290720
	am 1:00	100	56.3	427744	4277441	1352646
	2:00	200	56.1	404480	4044800	1279078
	3:00	300	54.7	293903	2939030	929403
	4:00	400	57.6	573036	5730361	1812099
	5:00	500	62.6	1817712	18177117	5748109
	6:00	600	64.2	2616285	26162847	8273419
	7:00	700	68.3	6825713	68257126	21584799
	8:00	800	69.0	8009456	80094556	25328123
	9:00	900	67.7	5943195	59431953	18794034
	10:00	1000	66.3	4246205	42462054	13427681
	11:00	1100	67.6	5738706	57387063	18147383
	12:00	1200	67.7	5853761	58537612	18511218
	pm 1:00	1300	67.5	5646509	56465087	17855828
	2:00	1400	67.4	5433854	54338544	17183356
	3:00	1500	68.1	6436355	64363552	20353542
	4:00	1600	68.0	6326886	63268859	20007370
	5:00	1700	68.1	6479925	64799253	20491323
	6:00	1800	65.9	3921010	39210105	12399324
	7:00	1900	65.4	3481729	34817293	11010195
	8:00	2000	64.6	2884463	28844632	9121473
	9:00	2100	63.8	2424482	24244822	7666886
	10:00	2200	62.7	1849286	18492857	5847955
	pm 11:00	2300	61.2	1317195	13171948	4165336

Leq Morning Peak Hour 7:00-10:00 a.m.
68 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
67 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
60 dBA

Leq Daytime 7:00 am-10:00 p.m.
67 dBA

Leq 24-Hour
66 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
69 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
69 dBA

CNEL - Ldr 0.43622544

Calculated Ldn from long-term noise monitoring data LT-2 41st Avenue and Sloat Avenue

			TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/13/2019	Midnight		0 / 24	60.0	990540	9905400	3132362
	am	1:00	100	55.5	355549	3555494	1124346
		2:00	200	55.5	351374	3513743	1111143
		3:00	300	53.4	219944	2199439	695524
		4:00	400	55.6	362404	3624040	1146022
		5:00	500	61.1	1298656	12986556	4106710
		6:00	600	63.8	2405758	24057583	7607676
		7:00	700	67.3	5400401	54004009	17077567
		8:00	800	67.8	5983096	59830964	18920212
		9:00	900	66.9	4845873	48458727	15323995
		10:00	1000	66.4	4405224	44052240	13930542
		11:00	1100	66.0	3955269	39552688	12507658
		12:00	1200	67.7	5844885	58448854	18483151
	pm	1:00	1300	66.4	4346743	43467434	13745609
		2:00	1400	67.0	4958987	49589873	15681695
		3:00	1500	67.5	5619181	56191807	17769410
		4:00	1600	67.4	5489932	54899324	17360691
		5:00	1700	67.2	5204236	52042362	16457240
		6:00	1800	66.3	4225285	42252849	13361524
		7:00	1900	65.3	3374800	33747997	10672054
		8:00	2000	65.2	3308979	33089789	10463910
		9:00	2100	64.2	2611013	26110128	8256747
		10:00	2200	63.7	2353309	23533092	7441817
	pm	11:00	2300	62.8	1926469	19264689	6092030

Leq Morning Peak Hour 7:00-10:00 a.m.
67 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
67 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
61 dBA

Leq Daytime 7:00 am-10:00 p.m.
67 dBA

Leq 24-Hour
65 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
69 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
69 dBA

CNEL - Ldr 0.47937764

Calculated Ldn from long-term noise monitoring data LT-2 41st Avenue and Sloat Avenue

			TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/14/2019	Midnight		0 / 24	61.3	1339458	13394577	4235737
	am	1:00	100	60.0	994420	9944203	3144633
		2:00	200	58.1	649240	6492396	2053076
		3:00	300	56.1	408517	4085169	1291844
		4:00	400	56.1	403184	4031837	1274979
		5:00	500	57.7	589731	5897311	1864893
		6:00	600	59.2	826120	8261197	2612420
		7:00	700	62.8	1913604	19136037	6051346
		8:00	800	65.2	3341404	33414041	10566448
		9:00	900	66.5	4441994	44419943	14046819
		10:00	1000	67.0	4973899	49738994	15728851
		11:00	1100	67.3	5338890	53388903	16883054
		12:00	1200	67.0	5035168	50351684	15922601
	pm	1:00	1300	67.6	5707435	57074353	18048495
		2:00	1400	68.1	6481641	64816414	20496750
		3:00	1500	68.1	6435081	64350807	20349512
		4:00	1600	67.0	4984344	49843439	15761879
		5:00	1700	66.6	4562344	45623437	14427398
		6:00	1800	66.3	4259415	42594154	13469454
		7:00	1900	65.5	3516940	35169403	11121542
		8:00	2000	63.8	2405891	24058913	7608096
		9:00	2100	64.0	2510643	25106432	7939351
		10:00	2200	63.4	2186915	21869155	6915634
	pm	11:00	2300	62.9	1946184	19461845	6154376

Leq Morning Peak Hour 7:00-10:00 a.m.
65 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
66 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
60 dBA

Leq Daytime 7:00 am-10:00 p.m.
66 dBA

Leq 24-Hour
65 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
68 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
69 dBA

CNEL - Ldr 0.47056481

Calculated Ldn from long-term noise monitoring data LT-2 41st Avenue and Sloat Avenue

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/15/2019	Midnight	0 / 24	60.9	1243950	12439502	3933716
	am 1:00	100	59.1	818218	8182179	2587432
	2:00	200	58.3	677103	6771034	2141189
	3:00	300	55.6	364050	3640500	1151227
	4:00	400	54.7	296139	2961386	936472
	5:00	500	57.4	552803	5528025	1748115
	6:00	600	59.0	800357	8003575	2530953
	7:00	700	62.5	1779730	17797295	5627999
	8:00	800	64.9	3061547	30615475	9681463
	9:00	900	65.6	3601911	36019112	11390243
	10:00	1000	66.6	4522504	45225044	14301415
	11:00	1100	66.5	4440072	44400719	14040740
	12:00	1200	66.6	4543453	45434526	14367659
	pm 1:00	1300	67.1	5140176	51401761	16254664
	2:00	1400	67.0	5069452	50694518	16031014
	3:00	1500	68.9	7718253	77182528	24407258
	4:00	1600	67.0	4976064	49760645	15735698
	5:00	1700	67.1	5081302	50813019	16068488
	6:00	1800	65.0	3153029	31530293	9970754
	7:00	1900	68.5	7008531	70085310	22162921
	8:00	2000	63.5	2255122	22551218	7131321
	9:00	2100	62.6	1825114	18251140	5771517
	10:00	2200	61.5	1408277	14082767	4453362
	pm 11:00	2300	60.4	1094407	10944073	3460820

Leq Morning Peak Hour 7:00-10:00 a.m.
64 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
67 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
59 dBA

Leq Daytime 7:00 am-10:00 p.m.
66 dBA

Leq 24-Hour
65 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
68 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
68 dBA

CNEL - Ldr 0.70171291

Calculated Ldn from long-term noise monitoring data LT-3 Skyline Boulevard

			TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/10/2019	Midnight		0 / 24	61.7	1467601	14676010	4640962
	am	1:00	100	58.6	722633	7226333	2285167
		2:00	200	57.4	545058	5450584	1723626
		3:00	300	63.4	2189934	21899339	6925179
		4:00	400	58.4	699691	6996905	2212616
		5:00	500	65.3	3407274	34072735	10774745
		6:00	600	69.4	8624978	86249781	27274576
		7:00	700	74.7	29845716	298457159	94380441
		8:00	800	75.0	31730945	317309445	100342057
		9:00	900	73.5	22417801	224178005	70891310
		10:00	1000	72.3	16941583	169415835	53573991
		11:00	1100	72.3	16939165	169391651	53566343
		12:00	1200	72.4	17480909	174809085	55279486
	pm	1:00	1300	72.2	16667367	166673671	52706843
		2:00	1400	73.3	21142483	211424835	66858403
		3:00	1500	74.4	27693255	276932547	87573761
		4:00	1600	74.2	26463848	264638484	83686037
		5:00	1700	74.1	25633210	256332103	81059328
		6:00	1800	74.4	27605206	276052065	87295328
		7:00	1900	74.6	29097321	290973207	92013807
		8:00	2000	73.2	21119129	211191289	66784549
		9:00	2100	71.2	13213869	132138691	41785923
		10:00	2200	69.2	8404386	84043862	26577003
	pm	11:00	2300	66.1	4089084	40890837	12930818

Leq Morning Peak Hour 7:00-10:00 a.m.
74 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
74 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
65 dBA

Leq Daytime 7:00 am-10:00 p.m.
74 dBA

Leq 24-Hour
72 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
74 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
75 dBA

CNEL - Ldr 0.83673754

Calculated Ldn from long-term noise monitoring data LT-3 Skyline Boulevard

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/11/2019	Midnight	0 / 24	62.9	1968702	19687021	6225583
	am 1:00	100	60.2	1052805	10528051	3329262
	2:00	200	58.2	653382	6533818	2066175
	3:00	300	58.5	706555	7065550	2234323
	4:00	400	60.8	1200834	12008341	3797371
	5:00	500	67.8	5977616	59776158	18902881
	6:00	600	72.6	18281676	182816757	57811735
	7:00	700	77.5	56425316	564253160	178432516
	8:00	800	77.7	59371497	593714971	187749159
	9:00	900	76.4	43660530	436605297	138066718
	10:00	1000	75.3	34147271	341472709	107983152
	11:00	1100	74.9	31051244	310512437	98192654
	12:00	1200	76.2	42054357	420543573	132987555
	pm 1:00	1300	75.3	33717006	337170058	106622534
	2:00	1400	76.0	39860157	398601565	126048883
	3:00	1500	77.3	54063729	540637293	170964523
	4:00	1600	76.8	47389814	473898135	149859749
	5:00	1700	75.5	35703188	357031883	112903395
	6:00	1800	74.4	27779793	277797927	87847418
	7:00	1900	74.3	26821867	268218667	84818190
	8:00	2000	72.8	18993806	189938061	60063689
	9:00	2100	72.4	17398988	173989885	55020433
	10:00	2200	69.9	9712969	97129689	30715105
	pm 11:00	2300	67.5	5592912	55929122	17686341

Leq Morning Peak Hour 7:00-10:00 a.m.
77 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
75 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
67 dBA

Leq Daytime 7:00 am-10:00 p.m.
76 dBA

Leq 24-Hour
74 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
76 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
77 dBA

CNEL - Ldr 0.54620301

Calculated Ldn from long-term noise monitoring data LT-3 Skyline Boulevard

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/12/2019	Midnight	0 / 24	62.4	1728339	17283393	5465489
	am 1:00	100	62.0	1575676	15756763	4982726
	2:00	200	61.9	1550187	15501867	4902121
	3:00	300	62.4	1731171	17311711	5474444
	4:00	400	61.0	1257112	12571121	3975337
	5:00	500	67.7	5913696	59136961	18700749
	6:00	600	71.8	15175150	151751503	47988039
	7:00	700	77.1	50901549	509015492	160964832
	8:00	800	76.9	48913529	489135293	154678161
	9:00	900	74.8	30215445	302154454	95549628
	10:00	1000	73.7	23538729	235387285	74435995
	11:00	1100	74.6	28643560	286435604	90578891
	12:00	1200	75.0	31329034	313290337	99071103
	pm 1:00	1300	74.9	30605325	306053253	96782536
	2:00	1400	76.1	40410944	404109444	127790627
	3:00	1500	76.3	42193544	421935435	133427700
	4:00	1600	75.8	38327986	383279861	121203734
	5:00	1700	75.0	31302714	313027145	98987875
	6:00	1800	74.2	26110429	261104286	82568425
	7:00	1900	72.4	17562446	175624459	55537330
	8:00	2000	71.2	13236221	132362207	41856605
	9:00	2100	70.7	11679278	116792781	36933120
	10:00	2200	69.5	8945940	89459404	28289547
	pm 11:00	2300	67.6	5781733	57817326	18283444

Leq Morning Peak Hour 7:00-10:00 a.m.
76 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
75 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
67 dBA

Leq Daytime 7:00 am-10:00 p.m.
75 dBA

Leq 24-Hour
73 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
76 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
76 dBA

CNEL - Ldr 0.42133469

Calculated Ldn from long-term noise monitoring data LT-3 Skyline Boulevard

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/13/2019	Midnight	0 / 24	64.5	2816839	28168388	8907627
	am 1:00	100	62.2	1678193	16781934	5306913
	2:00	200	60.4	1087129	10871288	3437803
	3:00	300	59.5	895550	8955503	2831979
	4:00	400	61.6	1454491	14544909	4599504
	5:00	500	67.1	5073924	50739245	16045158
	6:00	600	70.6	11428625	114286255	36140487
	7:00	700	75.8	37958059	379580593	120033923
	8:00	800	76.2	41409692	414096920	130948944
	9:00	900	74.4	27345634	273456342	86474488
	10:00	1000	73.4	21737320	217373201	68739442
	11:00	1100	73.8	23998881	239988814	75891127
	12:00	1200	73.8	23941535	239415355	75709783
	pm 1:00	1300	73.6	22932162	229321619	72517863
	2:00	1400	74.5	28019282	280192819	88604749
	3:00	1500	75.4	34979371	349793713	110614485
	4:00	1600	75.2	33336807	333368069	105420240
	5:00	1700	74.7	29334926	293349262	92765182
	6:00	1800	73.7	23679689	236796893	74881753
	7:00	1900	72.6	18020216	180202163	56984927
	8:00	2000	72.5	17827276	178272765	56374798
	9:00	2100	71.6	14404295	144042948	45550380
	10:00	2200	70.1	10299758	102997575	32570693
	pm 11:00	2300	68.0	6303779	63037793	19934300

Leq Morning Peak Hour 7:00-10:00 a.m.
76 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
74 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
67 dBA

Leq Daytime 7:00 am-10:00 p.m.
74 dBA

Leq 24-Hour
73 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
75 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
76 dBA

CNEL - Ldr 0.5471291

Calculated Ldn from long-term noise monitoring data LT-3 Skyline Boulevard

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/14/2019	Midnight	0 / 24	66.5	4458810	44588103	14099996
	am 1:00	100	64.6	2876928	28769280	9097645
	2:00	200	62.8	1926176	19261761	6091104
	3:00	300	60.4	1109144	11091442	3507422
	4:00	400	61.0	1249870	12498704	3952437
	5:00	500	63.1	2050463	20504633	6484134
	6:00	600	67.3	5399008	53990084	17073164
	7:00	700	71.6	14501636	145016360	45858200
	8:00	800	73.4	22055454	220554539	69745469
	9:00	900	73.4	22124069	221240688	69962448
	10:00	1000	73.9	24513030	245130302	77517008
	11:00	1100	74.0	24864286	248642864	78627777
	12:00	1200	74.3	27045312	270453123	85524787
	pm 1:00	1300	73.6	22895704	228957039	72402573
	2:00	1400	74.3	27012825	270128247	85422052
	3:00	1500	74.2	26565439	265654392	84007295
	4:00	1600	73.8	23782253	237822533	75206088
	5:00	1700	73.0	19731132	197311319	62395318
	6:00	1800	74.3	27099857	270998570	85697273
	7:00	1900	72.0	16003243	160032430	50606698
	8:00	2000	69.3	8604785	86047845	27210718
	9:00	2100	70.4	10891984	108919841	34443478
	10:00	2200	69.3	8567202	85672019	27091871
	pm 11:00	2300	68.5	7107028	71070276	22474395

Leq Morning Peak Hour 7:00-10:00 a.m.
73 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
73 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
66 dBA

Leq Daytime 7:00 am-10:00 p.m.
73 dBA

Leq 24-Hour
72 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
74 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
75 dBA

CNEL - Ldr 0.47433003

Calculated Ldn from long-term noise monitoring data LT-3 Skyline Boulevard

		TIME	dBA	Remove LOG	10 dBA Penalized Values	5 dBA Penalized Values
12/15/2019	Midnight	0 / 24	65.9	3874637	38746368	12252677
	am 1:00	100	65.7	3684555	36845546	11651585
	2:00	200	60.7	1161580	11615797	3673237
	3:00	300	60.3	1066793	10667926	3373494
	4:00	400	59.0	800903	8009031	2532678
	5:00	500	59.5	900067	9000673	2846263
	6:00	600	64.9	3113988	31139885	9847296
	7:00	700	69.6	9171724	91717245	29003539
	8:00	800	71.3	13350391	133503915	42217645
	9:00	900	72.0	15726751	157267506	49732352
	10:00	1000	72.3	17177185	171771853	54319029
	11:00	1100	73.0	20042043	200420435	63378506
	12:00	1200	73.4	21990697	219906973	69540691
	pm 1:00	1300	74.3	27005424	270054240	85398649
	2:00	1400	72.8	18945802	189458023	59911887
	3:00	1500	74.2	26216699	262166985	82904480
	4:00	1600	72.6	18254334	182543343	57725274
	5:00	1700	71.9	15618273	156182726	49389315
	6:00	1800	70.3	10651211	106512113	33682088
	7:00	1900	69.4	8623171	86231710	27268861
	8:00	2000	68.4	6843858	68438582	21642180
	9:00	2100	68.3	6705065	67050651	21203278
	10:00	2200	66.2	4187376	41873764	13241647
	pm 11:00	2300	63.3	2141465	21414651	6771907

Leq Morning Peak Hour 7:00-10:00 a.m.
71 dBA

Leq Evening Peak Hour 4:00-8:00 p.m.
71 dBA

Leq Nighttime 10:00 pm-7:00 a.m. (not penalized)
64 dBA

Leq Daytime 7:00 am-10:00 p.m.
72 dBA

Leq 24-Hour
70 dBA

Ldn: 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
73 dBA

CNEL: 5 dBA penalty for noise between 7:00p.m. and 10:00 p.m., and 10 dBA penalty for noise between 10:00 p.m. and 7:00 a.m.
73 dBA

CNEL - Ldr 0.44375698

Summary	
File Name on Meter	LxT_Data.024
File Name on PC	SLM_0004337_LxT_Data_024.00.ldbin
Serial Number	0004337
Model	SoundTrack LxT®
Firmware Version	2.302
User	PDZ
Location	LT-1
Job Description	120468.23
Note	

Measurement	
Description	
Start	2019-12-09 13:00:00
Stop	2019-12-16 13:00:00
Duration	168:00:00.0
Run Time	168:00:00.0
Pause	00:00:00.0
Pre Calibration	2019-12-09 11:35:07
Post Calibration	None
Calibration Deviation	---

Overall Settings				
RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT2B			
Microphone Correction	Off			
Integration Method	Exponential			
Overload	143.0 dB			
	A	**C**	**Z**	
Under Range Peak	99.2	96.2	**101.2**	dB
Under Range Limit	**48.2**	46.2	54.2	dB
Noise Floor	35.1	35.7	43.3	dB

Results		
LASeq	65.3	
LASE	123.1	
EAS	228.616 mPa²h	
EAS8	10.886 mPa²h	
EAS40	54.432 mPa²h	
LZSpeak (max)	2019-12-14 19:05:47	123.6 dB
LASmax	2019-12-15 09:58:21	98.3 dB
LASmin	2019-12-10 04:40:13	41.4 dB
SEA	144.0 dB	
LAS > 85.0 dB (Exceedance Counts / Duration)	165	809.7 s
LAS > 115.0 dB (Exceedance Counts / Duration)	0	0.0 s
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0 s
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0 s
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0 s
LCSeq	76.1 dB	
LASeq	65.3 dB	
LCSeq - LASeq	10.7 dB	
LAIeq	67.4 dB	
LAeq	65.3 dB	
LAIeq - LAeq	2.1 dB	

	A		C		Z	
	dB	**Time Stamp**	**dB**	**Time Stamp**	**dB**	**Time Stamp**
Leq	65.3					
LS(max)	98.3	2019/12/15 9:58:21				
LS(min)	41.4	2019/12/10 4:40:13				
LPeak(max)					123.6	2019/12/14 19:05:47

Record #	Record Type	Date	Time	LASeq	LZpeak	LASmax	LASmin	OVLD	Marker
1	Calibration Change	2019-12-09	11:35:07						
2	Run	2019-12-09	13:00:00						
3		2019-12-09	13:00:00	65.1	107.3	86.3	48.7	No	
4		2019-12-09	14:00:00	65.2	105.4	87.9	50.6	No	
5		2019-12-09	15:00:00	67.4	110.7	89.8	50.5	No	
6		2019-12-09	16:00:00	64.7	104.5	84.9	50.2	No	
7		2019-12-09	17:00:00	64.0	111.4	86.6	47.7	No	
8		2019-12-09	18:00:00	64.4	113.0	92.7	50.7	No	
9		2019-12-09	19:00:00	61.7	105.6	81.0	53.0	No	
10		2019-12-09	20:00:00	62.1	115.2	87.8	51.0	No	
11		2019-12-09	21:00:00	58.9	103.1	77.8	45.7	No	
12		2019-12-09	22:00:00	60.7	115.2	89.1	42.9	No	
13		2019-12-09	23:00:00	57.9	106.0	78.0	42.6	No	
14		2019-12-10	0:00:00	53.3	95.1	75.2	42.1	No	
15		2019-12-10	1:00:00	53.8	101.9	79.7	44.1	No	
16		2019-12-10	2:00:00	51.9	98.3	72.0	47.2	No	
17		2019-12-10	3:00:00	49.9	94.0	69.8	43.8	No	
18		2019-12-10	4:00:00	51.5	96.8	68.5	41.4	No	
19		2019-12-10	5:00:00	59.8	100.7	79.6	46.0	No	
20		2019-12-10	6:00:00	61.8	103.2	83.5	46.1	No	
21		2019-12-10	7:00:00	65.7	108.9	92.0	50.1	No	
22		2019-12-10	8:00:00	66.1	105.2	84.7	53.2	No	
23		2019-12-10	9:00:00	65.0	104.1	83.1	49.9	No	
24		2019-12-10	10:00:00	65.2	109.7	89.5	50.6	No	
25		2019-12-10	11:00:00	65.3	109.1	83.0	48.9	No	
26		2019-12-10	12:00:00	68.3	109.6	92.9	44.9	No	
27		2019-12-10	13:00:00	65.0	103.9	88.0	51.0	No	
28		2019-12-10	14:00:00	64.0	103.5	82.6	49.2	No	
29		2019-12-10	15:00:00	64.7	112.3	86.4	50.2	No	
30		2019-12-10	16:00:00	68.8	105.9	84.3	51.6	No	
31		2019-12-10	17:00:00	63.4	105.7	79.8	48.6	No	
32		2019-12-10	18:00:00	65.7	109.2	84.9	51.8	No	
33		2019-12-10	19:00:00	66.3	112.7	89.2	47.5	No	
34		2019-12-10	20:00:00	64.2	107.5	77.6	47.3	No	
35		2019-12-10	21:00:00	62.6	98.0	77.4	46.7	No	
36		2019-12-10	22:00:00	60.9	102.3	85.9	44.7	No	
37		2019-12-10	23:00:00	59.2	113.5	87.9	42.8	No	
38		2019-12-11	0:00:00	52.7	94.4	74.3	42.4	No	
39		2019-12-11	1:00:00	53.5	101.0	74.3	43.7	No	
40		2019-12-11	2:00:00	53.2	101.8	80.1	45.6	No	
41		2019-12-11	3:00:00	56.5	104.1	85.0	45.9	No	
42		2019-12-11	4:00:00	53.9	91.3	70.8	44.0	No	
43		2019-12-11	5:00:00	63.0	107.1	88.4	45.1	No	
44		2019-12-11	6:00:00	65.5	109.5	83.6	48.5	No	
45		2019-12-11	7:00:00	73.2	109.1	85.0	54.4	No	
46		2019-12-11	8:00:00	68.6	110.4	89.5	56.4	No	
47		2019-12-11	9:00:00	68.6	106.3	90.4	53.2	No	
48		2019-12-11	10:00:00	67.1	109.1	82.3	53.0	No	
49		2019-12-11	11:00:00	65.5	104.4	82.1	52.8	No	
50		2019-12-11	12:00:00	67.9	109.3	87.2	49.8	No	
51		2019-12-11	13:00:00	65.1	105.0	81.4	49.2	No	
52		2019-12-11	14:00:00	68.4	111.2	91.6	50.0	No	
53		2019-12-11	15:00:00	80.6	112.0	91.4	54.7	No	
54		2019-12-11	16:00:00	66.6	109.3	86.6	51.4	No	
55		2019-12-11	17:00:00	65.9	106.7	85.5	52.3	No	
56		2019-12-11	18:00:00	64.3	101.9	85.4	51.4	No	
57		2019-12-11	19:00:00	65.9	116.3	87.3	50.2	No	
58		2019-12-11	20:00:00	64.9	109.3	83.3	50.1	No	
59		2019-12-11	21:00:00	63.6	101.4	78.4	48.5	No	
60		2019-12-11	22:00:00	63.3	110.8	84.8	50.5	No	
61		2019-12-11	23:00:00	61.8	116.1	86.9	53.1	No	
62		2019-12-12	0:00:00	60.0	110.2	83.3	54.7	No	
63		2019-12-12	1:00:00	58.8	111.9	71.3	54.7	No	

64	2019-12-12	2:00:00	59.3	109.5	81.7	55.1	No
65	2019-12-12	3:00:00	58.3	104.1	68.8	54.5	No
66	2019-12-12	4:00:00	59.9	100.7	74.3	55.2	No
67	2019-12-12	5:00:00	67.4	105.7	87.6	54.8	No
68	2019-12-12	6:00:00	67.5	104.2	85.6	55.0	No
69	2019-12-12	7:00:00	67.1	105.1	85.6	57.8	No
70	2019-12-12	8:00:00	65.8	103.1	80.6	55.8	No
71	2019-12-12	9:00:00	65.4	100.7	82.9	57.8	No
72	2019-12-12	10:00:00	73.7	111.3	92.1	56.9	No
73	2019-12-12	11:00:00	66.6	104.2	81.9	57.9	No
74	2019-12-12	12:00:00	66.8	107.6	82.4	57.2	No
75	2019-12-12	13:00:00	66.5	104.6	84.9	55.5	No
76	2019-12-12	14:00:00	68.7	115.8	97.3	54.8	No
77	2019-12-12	15:00:00	65.5	104.0	81.3	55.4	No
78	2019-12-12	16:00:00	68.2	114.4	92.2	51.9	No
79	2019-12-12	17:00:00	64.0	108.1	83.7	52.5	No
80	2019-12-12	18:00:00	62.8	103.3	76.2	50.9	No
81	2019-12-12	19:00:00	62.4	105.5	77.1	51.9	No
82	2019-12-12	20:00:00	64.8	111.1	86.3	49.6	No
83	2019-12-12	21:00:00	62.8	104.9	82.5	49.4	No
84	2019-12-12	22:00:00	62.8	107.7	83.9	53.4	No
85	2019-12-12	23:00:00	59.0	103.9	75.2	51.3	No
86	2019-12-13	0:00:00	58.9	102.0	81.4	51.3	No
87	2019-12-13	1:00:00	55.5	100.2	77.0	48.0	No
88	2019-12-13	2:00:00	52.6	95.8	74.0	46.4	No
89	2019-12-13	3:00:00	52.9	94.5	68.3	47.1	No
90	2019-12-13	4:00:00	54.1	96.5	72.3	49.1	No
91	2019-12-13	5:00:00	61.4	103.0	85.3	48.4	No
92	2019-12-13	6:00:00	61.2	104.8	80.0	49.0	No
93	2019-12-13	7:00:00	64.1	102.2	80.9	49.4	No
94	2019-12-13	8:00:00	63.7	103.1	85.7	51.0	No
95	2019-12-13	9:00:00	63.5	104.9	80.5	51.8	No
96	2019-12-13	10:00:00	63.9	110.0	82.0	53.6	No
97	2019-12-13	11:00:00	63.2	107.1	81.3	51.6	No
98	2019-12-13	12:00:00	63.4	107.6	82.8	49.0	No
99	2019-12-13	13:00:00	63.7	110.8	82.8	50.9	No
100	2019-12-13	14:00:00	63.5	108.3	84.0	50.8	No
101	2019-12-13	15:00:00	65.4	114.0	86.3	50.3	No
102	2019-12-13	16:00:00	64.8	109.1	82.4	49.7	No
103	2019-12-13	17:00:00	63.4	108.2	81.0	50.7	No
104	2019-12-13	18:00:00	62.7	107.1	77.0	50.5	No
105	2019-12-13	19:00:00	65.4	113.7	87.7	55.4	No
106	2019-12-13	20:00:00	64.4	105.9	80.3	57.5	No
107	2019-12-13	21:00:00	64.1	104.8	77.3	57.5	No
108	2019-12-13	22:00:00	64.5	110.6	84.1	59.4	No
109	2019-12-13	23:00:00	63.2	110.0	75.7	59.2	No
110	2019-12-14	0:00:00	62.4	114.6	76.3	58.1	No
111	2019-12-14	1:00:00	61.3	115.6	78.4	57.6	No
112	2019-12-14	2:00:00	61.0	117.7	83.6	57.2	No
113	2019-12-14	3:00:00	59.9	113.5	75.8	56.6	No
114	2019-12-14	4:00:00	59.8	114.1	78.2	56.5	No
115	2019-12-14	5:00:00	61.9	112.7	88.9	56.4	No
116	2019-12-14	6:00:00	60.3	109.1	73.3	56.3	No
117	2019-12-14	7:00:00	63.8	118.1	83.9	57.3	No
118	2019-12-14	8:00:00	64.4	118.8	80.9	58.8	No
119	2019-12-14	9:00:00	67.7	116.9	97.3	58.5	No
120	2019-12-14	10:00:00	66.3	120.4	87.6	59.6	No
121	2019-12-14	11:00:00	65.8	120.9	81.1	60.1	No
122	2019-12-14	12:00:00	69.7	121.0	91.0	60.9	No
123	2019-12-14	13:00:00	66.3	119.7	82.9	60.0	No
124	2019-12-14	14:00:00	66.1	115.9	89.6	58.5	No
125	2019-12-14	15:00:00	64.9	115.9	80.5	57.9	No
126	2019-12-14	16:00:00	65.1	112.3	80.7	57.8	No
127	2019-12-14	17:00:00	64.9	114.8	77.4	56.9	No

128		2019-12-14	18:00:00	65.8	118.9	83.9	57.6	No
129		2019-12-14	19:00:00	65.2	123.6	91.3	55.9	No
130		2019-12-14	20:00:00	63.5	108.7	89.2	54.1	No
131		2019-12-14	21:00:00	63.0	111.6	81.9	56.0	No
132		2019-12-14	22:00:00	62.2	118.0	75.4	56.1	No
133		2019-12-14	23:00:00	63.0	117.8	83.9	57.6	No
134		2019-12-15	0:00:00	61.4	112.6	75.4	56.9	No
135		2019-12-15	1:00:00	61.8	115.1	87.3	57.3	No
136		2019-12-15	2:00:00	59.1	110.2	70.9	55.2	No
137		2019-12-15	3:00:00	57.2	103.2	73.8	53.3	No
138		2019-12-15	4:00:00	56.5	104.9	79.1	52.6	No
139		2019-12-15	5:00:00	57.1	105.2	82.2	48.4	No
140		2019-12-15	6:00:00	57.7	103.7	77.5	49.2	No
141		2019-12-15	7:00:00	61.0	110.6	82.7	52.8	No
142		2019-12-15	8:00:00	62.1	107.8	83.8	54.3	No
143		2019-12-15	9:00:00	67.6	117.8	98.3	56.5	No
144		2019-12-15	10:00:00	64.5	111.4	85.1	56.5	No
145		2019-12-15	11:00:00	63.9	110.1	78.6	56.2	No
146		2019-12-15	12:00:00	65.0	118.7	83.0	56.8	No
147		2019-12-15	13:00:00	65.3	118.5	83.7	59.1	No
148		2019-12-15	14:00:00	65.4	119.2	83.4	58.7	No
149		2019-12-15	15:00:00	66.5	121.2	86.7	59.4	No
150		2019-12-15	16:00:00	63.9	114.7	76.1	55.4	No
151		2019-12-15	17:00:00	65.4	109.5	84.9	56.4	No
152		2019-12-15	18:00:00	62.4	111.2	77.0	54.3	No
153		2019-12-15	19:00:00	62.0	108.0	83.5	52.4	No
154		2019-12-15	20:00:00	60.4	107.4	77.0	49.2	No
155		2019-12-15	21:00:00	60.7	108.7	85.3	49.8	No
156		2019-12-15	22:00:00	58.7	98.0	72.7	53.0	No
157		2019-12-15	23:00:00	57.6	95.0	72.4	52.2	No
158		2019-12-16	0:00:00	59.3	98.9	82.6	53.1	No
159		2019-12-16	1:00:00	57.6	100.0	78.1	51.4	No
160		2019-12-16	2:00:00	56.2	96.3	69.7	50.8	No
161		2019-12-16	3:00:00	58.5	100.5	79.4	51.6	No
162		2019-12-16	4:00:00	65.1	113.2	94.4	51.4	No
163		2019-12-16	5:00:00	58.8	99.9	77.9	50.1	No
164		2019-12-16	6:00:00	65.2	115.1	90.9	50.5	No
165		2019-12-16	7:00:00	67.6	113.5	93.7	50.2	No
166		2019-12-16	8:00:00	62.7	103.4	81.3	48.7	No
167		2019-12-16	9:00:00	62.3	102.3	82.9	47.8	No
168		2019-12-16	10:00:00	62.8	99.8	85.2	47.3	No
169		2019-12-16	11:00:00	66.3	111.9	90.8	45.4	No
170		2019-12-16	12:00:00	62.3	104.2	82.2	46.6	No
171	Stop	2019-12-16	13:00:00					

Summary	
File Name on Meter	LxT_Data.063
File Name on PC	SLM_0004437_LxT_Data_063.00.ldbin
Serial Number	0004437
Model	SoundTrack LxT®
Firmware Version	2.302
User	PDZ
Location	LT-2
Job Description	120468.23
Note	

Measurement	
Description	
Start	2019-12-09 13:00:00
Stop	2019-12-16 13:00:00
Duration	168:00:00.0
Run Time	168:00:00.0
Pause	00:00:00.0
Pre Calibration	2019-12-09 11:34:42
Post Calibration	None
Calibration Deviation	---

Overall Settings				
RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT2B			
Microphone Correction	Off			
Integration Method	Exponential			
Overload	142.3 dB			
	A	**C**	**Z**	
Under Range Peak	98.6	95.6	**100.6**	dB
Under Range Limit	**47.6**	45.6	53.6	dB
Noise Floor	34.4	35.1	42.7	dB

Results			
LASeq	65.4		
LASE	123.2		
EAS	232.973 mPa²h		
EAS8	11.094 mPa²h		
EAS40	55.470 mPa²h		
LZSpeak (max)	2019-12-14 15:03:14	118.6	dB
LASmax	2019-12-14 15:03:14	94.9	dB
LASmin	2019-12-10 03:26:35	33.1	dB
SEA	-99.9 dB		
LAS > 85.0 dB (Exceedance Counts / Duration)	49	130.1	s
LAS > 115.0 dB (Exceedance Counts / Duration)	0	0.0	s
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0	s
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0	s
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0	s
LCSeq	71.1 dB		
LASeq	65.4 dB		
LCSeq - LASeq	5.7 dB		
LAIeq	67.1 dB		
LAeq	65.4 dB		
LAIeq - LAeq	1.7 dB		

	A		C		Z	
	dB	**Time Stamp**	**dB**	**Time Stamp**	**dB**	**Time Stamp**
Leq	65.4					
LS(max)	94.9	2019/12/14 15:03:14				
LS(min)	33.1	2019/12/10 3:26:35				
LPeak(max)					118.6	2019/12/14 15:03:14

Record #	Record Type	Date	Time	LASeq	LZpeak	LASmax	LASmin	OVLD	Marker
1	Calibration Change	2019-12-09	11:34:42						
2	Run	2019-12-09	13:00:00						
3		2019-12-09	13:00:00	65.8	99.3	78.2	45.2	No	
4		2019-12-09	14:00:00	67.0	105.5	85.2	44.6	No	
5		2019-12-09	15:00:00	67.4	102.5	82.7	45.9	No	
6		2019-12-09	16:00:00	67.8	103.9	82.6	50.7	No	
7		2019-12-09	17:00:00	67.5	104.6	84.9	50.8	No	
8		2019-12-09	18:00:00	66.3	102.2	80.4	47.8	No	
9		2019-12-09	19:00:00	65.6	110.9	89.4	49.3	No	
10		2019-12-09	20:00:00	64.4	100.1	78.3	48.0	No	
11		2019-12-09	21:00:00	63.1	97.7	74.9	37.8	No	
12		2019-12-09	22:00:00	61.8	94.9	73.5	37.8	No	
13		2019-12-09	23:00:00	59.9	101.3	73.7	38.3	No	
14		2019-12-10	0:00:00	58.5	102.8	77.4	36.3	No	
15		2019-12-10	1:00:00	54.1	91.3	72.6	35.5	No	
16		2019-12-10	2:00:00	53.1	92.6	73.9	34.9	No	
17		2019-12-10	3:00:00	53.8	99.4	75.5	33.1	No	
18		2019-12-10	4:00:00	56.0	102.8	77.1	33.4	No	
19		2019-12-10	5:00:00	60.8	100.1	76.0	37.3	No	
20		2019-12-10	6:00:00	63.7	103.8	85.1	41.4	No	
21		2019-12-10	7:00:00	69.5	109.2	91.2	46.0	No	
22		2019-12-10	8:00:00	68.8	106.2	86.6	52.3	No	
23		2019-12-10	9:00:00	66.5	102.2	75.4	46.0	No	
24		2019-12-10	10:00:00	68.3	108.4	89.5	45.3	No	
25		2019-12-10	11:00:00	67.2	109.4	87.4	45.7	No	
26		2019-12-10	12:00:00	67.3	104.0	81.9	44.9	No	
27		2019-12-10	13:00:00	66.6	106.9	87.1	45.5	No	
28		2019-12-10	14:00:00	67.5	107.7	89.3	42.7	No	
29		2019-12-10	15:00:00	67.6	104.8	80.5	50.2	No	
30		2019-12-10	16:00:00	68.0	104.7	84.1	49.3	No	
31		2019-12-10	17:00:00	67.4	108.8	86.7	52.3	No	
32		2019-12-10	18:00:00	67.6	102.2	84.1	52.0	No	
33		2019-12-10	19:00:00	68.0	101.3	79.4	51.2	No	
34		2019-12-10	20:00:00	67.4	107.5	80.4	51.5	No	
35		2019-12-10	21:00:00	65.5	96.4	77.0	42.2	No	
36		2019-12-10	22:00:00	62.7	98.5	74.9	37.6	No	
37		2019-12-10	23:00:00	60.5	93.7	75.7	38.1	No	
38		2019-12-11	0:00:00	58.9	95.9	75.0	37.2	No	
39		2019-12-11	1:00:00	55.3	104.5	72.8	37.2	No	
40		2019-12-11	2:00:00	55.2	95.2	75.8	36.3	No	
41		2019-12-11	3:00:00	53.9	98.4	74.5	36.6	No	
42		2019-12-11	4:00:00	56.8	100.2	77.1	38.1	No	
43		2019-12-11	5:00:00	62.2	100.2	83.4	41.6	No	
44		2019-12-11	6:00:00	65.4	99.4	77.8	48.3	No	
45		2019-12-11	7:00:00	69.6	107.7	84.2	51.6	No	
46		2019-12-11	8:00:00	69.6	105.3	80.8	56.3	No	
47		2019-12-11	9:00:00	68.7	112.7	90.2	53.2	No	
48		2019-12-11	10:00:00	67.2	105.9	89.0	49.5	No	
49		2019-12-11	11:00:00	66.7	99.8	78.6	49.8	No	
50		2019-12-11	12:00:00	68.5	101.5	83.9	51.9	No	
51		2019-12-11	13:00:00	67.1	101.8	80.4	49.8	No	
52		2019-12-11	14:00:00	67.4	103.1	86.3	48.8	No	
53		2019-12-11	15:00:00	68.4	102.4	85.8	52.3	No	
54		2019-12-11	16:00:00	68.1	104.6	85.8	52.8	No	
55		2019-12-11	17:00:00	67.6	98.4	79.5	52.4	No	
56		2019-12-11	18:00:00	66.8	102.4	81.1	52.0	No	
57		2019-12-11	19:00:00	67.6	106.4	85.0	53.0	No	
58		2019-12-11	20:00:00	66.0	100.2	76.5	51.0	No	
59		2019-12-11	21:00:00	65.3	98.5	78.3	48.9	No	
60		2019-12-11	22:00:00	64.4	96.9	76.2	49.2	No	
61		2019-12-11	23:00:00	61.9	104.2	77.4	48.6	No	
62		2019-12-12	0:00:00	58.6	105.1	73.3	47.8	No	
63		2019-12-12	1:00:00	56.3	113.7	73.0	45.3	No	

64	2019-12-12	2:00:00	56.1	113.3	71.9	46.1	No
65	2019-12-12	3:00:00	54.7	99.7	74.1	44.1	No
66	2019-12-12	4:00:00	57.6	97.2	80.4	48.0	No
67	2019-12-12	5:00:00	62.6	100.4	84.0	49.3	No
68	2019-12-12	6:00:00	64.2	107.2	76.0	49.8	No
69	2019-12-12	7:00:00	68.3	104.6	79.2	52.3	No
70	2019-12-12	8:00:00	69.0	106.2	80.5	53.7	No
71	2019-12-12	9:00:00	67.7	102.1	86.5	51.5	No
72	2019-12-12	10:00:00	66.3	104.9	80.4	51.6	No
73	2019-12-12	11:00:00	67.6	102.9	86.8	52.2	No
74	2019-12-12	12:00:00	67.7	104.6	86.0	52.1	No
75	2019-12-12	13:00:00	67.5	106.5	86.8	49.8	No
76	2019-12-12	14:00:00	67.4	102.2	77.8	50.9	No
77	2019-12-12	15:00:00	68.1	101.9	89.6	51.2	No
78	2019-12-12	16:00:00	68.0	102.8	82.9	53.8	No
79	2019-12-12	17:00:00	68.1	110.4	91.6	52.3	No
80	2019-12-12	18:00:00	65.9	99.0	77.7	50.1	No
81	2019-12-12	19:00:00	65.4	101.3	77.2	49.5	No
82	2019-12-12	20:00:00	64.6	100.4	78.8	48.0	No
83	2019-12-12	21:00:00	63.8	98.3	76.8	41.7	No
84	2019-12-12	22:00:00	62.7	101.4	80.7	41.9	No
85	2019-12-12	23:00:00	61.2	104.3	78.1	40.3	No
86	2019-12-13	0:00:00	60.0	98.7	79.4	38.8	No
87	2019-12-13	1:00:00	55.5	92.2	73.4	35.9	No
88	2019-12-13	2:00:00	55.5	96.5	75.3	34.2	No
89	2019-12-13	3:00:00	53.4	97.9	73.8	34.2	No
90	2019-12-13	4:00:00	55.6	97.6	74.5	37.4	No
91	2019-12-13	5:00:00	61.1	101.2	78.4	39.4	No
92	2019-12-13	6:00:00	63.8	101.1	86.5	40.2	No
93	2019-12-13	7:00:00	67.3	106.1	79.9	43.8	No
94	2019-12-13	8:00:00	67.8	99.9	79.5	49.4	No
95	2019-12-13	9:00:00	66.9	104.9	83.9	50.2	No
96	2019-12-13	10:00:00	66.4	109.6	88.0	50.3	No
97	2019-12-13	11:00:00	66.0	105.7	81.6	46.8	No
98	2019-12-13	12:00:00	67.7	110.6	91.9	44.4	No
99	2019-12-13	13:00:00	66.4	102.1	81.2	47.3	No
100	2019-12-13	14:00:00	67.0	105.0	86.4	49.4	No
101	2019-12-13	15:00:00	67.5	105.2	78.0	50.4	No
102	2019-12-13	16:00:00	67.4	104.7	81.6	50.9	No
103	2019-12-13	17:00:00	67.2	102.8	83.5	52.0	No
104	2019-12-13	18:00:00	66.3	106.3	85.9	51.1	No
105	2019-12-13	19:00:00	65.3	103.3	79.2	52.5	No
106	2019-12-13	20:00:00	65.2	105.2	80.4	52.8	No
107	2019-12-13	21:00:00	64.2	99.9	77.2	50.2	No
108	2019-12-13	22:00:00	63.7	102.1	77.8	51.1	No
109	2019-12-13	23:00:00	62.8	107.0	74.1	49.2	No
110	2019-12-14	0:00:00	61.3	105.6	80.3	47.8	No
111	2019-12-14	1:00:00	60.0	108.0	78.8	47.0	No
112	2019-12-14	2:00:00	58.1	104.8	78.1	46.6	No
113	2019-12-14	3:00:00	56.1	106.3	76.3	46.9	No
114	2019-12-14	4:00:00	56.1	106.7	77.2	46.1	No
115	2019-12-14	5:00:00	57.7	103.9	76.8	45.9	No
116	2019-12-14	6:00:00	59.2	105.1	73.9	45.4	No
117	2019-12-14	7:00:00	62.8	105.0	75.4	47.1	No
118	2019-12-14	8:00:00	65.2	115.3	83.6	49.4	No
119	2019-12-14	9:00:00	66.5	111.4	80.2	51.0	No
120	2019-12-14	10:00:00	67.0	113.1	81.7	52.1	No
121	2019-12-14	11:00:00	67.3	113.6	88.6	51.0	No
122	2019-12-14	12:00:00	67.0	114.0	86.8	52.6	No
123	2019-12-14	13:00:00	67.6	115.0	89.6	52.4	No
124	2019-12-14	14:00:00	68.1	115.1	91.8	51.8	No
125	2019-12-14	15:00:00	68.1	118.6	94.9	51.7	No
126	2019-12-14	16:00:00	67.0	106.8	81.0	52.0	No
127	2019-12-14	17:00:00	66.6	114.8	88.4	52.1	No

128		2019-12-14	18:00:00	66.3	110.8	86.5	50.8	No
129		2019-12-14	19:00:00	65.5	117.7	83.3	50.0	No
130		2019-12-14	20:00:00	63.8	100.9	74.3	48.9	No
131		2019-12-14	21:00:00	64.0	106.3	79.0	48.0	No
132		2019-12-14	22:00:00	63.4	111.4	75.1	47.0	No
133		2019-12-14	23:00:00	62.9	115.0	85.5	46.9	No
134		2019-12-15	0:00:00	60.9	110.2	75.4	46.8	No
135		2019-12-15	1:00:00	59.1	106.9	74.3	46.7	No
136		2019-12-15	2:00:00	58.3	110.4	84.9	43.1	No
137		2019-12-15	3:00:00	55.6	96.4	73.1	42.3	No
138		2019-12-15	4:00:00	54.7	99.2	78.0	41.5	No
139		2019-12-15	5:00:00	57.4	98.9	73.4	41.6	No
140		2019-12-15	6:00:00	59.0	95.8	75.1	43.2	No
141		2019-12-15	7:00:00	62.5	101.1	82.2	45.7	No
142		2019-12-15	8:00:00	64.9	111.1	90.6	45.1	No
143		2019-12-15	9:00:00	65.6	103.6	78.6	47.4	No
144		2019-12-15	10:00:00	66.6	102.5	83.0	47.6	No
145		2019-12-15	11:00:00	66.5	102.8	77.4	48.1	No
146		2019-12-15	12:00:00	66.6	107.0	85.5	48.3	No
147		2019-12-15	13:00:00	67.1	111.3	82.8	51.0	No
148		2019-12-15	14:00:00	67.0	116.5	84.5	51.3	No
149		2019-12-15	15:00:00	68.9	114.6	92.8	50.7	No
150		2019-12-15	16:00:00	67.0	111.0	80.8	50.6	No
151		2019-12-15	17:00:00	67.1	110.8	87.2	49.4	No
152		2019-12-15	18:00:00	65.0	105.3	83.1	48.1	No
153		2019-12-15	19:00:00	68.5	117.8	93.3	47.1	No
154		2019-12-15	20:00:00	63.5	100.1	77.0	47.4	No
155		2019-12-15	21:00:00	62.6	98.0	78.9	47.5	No
156		2019-12-15	22:00:00	61.5	97.9	74.1	43.8	No
157		2019-12-15	23:00:00	60.4	103.0	79.7	43.0	No
158		2019-12-16	0:00:00	57.8	96.7	74.8	44.2	No
159		2019-12-16	1:00:00	56.1	95.7	74.1	40.1	No
160		2019-12-16	2:00:00	54.1	95.9	72.6	39.0	No
161		2019-12-16	3:00:00	57.5	101.0	80.9	39.1	No
162		2019-12-16	4:00:00	58.0	100.9	76.2	48.7	No
163		2019-12-16	5:00:00	60.6	100.6	74.9	42.7	No
164		2019-12-16	6:00:00	63.7	104.0	82.2	45.0	No
165		2019-12-16	7:00:00	67.1	103.0	81.6	47.6	No
166		2019-12-16	8:00:00	67.9	106.2	82.4	47.7	No
167		2019-12-16	9:00:00	66.9	107.6	87.6	44.7	No
168		2019-12-16	10:00:00	65.7	99.3	77.0	44.9	No
169		2019-12-16	11:00:00	65.9	104.2	83.6	43.7	No
170		2019-12-16	12:00:00	65.7	109.6	76.1	44.5	No
171	Stop	2019-12-16	13:00:00					

Summary				
File Name on Meter	LxT_Data.047			
File Name on PC	SLM_0004435_LxT_Data_047.00.ldbin			
Serial Number	0004435			
Model	SoundTrack LxT®			
Firmware Version	2.302			
User	PDZ			
Location	LT-3			
Job Description	120468.23			
Note				

Measurement				
Description				
Start	2019-12-09 13:00:00			
Stop	2019-12-16 13:00:00			
Duration	168:00:00.0			
Run Time	168:00:00.0			
Pause	00:00:00.0			
Pre Calibration	2019-12-09 11:08:49			
Post Calibration	None			
Calibration Deviation	---			

Overall Settings				
RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT2B			
Microphone Correction	Off			
Integration Method	Linear			
Overload	142.8 dB			
	A	**C**	**Z**	
Under Range Peak	99.0	96.0	**101.0**	dB
Under Range Limit	**48.0**	46.0	54.0	dB
Noise Floor	34.9	35.5	43.1	dB

Results			
LAeq	72.2		
LAE	130.1		
EA	1.127 Pa²h		
EA8	53.688 mPa²h		
EA40	268.440 mPa²h		
LZpeak (max)	2019-12-14 12:44:41	121.9	dB
LASmax	2019-12-15 15:13:42	102.1	dB
LASmin	2019-12-10 04:05:01	33.5	dB
SEA	137.1 dB		
LAS > 85.0 dB (Exceedance Counts / Duration)	128	322.5	s
LAS > 115.0 dB (Exceedance Counts / Duration)	0	0.0	s
LZpeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0	s
LZpeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0	s
LZpeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0	s
LCeq	74.2 dB		
LAeq	72.2 dB		
LCeq - LAeq	1.9 dB		
LAIeq	73.5 dB		
LAeq	72.2 dB		
LAIeq - LAeq	1.3 dB		

Record #	Record Type	Date	Time	LAeq	LZpeak	LASmax	LASmin	OVLD	Marker
1	Calibration Change	2019-12-09	11:07:24						
2	Calibration Change	2019-12-09	11:08:49						
3	Run	2019-12-09	13:00:00						
4		2019-12-09	13:00:00	72.6	120.4	89.1	50.7	No	
5		2019-12-09	14:00:00	73.4	103.1	83.7	52.6	No	
6		2019-12-09	15:00:00	75.1	117.3	98.8	50.6	No	
7		2019-12-09	16:00:00	74.6	112.3	87.9	52.9	No	
8		2019-12-09	17:00:00	73.8	105.0	88.9	49.2	No	
9		2019-12-09	18:00:00	72.6	104.2	84.3	44.3	No	
10		2019-12-09	19:00:00	70.2	100.3	81.5	46.8	No	
11		2019-12-09	20:00:00	68.8	102.2	81.3	39.2	No	
12		2019-12-09	21:00:00	67.7	102.1	81.1	38.1	No	
13		2019-12-09	22:00:00	65.6	99.6	79.7	39.9	No	
14		2019-12-09	23:00:00	64.0	107.4	84.2	39.6	No	
15		2019-12-10	0:00:00	61.7	98.6	80.7	37.3	No	
16		2019-12-10	1:00:00	58.6	98.5	78.3	34.1	No	
17		2019-12-10	2:00:00	57.4	97.3	79.4	34.2	No	
18		2019-12-10	3:00:00	63.4	102.9	88.3	34.0	No	
19		2019-12-10	4:00:00	58.4	98.8	77.7	33.5	No	
20		2019-12-10	5:00:00	65.3	97.9	79.9	38.9	No	
21		2019-12-10	6:00:00	69.4	105.0	81.7	44.4	No	
22		2019-12-10	7:00:00	74.7	106.8	85.7	49.5	No	
23		2019-12-10	8:00:00	75.0	106.3	85.2	51.5	No	
24		2019-12-10	9:00:00	73.5	107.6	85.0	46.8	No	
25		2019-12-10	10:00:00	72.3	105.6	84.3	50.0	No	
26		2019-12-10	11:00:00	72.3	105.4	84.6	50.4	No	
27		2019-12-10	12:00:00	72.4	109.5	88.8	49.7	No	
28		2019-12-10	13:00:00	72.2	106.3	84.4	51.0	No	
29		2019-12-10	14:00:00	73.3	103.2	87.4	51.4	No	
30		2019-12-10	15:00:00	74.4	110.8	86.3	51.0	No	
31		2019-12-10	16:00:00	74.2	104.7	82.7	52.5	No	
32		2019-12-10	17:00:00	74.1	105.3	86.8	55.2	No	
33		2019-12-10	18:00:00	74.4	112.0	94.1	55.5	No	
34		2019-12-10	19:00:00	74.6	101.2	84.5	50.9	No	
35		2019-12-10	20:00:00	73.2	103.5	85.8	50.4	No	
36		2019-12-10	21:00:00	71.2	100.9	84.2	43.3	No	
37		2019-12-10	22:00:00	69.2	110.1	86.2	38.5	No	
38		2019-12-10	23:00:00	66.1	101.2	82.1	39.4	No	
39		2019-12-11	0:00:00	62.9	98.9	79.9	38.6	No	
40		2019-12-11	1:00:00	60.2	98.2	81.0	37.9	No	
41		2019-12-11	2:00:00	58.2	98.4	79.8	36.6	No	
42		2019-12-11	3:00:00	58.5	98.3	79.5	36.4	No	
43		2019-12-11	4:00:00	60.8	95.9	79.7	38.5	No	
44		2019-12-11	5:00:00	67.8	100.5	82.2	41.5	No	
45		2019-12-11	6:00:00	72.6	103.4	85.5	48.9	No	
46		2019-12-11	7:00:00	77.5	106.2	85.9	57.8	No	
47		2019-12-11	8:00:00	77.7	105.7	85.7	59.6	No	
48		2019-12-11	9:00:00	76.4	107.4	87.2	54.8	No	
49		2019-12-11	10:00:00	75.3	104.8	87.4	54.2	No	
50		2019-12-11	11:00:00	74.9	107.9	88.5	55.1	No	
51		2019-12-11	12:00:00	76.2	109.9	89.1	54.1	No	
52		2019-12-11	13:00:00	75.3	107.3	86.4	53.9	No	
53		2019-12-11	14:00:00	76.0	108.8	85.6	53.7	No	
54		2019-12-11	15:00:00	77.3	104.9	85.4	57.3	No	
55		2019-12-11	16:00:00	76.8	104.4	86.7	53.3	No	
56		2019-12-11	17:00:00	75.5	103.6	85.4	57.3	No	
57		2019-12-11	18:00:00	74.4	103.4	83.6	55.8	No	
58		2019-12-11	19:00:00	74.3	100.9	85.0	54.4	No	
59		2019-12-11	20:00:00	72.8	99.7	83.9	48.7	No	
60		2019-12-11	21:00:00	72.4	109.7	84.6	51.9	No	
61		2019-12-11	22:00:00	69.9	111.5	87.6	48.0	No	
62		2019-12-11	23:00:00	67.5	104.4	81.1	45.5	No	
63		2019-12-12	0:00:00	62.4	96.8	80.4	43.9	No	

64	2019-12-12	1:00:00	62.0	95.3	78.4	43.0	No
65	2019-12-12	2:00:00	61.9	103.3	83.9	43.6	No
66	2019-12-12	3:00:00	62.4	104.4	87.0	42.3	No
67	2019-12-12	4:00:00	61.0	111.5	81.8	45.0	No
68	2019-12-12	5:00:00	67.7	112.0	80.8	46.2	No
69	2019-12-12	6:00:00	71.8	100.8	84.0	46.3	No
70	2019-12-12	7:00:00	77.1	108.7	86.3	51.5	No
71	2019-12-12	8:00:00	76.9	108.9	89.3	57.8	No
72	2019-12-12	9:00:00	74.8	107.4	87.5	55.1	No
73	2019-12-12	10:00:00	73.7	108.1	86.4	55.6	No
74	2019-12-12	11:00:00	74.6	104.8	86.8	54.0	No
75	2019-12-12	12:00:00	75.0	108.6	85.3	55.3	No
76	2019-12-12	13:00:00	74.9	106.4	88.3	55.3	No
77	2019-12-12	14:00:00	76.1	106.1	86.3	55.9	No
78	2019-12-12	15:00:00	76.3	104.4	89.3	57.2	No
79	2019-12-12	16:00:00	75.8	106.6	85.2	53.8	No
80	2019-12-12	17:00:00	75.0	103.5	82.8	53.9	No
81	2019-12-12	18:00:00	74.2	100.3	83.2	52.8	No
82	2019-12-12	19:00:00	72.4	107.9	82.6	47.9	No
83	2019-12-12	20:00:00	71.2	101.9	82.7	42.0	No
84	2019-12-12	21:00:00	70.7	102.4	83.7	42.1	No
85	2019-12-12	22:00:00	69.5	100.2	83.0	41.7	No
86	2019-12-12	23:00:00	67.6	98.6	82.6	40.1	No
87	2019-12-13	0:00:00	64.5	96.4	80.0	37.5	No
88	2019-12-13	1:00:00	62.2	100.4	85.6	36.9	No
89	2019-12-13	2:00:00	60.4	101.3	81.0	35.6	No
90	2019-12-13	3:00:00	59.5	100.4	82.4	34.6	No
91	2019-12-13	4:00:00	61.6	96.4	81.0	35.3	No
92	2019-12-13	5:00:00	67.1	104.9	87.5	36.2	No
93	2019-12-13	6:00:00	70.6	100.8	82.4	42.2	No
94	2019-12-13	7:00:00	75.8	105.9	87.6	51.5	No
95	2019-12-13	8:00:00	76.2	109.8	92.8	51.9	No
96	2019-12-13	9:00:00	74.4	107.1	87.1	49.5	No
97	2019-12-13	10:00:00	73.4	105.5	84.6	49.5	No
98	2019-12-13	11:00:00	73.8	112.4	90.2	53.0	No
99	2019-12-13	12:00:00	73.8	108.3	90.0	51.0	No
100	2019-12-13	13:00:00	73.6	105.1	83.8	54.0	No
101	2019-12-13	14:00:00	74.5	107.0	86.3	53.0	No
102	2019-12-13	15:00:00	75.4	101.8	83.6	55.0	No
103	2019-12-13	16:00:00	75.2	106.6	88.2	51.9	No
104	2019-12-13	17:00:00	74.7	105.5	82.6	55.3	No
105	2019-12-13	18:00:00	73.7	104.2	84.0	53.0	No
106	2019-12-13	19:00:00	72.6	106.3	85.3	53.2	No
107	2019-12-13	20:00:00	72.5	103.8	84.7	51.6	No
108	2019-12-13	21:00:00	71.6	103.8	83.8	50.7	No
109	2019-12-13	22:00:00	70.1	103.2	82.0	47.5	No
110	2019-12-13	23:00:00	68.0	100.9	81.0	45.6	No
111	2019-12-14	0:00:00	66.5	105.0	84.1	44.8	No
112	2019-12-14	1:00:00	64.6	105.3	84.1	43.6	No
113	2019-12-14	2:00:00	62.8	102.2	81.6	44.3	No
114	2019-12-14	3:00:00	60.4	103.3	80.0	42.7	No
115	2019-12-14	4:00:00	61.0	98.9	79.0	41.7	No
116	2019-12-14	5:00:00	63.1	104.7	84.4	42.3	No
117	2019-12-14	6:00:00	67.3	99.8	82.5	41.7	No
118	2019-12-14	7:00:00	71.6	106.6	84.1	47.8	No
119	2019-12-14	8:00:00	73.4	115.5	91.3	48.7	No
120	2019-12-14	9:00:00	73.4	103.8	84.5	46.3	No
121	2019-12-14	10:00:00	73.9	112.2	84.7	53.1	No
122	2019-12-14	11:00:00	74.0	107.9	85.0	51.3	No
123	2019-12-14	12:00:00	74.3	121.9	99.5	51.2	No
124	2019-12-14	13:00:00	73.6	112.8	87.6	52.3	No
125	2019-12-14	14:00:00	74.3	116.6	93.2	52.9	No
126	2019-12-14	15:00:00	74.2	112.5	93.4	49.0	No
127	2019-12-14	16:00:00	73.8	105.0	84.7	56.1	No

128		2019-12-14	17:00:00	73.0	108.9	86.7	49.9	No
129		2019-12-14	18:00:00	74.3	105.6	83.5	54.3	No
130		2019-12-14	19:00:00	72.0	105.9	81.8	48.4	No
131		2019-12-14	20:00:00	69.3	101.4	81.9	45.3	No
132		2019-12-14	21:00:00	70.4	103.9	84.0	47.3	No
133		2019-12-14	22:00:00	69.3	108.6	85.5	45.1	No
134		2019-12-14	23:00:00	68.5	103.0	84.6	46.6	No
135		2019-12-15	0:00:00	65.9	111.1	89.7	43.1	No
136		2019-12-15	1:00:00	65.7	101.5	86.5	42.0	No
137		2019-12-15	2:00:00	60.7	98.8	80.0	39.1	No
138		2019-12-15	3:00:00	60.3	97.1	80.4	38.0	No
139		2019-12-15	4:00:00	59.0	94.1	76.8	38.5	No
140		2019-12-15	5:00:00	59.5	98.9	79.6	37.7	No
141		2019-12-15	6:00:00	64.9	103.0	80.0	38.8	No
142		2019-12-15	7:00:00	69.6	116.1	94.4	43.2	No
143		2019-12-15	8:00:00	71.3	102.6	83.5	43.3	No
144		2019-12-15	9:00:00	72.0	108.3	89.2	48.9	No
145		2019-12-15	10:00:00	72.3	105.1	84.5	48.3	No
146		2019-12-15	11:00:00	73.0	104.1	83.8	49.2	No
147		2019-12-15	12:00:00	73.4	109.7	86.4	50.1	No
148		2019-12-15	13:00:00	74.3	117.2	99.0	51.2	No
149		2019-12-15	14:00:00	72.8	106.6	82.2	51.6	No
150		2019-12-15	15:00:00	74.2	113.0	102.1	50.0	No
151		2019-12-15	16:00:00	72.6	106.3	82.9	51.1	No
152		2019-12-15	17:00:00	71.9	109.8	91.5	46.7	No
153		2019-12-15	18:00:00	70.3	103.4	81.1	45.8	No
154		2019-12-15	19:00:00	69.4	113.0	90.1	44.2	No
155		2019-12-15	20:00:00	68.4	105.0	84.6	44.4	No
156		2019-12-15	21:00:00	68.3	100.6	81.7	44.7	No
157		2019-12-15	22:00:00	66.2	102.6	81.5	43.4	No
158		2019-12-15	23:00:00	63.3	96.6	79.0	40.7	No
159		2019-12-16	0:00:00	62.1	107.8	85.0	40.8	No
160		2019-12-16	1:00:00	59.8	98.7	82.6	37.3	No
161		2019-12-16	2:00:00	55.0	96.9	75.2	35.9	No
162		2019-12-16	3:00:00	58.0	98.1	80.4	36.6	No
163		2019-12-16	4:00:00	59.1	94.2	79.3	37.3	No
164		2019-12-16	5:00:00	64.7	97.0	80.1	42.4	No
165		2019-12-16	6:00:00	68.4	106.7	81.5	47.5	No
166		2019-12-16	7:00:00	74.5	102.8	84.8	53.1	No
167		2019-12-16	8:00:00	74.3	108.6	87.3	54.1	No
168		2019-12-16	9:00:00	72.6	103.0	85.1	49.6	No
169		2019-12-16	10:00:00	71.4	108.6	90.4	48.2	No
170		2019-12-16	11:00:00	71.0	105.1	84.0	47.8	No
171		2019-12-16	12:00:00	71.2	111.2	88.7	49.6	No
172	Stop	2019-12-16	13:00:00					

Summary

File Name on Meter	LxT_Data.023
File Name on PC	SLM_0004337_LxT_Data_023.00.ldbin
Serial Number	0004337
Model	SoundTrack LxT®
Firmware Version	2.302
User	PDZ
Location	ST-1
Job Description	D120468.23
Note	Daytime - active construction

Measurement

Description	
Start	2019-12-05 13:03:59
Stop	2019-12-05 13:25:00
Duration	00:21:01.8
Run Time	00:21:01.8
Pause	00:00:00.0
Pre Calibration	2019-12-05 10:37:03
Post Calibration	None
Calibration Deviation	---

Overall Settings

RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT2B			
Microphone Correction	Off			
Integration Method	Exponential			
Overload	142.9 dB			
	A	**C**	**Z**	
Under Range Peak	99.2	96.2	**101.2**	dB
Under Range Limit	**48.2**	46.2	54.2	dB
Noise Floor	35.1	35.7	43.3	dB

Results

LASeq	63.9		
LASE	94.9		
EAS	342.557 µPa²h		
EAS8	7.819 mPa²h		
EAS40	39.094 mPa²h		
LZSpeak (max)	2019-12-05 13:20:06	100.8	dB
LASmax	2019-12-05 13:15:47	75.9	dB
LASmin	2019-12-05 13:15:01	52.9	dB
SEA	-99.9 dB		
LAS > 85.0 dB (Exceedance Counts / Duration)	0	0.0	s
LAS > 115.0 dB (Exceedance Counts / Duration)	0	0.0	s
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0	s
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0	s
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0	s
LCSeq	78.5 dB		
LASeq	63.9 dB		
LCSeq - LASeq	14.6 dB		
LAIeq	65.2 dB		
LAeq	63.9 dB		
LAIeq - LAeq	1.4 dB		

Record #	Record Type	Date	Time	LASeq	LZpeak	LASmax	LASmin	OVLD	Marker
1	Run	2019-12-05	13:03:58						
2		2019-12-05	13:03:59	63.4	95.6	71.8	56.0	No	
3		2019-12-05	13:04:59	60.7	90.7	65.9	55.2	No	
4		2019-12-05	13:05:59	61.9	90.5	68.2	54.4	No	
5		2019-12-05	13:06:59	66.4	93.5	70.1	60.9	No	
6		2019-12-05	13:07:59	63.8	94.5	67.8	58.9	No	
7		2019-12-05	13:08:59	66.0	96.0	68.6	62.4	No	
8		2019-12-05	13:09:59	67.3	98.9	70.2	61.2	No	
9		2019-12-05	13:10:59	65.7	100.7	73.7	59.6	No	
10		2019-12-05	13:11:59	60.1	93.9	64.3	56.5	No	
11		2019-12-05	13:12:59	62.9	94.4	67.0	56.1	No	
12		2019-12-05	13:13:59	62.3	93.9	67.1	55.3	No	
13		2019-12-05	13:14:59	67.4	96.3	75.9	52.9	No	
14		2019-12-05	13:15:59	61.5	93.6	67.6	55.3	No	
15		2019-12-05	13:16:59	61.8	92.6	65.5	54.2	No	
16		2019-12-05	13:17:59	62.2	94.4	65.7	54.8	No	
17		2019-12-05	13:18:59	63.5	92.6	68.4	54.8	No	
18		2019-12-05	13:19:59	65.6	100.8	75.3	58.8	No	
19		2019-12-05	13:20:59	61.6	91.9	64.4	57.0	No	
20		2019-12-05	13:21:59	59.6	90.2	65.6	55.3	No	
21		2019-12-05	13:22:59	62.0	92.1	66.9	56.6	No	
22		2019-12-05	13:23:59	63.1	93.6	68.1	56.1	No	
23		2019-12-05	13:24:59	56.5	87.5	57.2	56.1	No	
24	Stop	2019-12-05	13:25:00						

Summary

File Name on Meter	LxT_Data.022	
File Name on PC	SLM_0004337_LxT_Data_022.00.ldbin	
Serial Number	0004337	
Model	SoundTrack LxT®	
Firmware Version	2.302	
User	PDZ	
Location	ST-2	
Job Description	D120468.23	
Note	Daytime	

Measurement

Description		
Start	2019-12-05 11:41:16	
Stop	2019-12-05 12:02:18	
Duration	00:21:01.5	
Run Time	00:21:01.5	
Pause	00:00:00.0	
Pre Calibration	2019-12-05 10:37:03	
Post Calibration	None	
Calibration Deviation	---	

Overall Settings

RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT2B			
Microphone Correction	Off			
Integration Method	Exponential			
Overload	142.9 dB			
	A	**C**	**Z**	
Under Range Peak	99.2	96.2	**101.2**	dB
Under Range Limit	**48.2**	46.2	54.2	dB
Noise Floor	35.1	35.7	43.3	dB

Results

LASeq	69.8	
LASE	100.9	
EAS	1.352 mPa²h	
EAS8	30.870 mPa²h	
EAS40	154.352 mPa²h	
LZSpeak (max)	2019-12-05 12:01:36	97.2 dB
LASmax	2019-12-05 11:54:28	78.7 dB
LASmin	2019-12-05 11:55:47	51.0 dB
SEA	-99.9 dB	
LAS > 85.0 dB (Exceedance Counts / Duration)	0	0.0 s
LAS > 115.0 dB (Exceedance Counts / Duration)	0	0.0 s
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0 s
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0 s
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0 s
LCSeq	73.1 dB	
LASeq	69.8 dB	
LCSeq - LASeq	3.2 dB	
LAIeq	71.1 dB	
LAeq	69.8 dB	
LAIeq - LAeq	1.3 dB	

Record #	Record Type	Date	Time	LASeq	LZpeak	LASmax	LASmin	OVLD	Marker
1	Run	2019-12-05	11:41:16						
2		2019-12-05	11:41:16	67.7	90.1	75.5	52.6	No	
3		2019-12-05	11:42:16	69.1	93.4	76.5	57.9	No	
4		2019-12-05	11:43:16	67.9	91.8	76.0	53.5	No	
5		2019-12-05	11:44:16	70.0	96.0	76.0	56.2	No	
6		2019-12-05	11:45:16	70.7	94.2	75.6	62.2	No	
7		2019-12-05	11:46:16	65.3	91.7	74.6	52.2	No	
8		2019-12-05	11:47:16	70.9	93.6	75.5	55.8	No	
9		2019-12-05	11:48:16	69.7	97.0	76.4	57.6	No	
10		2019-12-05	11:49:16	69.8	93.1	76.8	59.4	No	
11		2019-12-05	11:50:16	65.8	91.5	74.6	55.2	No	
12		2019-12-05	11:51:16	69.2	91.6	74.5	57.2	No	
13		2019-12-05	11:52:16	69.3	92.7	76.3	57.4	No	
14		2019-12-05	11:53:16	71.9	92.6	76.6	59.2	No	
15		2019-12-05	11:54:16	70.5	96.1	78.7	60.7	No	
16		2019-12-05	11:55:16	69.5	95.0	76.4	51.0	No	
17		2019-12-05	11:56:16	70.6	94.1	77.6	53.0	No	
18		2019-12-05	11:57:16	71.7	95.9	78.6	63.4	No	
19		2019-12-05	11:58:16	63.8	90.9	73.5	53.1	No	
20		2019-12-05	11:59:16	70.9	94.4	75.8	55.1	No	
21		2019-12-05	12:00:16	69.9	96.2	74.7	60.9	No	
22		2019-12-05	12:01:16	72.8	97.2	77.7	60.9	No	
23		2019-12-05	12:02:16	63.7	83.8	67.0	61.0	No	
24	Stop	2019-12-05	12:02:18						

Summary

File Name on Meter	LxT_Data.019		
File Name on PC	SLM_0004337_LxT_Data_019.00.ldbin		
Serial Number	0004337		
Model	SoundTrack LxT®		
Firmware Version	2.302		
User	PDZ		
Location	ST-3		
Job Description	D120468.23		
Note	Daytime		

Measurement

Description			
Start	2019-12-05 10:40:06		
Stop	2019-12-05 11:01:08		
Duration	00:21:02.1		
Run Time	00:21:02.1		
Pause	00:00:00.0		
Pre Calibration	2019-12-05 10:37:05		
Post Calibration	None		
Calibration Deviation	---		

Overall Settings

RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT2B			
Microphone Correction	Off			
Integration Method	Exponential			
Overload	142.9 dB			
	A	**C**	**Z**	
Under Range Peak	99.2	96.2	**101.2**	dB
Under Range Limit	**48.2**	46.2	54.2	dB
Noise Floor	35.1	35.7	43.3	dB

Results

LASeq	59.1		
LASE	90.1		
EAS	112.852 µPa²h		
EAS8	2.575 mPa²h		
EAS40	12.876 mPa²h		
LZSpeak (max)	2019-12-05 10:51:13	104.9	dB
LASmax	2019-12-05 10:50:28	74.2	dB
LASmin	2019-12-05 10:58:27	46.2	dB
SEA	-99.9 dB		
LAS > 85.0 dB (Exceedance Counts / Duration)	0	0.0	s
LAS > 115.0 dB (Exceedance Counts / Duration)	0	0.0	s
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0	s
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0	s
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0	s
LCSeq	66.4 dB		
LASeq	59.1 dB		
LCSeq - LASeq	7.4 dB		
LAIeq	61.7 dB		
LAeq	59.1 dB		
LAIeq - LAeq	2.6 dB		

Record #	Record Type	Date	Time	LASeq	LZpeak	LASmax	LASmin	OVLD	Marker
1	alibration Chang	2019-12-05	10:37:05						
2	Run	2019-12-05	10:40:06						
3		2019-12-05	10:40:06	53.2	85.6	61.2	46.6	No	
4		2019-12-05	10:41:06	53.6	85.2	63.4	46.5	No	
5		2019-12-05	10:42:06	58.2	89.7	68.4	49.6	No	
6		2019-12-05	10:43:06	57.4	95.9	67.1	50.8	No	
7		2019-12-05	10:44:06	57.5	87.0	68.3	49.8	No	
8		2019-12-05	10:45:06	60.3	89.0	67.3	49.1	No	
9		2019-12-05	10:46:06	61.7	91.7	72.9	46.6	No	
10		2019-12-05	10:47:06	55.7	82.5	67.8	48.2	No	
11		2019-12-05	10:48:06	60.5	92.2	73.2	48.5	No	
12		2019-12-05	10:49:06	52.7	82.4	56.8	48.3	No	
13		2019-12-05	10:50:06	62.0	99.0	74.2	51.5	No	
14		2019-12-05	10:51:06	59.8	104.9	72.0	50.5	No	
15		2019-12-05	10:52:06	58.8	91.5	70.0	46.4	No	
16		2019-12-05	10:53:06	63.1	99.2	74.1	48.5	No	
17		2019-12-05	10:54:06	55.1	90.6	63.5	49.6	No	
18		2019-12-05	10:55:06	58.6	87.0	69.2	49.5	No	
19		2019-12-05	10:56:06	58.9	89.1	70.3	46.9	No	
20		2019-12-05	10:57:06	60.6	89.9	73.1	47.4	No	
21		2019-12-05	10:58:06	57.3	89.7	68.5	46.2	No	
22		2019-12-05	10:59:06	61.2	91.1	71.7	50.0	No	
23		2019-12-05	11:00:06	55.8	92.7	65.5	48.9	No	
24		2019-12-05	11:01:06	52.7	77.6	52.9	52.4	No	
25	Stop	2019-12-05	11:01:08						

Summary

File Name on Meter	LxT_Data.020		
File Name on PC	SLM_0004337_LxT_Data_020.00.ldbin		
Serial Number	0004337		
Model	SoundTrack LxT®		
Firmware Version	2.302		
User	PDZ		
Location	ST-4		
Job Description	D120468.23		
Note	Daytime		

Measurement

Description			
Start	2019-12-05 11:05:17		
Stop	2019-12-05 11:26:20		
Duration	00:21:02.6		
Run Time	00:21:02.6		
Pause	00:00:00.0		
Pre Calibration	2019-12-05 10:37:03		
Post Calibration	None		
Calibration Deviation	---		

Overall Settings

RMS Weight	A Weighting			
Peak Weight	Z Weighting			
Detector	Slow			
Preamp	PRMLxT2B			
Microphone Correction	Off			
Integration Method	Exponential			
Overload	142.9 dB			
	A	**C**	**Z**	
Under Range Peak	99.2	96.2	**101.2**	dB
Under Range Limit	**48.2**	46.2	54.2	dB
Noise Floor	35.1	35.7	43.3	dB

Results

LASeq	58.7	
LASE	89.7	
EAS	104.401 µPa²h	
EAS8	2.381 mPa²h	
EAS40	11.907 mPa²h	
LZSpeak (max)	2019-12-05 11:11:08	98.3 dB
LASmax	2019-12-05 11:11:08	75.8 dB
LASmin	2019-12-05 11:20:51	54.4 dB
SEA	-99.9 dB	
LAS > 85.0 dB (Exceedance Counts / Duration)	0	0.0 s
LAS > 115.0 dB (Exceedance Counts / Duration)	0	0.0 s
LZSpeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0 s
LZSpeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0 s
LZSpeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0 s
LCSeq	66.7 dB	
LASeq	58.7 dB	
LCSeq - LASeq	7.9 dB	
LAIeq	59.9 dB	
LAeq	58.7 dB	
LAIeq - LAeq	1.2 dB	

Record #	Record Type	Date	Time	LASeq	LZpeak	LASmax	LASmin	OVLD	Marker
1	Run	2019-12-05	11:05:17						
2		2019-12-05	11:05:17	58.9	88.4	66.4	55.1	No	
3		2019-12-05	11:06:17	57.2	86.8	60.5	54.9	No	
4		2019-12-05	11:07:17	58.7	87.2	63.9	56.5	No	
5		2019-12-05	11:08:17	56.5	82.9	58.4	55.1	No	
6		2019-12-05	11:09:17	57.2	87.2	58.8	55.4	No	
7		2019-12-05	11:10:17	63.2	98.3	75.8	56.4	No	
8		2019-12-05	11:11:17	56.2	80.3	58.6	55.1	No	
9		2019-12-05	11:12:17	61.3	91.9	73.2	56.2	No	
10		2019-12-05	11:13:17	60.5	87.8	69.4	55.2	No	
11		2019-12-05	11:14:17	60.2	96.9	71.4	55.0	No	
12		2019-12-05	11:15:17	58.9	94.1	66.4	55.1	No	
13		2019-12-05	11:16:17	57.1	84.1	59.4	55.5	No	
14		2019-12-05	11:17:17	57.2	84.0	63.8	55.1	No	
15		2019-12-05	11:18:17	60.1	87.6	69.5	55.9	No	
16		2019-12-05	11:19:17	57.8	80.1	61.2	55.0	No	
17		2019-12-05	11:20:17	56.6	85.0	59.3	54.4	No	
18		2019-12-05	11:21:17	56.6	80.7	58.5	54.8	No	
19		2019-12-05	11:22:17	56.4	82.4	59.0	54.7	No	
20		2019-12-05	11:23:17	57.0	81.1	59.7	55.1	No	
21		2019-12-05	11:24:17	59.4	83.9	64.0	55.3	No	
22		2019-12-05	11:25:17	56.6	84.2	58.5	55.0	No	
23		2019-12-05	11:26:17	57.2	81.4	57.5	56.9	No	
24	Stop	2019-12-05	11:26:20						

APPENDIX F
BIOLOGICAL RESOURCES SUPPORTING INFORMATION

F1 SPECIAL-STATUS AND OTHER SENSITIVE SPECIES DESCRIPTIONS, TABLES, AND FIGURES

APPENDIX F1
SPECIAL-STATUS AND OTHER SENSITIVE SPECIES DESCRIPTIONS, TABLES, AND FIGURES

Tables F-1, **F-2**, **F-3**, **and F-4**, below, list the full results of California Native Plant Society, California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, National Marine Fisheries Service queries for special-status and other sensitive plants and animals in the project area, including those not expected or which have low potential to occur in the project area. Tables 4.6-1 and 4.6-2 in EIR Section 4.6, Biological Resources, include only those special-status species with moderate or higher potential, or which are known to be present in the study area. Following the tables, this appendix presents summaries of the special-status plants and animals present or with moderate or high potential to occur, and other sensitive species and resources of note within the project terrestrial and marine study areas. **Figure F-1**, Special-Status Plant and Animal Species Occurrences within 5 miles of the Project Study Areas, located at the end of the appendix, depicts California Natural Diversity Database occurrence records for species within 5 miles of the project study areas.

- Table F-1: Special-Status or Otherwise Protected Plant Species that May Occur in the Terrestrial Study Area
- Table F-2: Special-Status or Otherwise Protected Animal Species that May Occur in the Terrestrial Study Area
- Table F-3: Special-Status Fish and Marine Mammal Species that may Occur in the Pacific Ocean Waters of the Study Area
- Table F-4: Managed Fish Species Known to Occur in the Marine Study Area under the Magnuson-Stevens Act
- Figure F-1: Special Status Plant and Animal Species Occurrences within 5 miles of the Project Site and the Marine Study Area

F.1 Special-Status and Other Sensitive Species Potential to Occur Tables

The four tables that follow indicate the likelihood of occurrence of each identified species based on a review of the biological literature of the region, information presented in previous environmental documentation, and an evaluation of the habitat conditions within the study areas. A species was designated to have "no potential" to occur if (1) its specific habitat requirements (e.g., serpentine grasslands, as opposed to grasslands occurring on other soils) are not present; or (2) it is presumed to be extirpated from the area or region based on the best scientific information available. A species was designated as having a "low" potential for occurrence if (1) its known current distribution or range is outside of the study area; or (2) only limited or marginally suitable habitat is present within the study area. A species was designated as having a "moderate" potential for occurrence if (1) there is low to moderate quality habitat present within the study area or immediately adjacent areas; and (2) the study area is within the known range of the species, even though the species was not observed during biological surveys. A species was designated as having a "high" potential for occurrence if (1) moderate to high quality habitat is present within the study area; and (2) the study area is within the known range of the species.

Lists of special-status and other sensitive plant and animal species assessed for their potential to occur within the study area for terrestrial biological resources were compiled based on data contained in the California Department of Fish and Wildlife Natural Diversity Database[1] and the California Native Plant Society Inventory of Rare and Endangered Plants[2], U.S. Fish and Wildlife Service Official Species List and CalIPaC Trust Report,[3] and the list of locally significant plants for San Francisco County.[4] Marine special-status species were compiled from the U.S. Fish and Wildlife Service, National Marine Fisheries Service, and the California Department of Fish and Wildlife listings, Federal Register notifications, and assorted published and non-published literature relevant to the marine study area. Several additional species were identified based on the findings of technical reports and environmental literature.

Table F-1 Special-Status and Other Sensitive Plant Species that may occur in the Terrestrial Study Area

Common Name *Scientific Name*	Federal Status	State Status	CRPR Rank	Habitat Description/ Blooming Period	Potential to Occur in the Study Area
PLANT SPECIES LISTED OR PROPOSED FOR LISTING					
Franciscan manzanita *Arctostaphylos franciscana*	FE	--	1B.1	Open, rocky, serpentine outcrops in chaparral. February – April	**No Potential.** No suitable habitat present, no serpentine areas. This species was rediscovered in Presidio National Park in late 2009 after being believed to be extinct in the wild (although still extant through cultivation).
San Bruno Mountain manzanita *Arctostaphylos imbricata*	--	CE	1B.1	Chaparral and coastal scrub, usually on sandstone outcrops. February – May	**No Potential**. Regional occurrences are restricted to San Bruno Mountain and the Santa Cruz Mountains. Suitable habitat potentially present, but this species is an evergreen shrub that would have been identifiable during 2019 and 2020 protocol-level special-status plant surveys.

1 California Department of Fish and Wildlife, California Natural Diversity Database (CNDDB) Rarefind version 5 query of the San Francisco North and San Francisco South USGS 7.5-minute topographic quadrangles, Commercial Version, accessed May 29, 2020.

2 California Native Plant Society (CNPS), Inventory of Rare and Endangered Plants for San Francisco North and San Francisco South USGS 7.5-minute topographic quadrangles, *http://www.rareplants.cnps.org/result.html?adv=t&quad=3712274:3712264,* accessed June 15, 2020.

3 U.S. Fish and Wildlife Service (USFWS), My Project, IPaC Trust Resource Report and Official Species List of Federally Endangered and Threatened Species that may occur in the Ocean Beach Long-Term Improvements Project location, and/or may be affected by the proposed project, July 20, 2020.

4 Wood Biological, Locally Significant Plant Species of San Francisco County, prepared by Mike Wood, July 4, 2015*, http://cnps-yerbabuena.org/wp-content/uploads/SF-locally-significant-plants_2015-07-04_sorted-alphabetically.pdf*, accessed February 20, 2018.

Table F-1 Special-Status and Other Sensitive Plant Species that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	CRPR Rank	Habitat Description/ Blooming Period	Potential to Occur in the Study Area
PLANT SPECIES LISTED OR PROPOSED FOR LISTING (CONT.)					
Presidio manzanita *Arctostaphylos montana (=hookeri)* ssp. *ravenii*	FE	CE	1B.1	Open, rocky, serpentine slopes in chaparral, coastal scrub, and coastal prairie. February – March	**No Potential.** Suitable serpentine habitat is not present. This species is an evergreen shrub that would have been identifiable during 2019 and 2020 protocol-level special-status plant surveys.
Pacific manzanita *Arctostaphylos pacifica*	--	CE	1B.2	Coastal scrub and chaparral. February – April	**No Potential**. Suitable habitat potentially present, but this species is an evergreen shrub that would have been identifiable during 2019 and 2020 protocol-level special-status species surveys. There is only one CNDDB record of this species in San Mateo County.
Marsh sandwort *Arenaria paludicola*	FE	CE	1B.1	Freshwater or brackish marshes and swamps. May – August	**No Potential**. No suitable habitat on site; species presumed extirpated in San Francisco.
Robust spineflower *Chorizanthe robusta var. robusta*	FE	--	1B.1	Sandy or gravelly coastal dunes, coastal scrub, cismontane woodland and maritime chaparral. April – September	**Low Potential**. Suitable habitat potentially present. Two CNDDB occurrences within 5 miles of the project area are historic and possibly extirpated. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Presidio clarkia *Clarkia franciscana*	FE	CE	1B.1	Serpentine outcrops in coastal scrub, and valley and foothill grassland. May – July	**No Potential.** Serpentine rock outcrops or soils are not present in the project study area. This species is not expected as there is no suitable habitat on site.
Marin western flax *Hesperolinon congestum*	FT	CT	1B.1	Chaparral and grassland, usually on serpentine barrens. April – July	**No Potential.** Serpentine rock outcrops or soils are not present in the project study area. This species is not expected as there is no suitable habitat on site.

Table F-1 Special-Status and Other Sensitive Plant Species that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	CRPR Rank	Habitat Description/ Blooming Period	Potential to Occur in the Study Area
PLANT SPECIES LISTED OR PROPOSED FOR LISTING (CONT.)					
Beach layia *Layia carnosa*	FE	CE	1B.1	Sand dunes and coastal strand. March – July	**Low Potential.** Suitable habitat potentially present. There is only one broadly mapped CNDDB record within 5 miles of the project study area and it is believed to be extirpated. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
San Francisco lessingia *Lessingia germanorum*	FE	CE	1B.1	Coastal scrub, sandy soils free of competing species. July – November	**Low Potential.** Suitable habitat potentially present. Occurs in the vicinity of the southern portion of the project study area at Fort Funston[5]. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
White-rayed pentachaeta *Pentachaeta bellidiflora*	FE	CE	1B.1	Open, dry, rocky slopes and grassy areas, usually on serpentine. March – May	**Low Potential.** Suitable habitat potentially present, but no serpentinite is present in the study area. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
San Francisco popcornflower *Plagiobothrys diffusus*	--	CE	1B.1	Coastal prairie, and valley and foothill grasslands. March – June	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Adobe sanicle *Sanicula maritima*	--	CR	1B.1	Moist clay or ultramafic soil in chaparral, coastal prairie, meadows, seeps, and valley and foothill grassland. February – May	**No Potential.** No suitable habitat present. No serpentine soils present in the project study area.
California seablite *Suaeda californica*	FE	--	1B.1	Coastal salt marshes and swamps. July – October	**No Potential.** No suitable habitat is present in the project study area and therefore this species is not expected on site.

5 Golden Gate National Recreation Area (GGRNA), 2013. Rare Plant Monitoring Data, Fort Funston, San Francisco, CA. This reference is confidential and cannot be publically released. The references are available on file for qualified individuals at the Golden Gate National Recreation Area, Fort Mason Building 201, San Francisco, CA.

Table F-1 Special-Status and Other Sensitive Plant Species that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	CRPR Rank	Habitat Description/ Blooming Period	Potential to Occur in the Study Area
PLANT SPECIES LISTED OR PROPOSED FOR LISTING (CONT.)					
Showy Indian (=two-fork) clover *Trifolium amoenum*	FE	--	1B.1	Valley grassland and wetland and riparian areas. Affinity to serpentine soils. April – June	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
CALIFORNIA RARE PLANT RANKED SPECIES					
Franciscan onion *Allium peninsulare var. franciscanum*	--	--	1B.2	Clay, volcanic, or serpentine substrate in valley and foothill grassland and cismontane woodland. May – June	**No Potential.** Serpentine rock outcrops or soils are not present in the project study area. This species is not expected as there is no suitable habitat on site.
Bent-flowered fiddleneck *Amsinckia lunaris*	--	--	1B.2	Coastal bluff scrub, cismontane woodland, and valley and foothill grassland. March – June	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Coast rock cress Arabis blepharophylla	--	--	4.3	Rocky soils in broadleaf upland forest, coastal bluff scrub, coastal prairie, and coastal scrub. February – May	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Montara manzanita *Arctostaphylos montaraensis*	--	--	1B.2	Slopes and ridges in chaparral and coastal scrub. January – March	**No Potential.** Suitable habitat potentially present, but this species is an evergreen shrub that would have been identifiable during 2019 and 2020 protocol-level special-status plant surveys.
Carlotta Hall's lace fern *Aspidotis carlotta-halliae*	--	--	4.2	Crevices, outcrops and slopes in chaparral and cismontane woodland, generally in serpentine soils. January – December	**No Potential.** Serpentine rock outcrops or soils are not present in the project study area. This species is not expected as there is no suitable habitat on site.
Nuttall's (=ocean bluff) milkvetch *Astragalus nuttallii var. nuttallii*	--	--	4.2	Coastal bluff scrub and coastal dunes. January – November	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.

Table F-1 Special-Status and Other Sensitive Plant Species that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	CRPR Rank	Habitat Description/ Blooming Period	Potential to Occur in the Study Area
CALIFORNIA RARE PLANT RANKED SPECIES (CONT.)					
Alkali milk-vetch *Astragalus tener var. tener*	--	--	1B.2	Alkali flats, flooded grassland, playas and vernal pools. March – June	**No Potential.** No suitable habitat present; species presumed extirpated in San Francisco.
Bristly sedge *Carex comosa*	--	--	2B.1	Lake margins, marshes, swamps, coastal prairie, and valley and foothill grasslands. May – September	**No Potential** This species is not expected as there is no suitable habitat on site. Not observed during 2019 and 2020 protocol-level special-status plant surveys which occurred within the blooming period range of this taxa.
northern meadow sedge *Carex praticola*	--	--	2B.2	Meadows and seeps in coastal prairie northern coastal coniferous forest. May – July	**No Potential** This species is not expected as there is no suitable habitat within the study area.
Johnny-nip *Castilleja ambigua var. ambigua*	--	--	4.2	Wet sites in coastal bluff scrub, coastal prairie, marshes and swamps, valley and foothill grassland, and at the margins of vernal pools. March – August	**No Potential** This species is not expected as there is no suitable habitat within the study area.
Pappose tarplant *Centromadia parryi ssp. parryi*	--	--	1B.2	Chaparral, coastal prairie, meadows, seeps, coastal salt marshes and swamps, and vernally mesic, often alkaline, valley and foothill grasslands. May – November	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Point Reyes bird's-beak *Chloropyron maritimum ssp. palustre*	--	--	1B.2	Coastal salt marshes and swamps. June – October	**No Potential** This species is not expected as there is no suitable habitat within the study area.

Table F-1 Special-Status and Other Sensitive Plant Species that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	CRPR Rank	Habitat Description/ Blooming Period	Potential to Occur in the Study Area
CALIFORNIA RARE PLANT RANKED SPECIES (CONT.)					
San Francisco spineflower *Chorizanthe cuspidata var. cuspidata*	--	--	1B.2	Sandy terraces and slopes of coastal bluff scrub, coastal dunes, coastal prairie and coastal scrub. April – July	**Present.** Occurs in the project study area south of the zoo gravel parking lot. Also occurs south of the project study area within Fort Funston[6]. While present in the study area, neither location is within the actual project area.
Franciscan thistle *Cirsium andrewsii*	--	--	1B.2	Coastal bluff scrub, coastal prairie, coastal mesic scrub, and broadleaf upland forest; sometimes on serpentine soils; often associated with seeps. March – July	**No Potential.** Serpentine soils are not present in the project study area. This species is not expected as there is no suitable habitat in the project study area.
Mt. Tamalpais thistle *Cirsium hydrophilum* var. *vaseyi*	--	--	1B.2	Serpentine seeps in meadows, broadleafed upland forest, and chaparral. May – August	**No Potential.** Serpentine rock outcrops with seeps are not present in the project study area. This species is not expected as there is no suitable habitat in the project study area.
Compact cobwebby thistle *Cirsium occidentale var. compactum*	--	--	1B.2	Coastal scrub, grassland, and dunes; often associated with seeps. April – June	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Round-headed Chinese-houses *Collinsia corymbosa*	--	--	1B.2	Coastal dunes and coastal prairie. April – June	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys. Has not been documented in San Francisco for more than 100 years.

6 Golden Gate National Recreation Area (GGRNA), 2013. Rare Plant Monitoring Data, Fort Funston, San Francisco, CA. This reference is confidential and cannot be publically released. The references are available on file for qualified individuals at the Golden Gate National Recreation Area, Fort Mason Building 201, San Francisco, CA.

Table F-1 Special-Status and Other Sensitive Plant Species that may occur in the Terrestrial Study Area (Continued)

Common Name ***Scientific Name***	**Federal Status**	**State Status**	**CRPR Rank**	**Habitat Description/ Blooming Period**	**Potential to Occur in the Study Area**
CALIFORNIA RARE PLANT RANKED SPECIES (CONT.)					
San Francisco collinsia *Collinsia multicolor*	--	--	1B.2	On humus-covered soil derived from mudstone in closed-cone coniferous forest and coastal scrub. March – May	**No Potential.** This species is not expected as there is no suitable habitat in the project study area.
Marsh horsetail *Equisetum palustre*	--	--	3	Freshwater marshes and swamps.	**No Potential.** This species is not expected as there is no suitable habitat in the project study area.
Slender cottongrass *Eriophorum gracile*	--	--	4.3	Acidic soils in bogs, and fens, meadows and seeps, and upper montane coniferous forest. May – September	**No Potential** This species is not expected as there is no suitable habitat within the study area.
San Francisco wallflower *Erysimum franciscanum*	--	--	4.2, LS	Coastal scrub and grassland, often on serpentine soils. March – June	**Low Potential.** Suitable habitat potentially present. Occurs south of the project study area within Fort Funston[7]. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Fragrant fritillary *Fritillaria liliacea*	--	--	1B.2	On clay, often serpentine derived soils in coastal scrub, grassland, and coastal prairie. February – April	**Low Potential.** Marginally suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Blue coast gilia *Gilia capitata ssp. chamissonis*	--	--	1B.1	Coastal dunes and scrub. April – July	**Low Potential.** Suitable habitat potentially present. Occurs south of the project study area within Fort Funston[8]. Not observed during 2019 and 2020 protocol-level special-status plant surveys.

7 Golden Gate National Recreation Area (GGRNA), 2013. Rare Plant Monitoring Data, Fort Funston, San Francisco, CA. This reference is confidential and cannot be publically released. The references are available on file for qualified individuals at the Golden Gate National Recreation Area, Fort Mason Building 201, San Francisco, CA.

8 Ibid

Table F-1 Special-Status and Other Sensitive Plant Species that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	CRPR Rank	Habitat Description/ Blooming Period	Potential to Occur in the Study Area
CALIFORNIA RARE PLANT RANKED SPECIES (CONT.)					
Dark-eyed gilia *Gilia millefoliata*	--	--	1B.2	Coastal dunes. April – July	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
San Francisco gumplant *Grindelia hirsutula var. maritima*	--	--	3.2	Coastal scrub and grasslands. June – September	**Present.** Occurs in the project study area in one location, between the north- and south-bound lanes of the Great Highway in a narrow strip of dune mat/ice plant mat. Also occurs south of the project study area within Fort Funston.
Diablo helianthella *Helianthella castanea*	--	--	1B.2	On rocky soils in broadleaf upland forest, cismontane woodland, coastal scrub, riparian woodland, and valley and foothill grassland. March – June	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
White seaside (=congested-headed hayfield) tarplant *Hemizonia congesta ssp. congesta*	--	--	1B.2	Grassy valleys and hills, often on fallow fields in coastal scrub. April – November	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Short-leaved evax *Hesperevax sparsiflora var. brevifolia*	--	--	1B.2	Sandy bluffs and flats in coastal scrub and coastal dunes. March – June	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Water star-grass *Heteranthera dubia*	--	--	2B.2	Marshes and swamps (alkaline, still or slow-moving water) July – October	**No Potential** This species is not expected as there is no suitable habitat within the study area.
Kellogg's horkelia *Horkelia cuneata ssp. sericea*	--	--	1B.1	Coastal scrub, dunes, and openings of closed-cone coniferous forests. February – July	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.

Table F-1 Special-Status and Other Sensitive Plant Species that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	CRPR Rank	Habitat Description/ Blooming Period	Potential to Occur in the Study Area
CALIFORNIA RARE PLANT RANKED SPECIES (CONT.)					
Point Reyes Horkelia *Horkelia marinensis*	--	--	1B.2	Coastal dunes, prairie, and scrub. May – September	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Island tube lichen *Hypogymnia schizidiata*	--	--	1B.3	Coastal scrub on or near old-growth shrubs in few locations throughout California and Mexico.	**Low Potential.** This species is not expected as there is no suitable habitat within the project area as currently understood for this species.
Coast iris *Iris longipetala*	--	--	4.2	Coastal prairie, lower montane coniferous forest, meadows and seeps, mesic sites. March – May	**No Potential.** This species is not expected as there is no suitable habitat within the project study area.
Rose leptosiphon *Leptosiphon rosaceus*	--	--	1B.1	Coastal bluff scrub. April – July	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Arcuate bush mallow *Malacothamnus arcuatus*	--	--	1B.2	Gravelly alluvium in chaparral and cismontane woodland. April – September	**No Potential.** This species is not expected as there is no suitable habitat within the project study area.
Mt. Diablo cottonweed *Micropus amphibolus*	--	--	3.2	Valley grassland, foothill woodland, and mixed evergreen forest with an affinity to serpentine soils. March – May	**No Potential** This species is not expected as there is no suitable habitat within the study area.
Marsh microseris *Microseris paludosa*	--	--	1B.2	Closed-cone coniferous forest, cismontane woodland, coastal scrub, and valley and foothill grassland. August – June	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Northern curly-leaved Monardella *Monardella sinuata ssp. nigrescens*	--	--	1B.2	Coastal dunes and scrub, chaparral, lower montane coniferous forest. (Apr) May – July (Aug-Sept)	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.

Table F-1 Special-Status and Other Sensitive Plant Species that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	CRPR Rank	Habitat Description/ Blooming Period	Potential to Occur in the Study Area
CALIFORNIA RARE PLANT RANKED SPECIES (CONT.)					
Choris's popcorn-flower *Plagiobothrys chorisianus* var. *chorisianus*	--	--	1B.2	Mesic sites in chaparral, coastal scrub, and coastal prairie. March – June	**No Potential.** This species is not expected as there is no suitable habitat within the project study area.
Hairless popcornflower *Plagiobothrys glaber*	--	--	1A	Coastal salt marshes and alkaline meadows. March – May	**No Potential** This species is not expected as there is no suitable habitat within the study area. This species is presumed extirpated in California.
Oregon polemonium *Polemonium carneum*	--	--	2B.2	Coastal prairie, coastal scrub, lower montane coniferous forest. April – September	**No Potential** This species is not expected as there is no suitable habitat within the study area.
Chaparral ragwort *Senecio aphanactis*	--	--	2B.2	Chaparral, cismontane woodland and coastal scrub, sometimes in alkaline soil. January – April (May)	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Scouler's catchfly *Silene scouleri* ssp. *scouleri*	--	--	2B.2	Coastal bluff scrub, coastal prairie, and valley and foothill grassland. (Mar-May) June – August (Sept)	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
San Francisco campion *Silene verecunda ssp. verecunda*	--	--	1B.2	Mudstone, shale, or serpentine substrates in coastal scrub, coastal prairie, chaparral and valley and foothill grassland. March – June	**Low Potential.** Suitable habitat potentially present. Historic occurrence at Lake Merced is possibly extirpated. Occurs south of the project study area in Fort Funston. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Santa Cruz microseris *Stebbinsoseris decipiens*	--	--	1B.2	On sandstone, shale or serpentine derived seaward facing slopes in broadleaf upland forest, closed-cone coniferous forest, chaparral, coastal prairie, and coastal scrub. April – May	**No Potential** This species is not expected as there is no suitable habitat within the study area.

Table F-1 Special-Status and Other Sensitive Plant Species that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	CRPR Rank	Habitat Description/ Blooming Period	Potential to Occur in the Study Area
CALIFORNIA RARE PLANT RANKED SPECIES (CONT.)					
San Francisco owl's clover *Triphysaria floribunda*	--	--	1B.2	Usually serpentinite coastal prairie, valley grasslands, and coastal scrub. April – June	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Coastal triquetrella *Triquetrella californica*	--	--	1B.2	This moss grows on coastal bluffs and in coastal scrub habitats.	**Low Potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
LOCALLY SIGNIFICANT SPECIES					
yellow sand verbena *Abronia latifolia*	--	--	LS	Coastal strand communities with sandy soil. March – October	**Present.** In low abundance, this species was observed within disturbed dune mat within the study area during project 2019 and 2020 rare plant surveys.
Heermann's bird's-foot trefoil *Acmispon heermannii* var. *orbicularis*	--	--	LS	Coastal strand communities with sandy soil. April – July	**Present.** In low abundance, this species was observed within disturbed dune mat within the study area during project 2019 and 2020 rare plant surveys.
spike bent grass *Agrostis exarata*	--	--	LS	North Coastal Coniferous Forest, Closed-cone Pine Forest, Redwood Forest, Yellow Pine Forest, Red Fir Forest, Lodgepole Forest, Subalpine Forest, Mixed Evergreen Forest, Foothill Woodland, Chaparral, Valley Grassland, and wetland-riparian areas. May – June	**Present.** In low abundance, this species was observed within disturbed dune mat within the study area during project 2019 and 2020 rare plant surveys.
silver beachweed (=beach burr) *Ambrosia chamissonis*	--	--	LS	Coastal strand. June – July	**Present.** In low abundance, this species was observed within disturbed dune mat within the study area during project 2019 and 2020 rare plant surveys.

Table F-1 Special-Status and Other Sensitive Plant Species that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	CRPR Rank	Habitat Description/ Blooming Period	Potential to Occur in the Study Area
LOCALLY SIGNIFICANT SPECIES (CONT.)					
silver dune lupine *Lupinus chamissonis*	--	--	LS	Coastal strand. April – June	**Present.** In low abundance, this species was observed within disturbed dune mat within the study area during project 2019 and 2020 rare plant surveys.
Pacific seaside plantain *Plantago maritima*	--	--	LS	Coastal salt marsh, coastal strand and wetland-riparian areas. May – September	**Present.** In low abundance, this species was observed within disturbed dune mat within the study area during project 2019 and 2020 rare plant surveys.

NOTES:
* The project study area for terrestrial biological resources includes the project disturbance area or footprint (project area) and a 15 to 50-foot buffer.

The "Potential for Effect" category is defined as follows:
- Present = Species was observed during reconnaissance or focused surveys of the project area.
- High = Species is expected to occur, habitat meets species requirements and is of moderate or high quality, and the study area is within the known species range.
- Moderate = Habitat is marginally suitable (i.e. of low or moderate quality) or the study area is within the known range of the species, even though the species was not observed during biological surveys.
- Low = Habitat does not meet species requirements as currently understood in the scientific community or the site is not within a species' geographic range.
- No Potential = Habitat does not meet species requirements or the species is presumed to be extirpated from the project area or region based on the best scientific information available.

FESA = Federal Endangered Species Act, CESA = California Endangered Species Act, CNDDB = California Natural Diversity Database

STATUS CODES:

Federal Status: U.S. Fish and Wildlife Service (USFWS)
- FE = Listed as "endangered" under the FESA
- FT = Listed as "threatened" under the FESA
- FPD = Proposed delisted
- FD = Delisted

State Status: California Department of Fish and Wildlife (CDFW)
- CE = Listed as "endangered" under the CESA
- CT = Listed as "threatened" under the CESA
- CR = Listed as "rare" under the CESA
- CSC = CDFW designated "species of special concern"
- CFP = CDFW designated "fully protected"
- SC = CDFW designated "candidate threatened"
- WL = CDFW designated "watch list"

California Rare Plant Rank (CRPR):
- Rank 1A = Plants presumed extirpated in California and either rare or extinct elsewhere.
- Rank 1B = Plants rare, threatened, or endangered in California and elsewhere.
- Rank 2A = Plants presumed extirpated in California, but more common elsewhere.
- Rank 2B = Plants rare, threatened, or endangered in California, but more common elsewhere.
- Rank 3 = Plants about which we need more information – a review list
- Rank 4 = Plants of limited distribution – a watch list

An extension reflecting the level of threat to each species is appended to each rarity category as follows:
- .1 – Seriously endangered in California.
- .2 – Fairly endangered in California.
- .3 – Not very endangered in California.

LS = Locally Significant Plant Species for San Francisco County as designated by the CNPS Yerba Buena Chapter

SOURCES: CDFW, 2020; CNPS, 2020; USFWS, 2020.

Table F-2 Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area

Common Name *Scientific Name*	Federal Status	State Status	Other	Habitat Description	Potential to Occur in the Study Area
SPECIES LISTED OR PROPOSED FOR LISTING					
INVERTEBRATES					
Western bumble bee *Bombus occidentalis*	--	SCE	--	Largely restricted to high elevation sites in the Sierra Nevada, with few observations of this species near the coast. Favors plant families *Melilotus, Cirsium, Trifolium, Centaurea, Chrysothamnus* and *Eriogonum.*	**Low.** The CNDDB documents eight occurrence records within 5 miles of the project area which are presumed extent, and located within parks or natural areas. Suitable foraging and burrow habitat are present in the study area; however, given the rarity of this species in California and range declines throughout the state, this species is not expected.
Crotch bumble bee *Bombus crotchii*	--	SCE	--	Nearly endemic to California, historically ranging across southern California, from the coast and coastal ranges, through the Central Valley, and to the adjacent foothills. Favors plant families *Fabaceae, Apocynaceae, Asteraceae, Lamiaceae, Hydrophyllacae, Asclepiadaceae* and *Boraginaceae*.	**Low.** No records for this species are documented in the CNDDB within 5 miles of the project area. Suitable foraging and burrow habitat are present in the study area; however, given the rarity of this species in California and range declines throughout the state, this species is not expected.
San Bruno elfin butterfly *Callophrys mossii bayensis*	FE	--	--	Coastal scrub or grassland on rocky outcrops with broadleaf stonecrop (*Sedum spathulifolium*).	**Low.** Three known populations occur at San Bruno Mountain, Montara, and Pacifica. Typical habitat does not occur within the study area and host plants for this species were not observed during 2019 field surveys; therefore this species is not expected.
Bay checkerspot butterfly *Euphydryas editha bayensis*	FT	--	--	Serpentine grasslands with larval host plants dwarf plantain (*Plantago erectis*) and purple owl's clover (*Castilleja exserta spp. exerta*).	**Low.** Serpentine grassland habitat for host plants does not occur within the study area and host plants not observed during 2019 field surveys; therefore this species is not expected.

Table F-2 Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Other	Habitat Description	Potential to Occur in the Study Area
SPECIES LISTED OR PROPOSED FOR LISTING (CONT.)					
INVERTEBRATES (CONT.)					
Mission blue butterfly *Plebejus icarioides missionensis*	FE	--	--	Grassland with *Lupinus albifrons*, *L. Formosa*, and *L. varicolor*.	**Low.** Typical grassland habitat for host plants does not occur within the study area and host plants not observed during 2019 field surveys; therefore this species is not expected.
Callippe silverspot butterfly *Speyeria callippe callippe*	FE	--	--	Found in native grasslands with *Viola pedunculata* as larval food plant.	**Low.** Typical grassland habitat for host plants does not occur within the study area and host plant not observed during 2019 field surveys; therefore, this species is not expected.
Myrtle's silverspot butterfly *Speyeria zerene myrtleae*	FE	--	--	Coastal dune habitat with host plants *Grindelia hirsutula, Abronia latifolia, Mondardella, Cirsium vulgare, and Erigeron glaucus* on the San Francisco and Marin peninsulas.	**Low.** Not known to occur in the San Francisco dune habitat; populations south of the Golden Gate Bridge are possibly extirpated. This species is not expected.
REPTILES					
San Francisco garter snake *Thamnophis sirtalis tetrataenia*	FE	CE, CFP	--	Densely vegetated ponds near open hillsides with abundant small mammal burrows.	**No Potential.** This species is considered likely extirpated from San Francisco. No suitable habitat occurs in or near the study area; therefore this species is not expected.
AMPHIBIANS					
California red-legged frog *Rana draytonii*	FT	CSC	--	Freshwater ponds and slow streams with emergent vegetation for egg attachment.	**No Potential.** Suitable habitat is not present in the study area. Historically present where habitat exists in the project vicinity including several CNDDB records in ponds within Golden Gate Park. This species is considered extirpated from Lake Merced.

Table F-2 Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Other	Habitat Description	Potential to Occur in the Study Area
SPECIES LISTED OR PROPOSED FOR LISTING (CONT.)					
BIRDS					
Golden eagle *Aquila chrysaetos*	--	CFP, WL	--	Rolling foothills, mountain areas, sage-juniper flats and deserts. Cliff-walled canyons provide nesting habitat in most parts of range; also large trees in open areas.	**No Potential.** Suitable habitat for this species is not found in the project study area.
Marbled murrelet *Brachyramphus marmoratus*	FT	CE	--	Breeds in coniferous forests near the coast and prefers old growth, mature stands. Nests on large horizontal branches high in the trees. Winters at sea.	**Low (No nesting potential).** Suitable breeding habitat for this species is not found in the project study area. Individuals may forage offshore of the landside project areas during the non-breeding season where they dive for fish and invertebrates underwater.
Western snowy plover *Charadrius nivosus nivosus*	FT	CSC	--	Sandy beaches, salt pond levels and shores of alkali lakes. Needs sandy, gravelly or friable soils for nesting.	**Present (No nesting potential).** Overwinters on Ocean Beach, generally present between July and May. Concentrated presence within the NPS designated protection area between Stairwell 21 and Sloat Boulevard.
American peregrine falcon *Falco peregrines anatum*	FD	CD, CFP	--	Woodlands, coastal habitats, riparian areas, coastal and inland waters, human made structures that may be used as nest or temporary perch sites.	**Moderate (Unlikely to nest).** May hunt birds on Ocean Beach within the project study area. No known nest sites within the study area; typical cliff features for nesting are not present within the study area though could nest on buildings or structures.
Bald eagle *Haliaeetus leucocephalus* (nesting and wintering)	FD	CE, CFP	--	Nests and forages on inland lakes, reservoirs, and rivers.	**Low (Unlikely to nest).** Marginal nesting habitat is present within the large trees around Lake Merced east of the study area; however, no existing nest site is known. May forage for fish in nearby Lake Merced.
California black rail *Laterallus jamaicensis coturniculus*	--	CT, CFP	--	Salt and brackish marshes; also in freshwater marshes at low elevations.	**No Potential.** Suitable habitat for this species is not found in the project study area.

Table F-2 Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area (Continued)

Common Name ***Scientific Name***	**Federal Status**	**State Status**	**Other**	**Habitat Description**	**Potential to Occur in the Study Area**
SPECIES LISTED OR PROPOSED FOR LISTING (CONT.)					
BIRDS (CONT.)					
Brown pelican *Pelecanus occidentalis californicus* (nesting colony / communal roosts)	FD	CD, CFP	--	Pelagic forager along ocean and bay shorelines whose breeding range extends from the Channel Islands south to Mexico.	**Present (No nesting potential).** Forages in the Pacific Ocean offshore of the terrestrial study area; may occur on occasion within the marine study area.
Short-tailed albatross *Phoebastria (=Diomedea) albatrus*	FE	CSC	--	A pelagic species that spends most of its time at sea and returns to land only for breeding purposes.	**Low (No nesting potential).** Breeds only at one or two sites off the coast of Japan, occasional visitor to California coast and could appear on a transient basis offshore of the study area.
Ridgway's rail *Rallus obsoletus obsoletus*	FE	CE, CFP	--	Salt marsh wetlands with dense vegetation along the San Francisco Bay.	**No Potential.** Suitable habitat for this species is not found in the project study area.
Bank swallow *Riparia riparia (nesting)*	--	CT	--	Vertical banks and cliffs with sandy soil, near water. Nests in holes dug in cliffs and river banks.	**Present (potential to nest).** Breeding colony located in the vertical bluffs above Ocean Beach across from the Oceanside Treatment Plant and south of the study area within the bluffs below Fort Funston; referred to generally as the "Fort Funston colony." Species is present during the breeding season, which spans April through July, according to the 1992 California Department of Fish and Wildlife Bank Swallow Recovery Plan and the National Park Service 2019 and 2020 Bank Swallow Monitoring Reports. Nesting was not documented within the project area in 2020 and 2021.
California least tern *Sternula antillarum browni*	FE	CE, CFP	--	Open beaches free of vegetation along the California coast.	**Low (No nesting potential).** May occasionally be sighted offshore of the study area while foraging. Closest nesting site is located on Alameda Naval Station.

Table F-2 Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Other	Habitat Description	Potential to Occur in the Study Area
OTHER SPECIAL-STATUS AND SENSITIVE SPECIES					
MAMMALS					
Salt marsh harvest mouse *Reithrodontomys raviventris*	FE	CE, CFP	--	Salt marsh habitat dominated by pickleweed.	**No Potential.** Suitable habitat for this species is not found in the project study area.
INVERTEBRATES					
Monarch butterfly *Danaus plexippus* (overwintering sites)	--	--	--	Eucalyptus groves (wintering sites).	**Low.** Several records of this species in Golden Gate Park and one in the Presidio but no wintering sites have been identified within the study area. Eucalyptus trees around Lake Merced east of the study area may provide overwintering sites for monarchs but none have been identified to date.
AMPHIBIANS					
California giant salamander *Dicamptodon ensatus*	--	CSC	--	Wet coastal forests in or near cold, permanent and semi-permanent streams and seepages.	**No Potential.** Freshwater stream habitat is not present within or near the study area; therefore this species is not expected.
REPTILES					
Western pond turtle *Actinemys marmorata*	--	CSC	--	Ponds, marshes, rivers, streams, and irrigation ditches with aquatic vegetation. Requires basking sites and suitable upland habitat for egg-laying. Nest sites most often characterized as having gentle slopes (<15%) with little vegetation or sandy banks.	**Low.** Freshwater habitat is not present in the study area. Documented in North Lake and East Lake Merced east of the study area; however, Skyline Boulevard is expected to act as a dispersal barrier for this species such that it is not expected within the project area.

Table F-2 Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Other	Habitat Description	Potential to Occur in the Study Area
OTHER SPECIAL-STATUS AND SENSITIVE SPECIES (CONT.)					
BIRDS					
Clark's grebe *Aechmophorusclar kia*	-	--	BCC	Freshwater lakes and marshes with extensive open water bordered by vegetation. Nest is typically built on floating vegetation hidden among emergent plants. Typically found in saltwater or brackish water environments like San Francisco Bay during winter.	**High (No nesting potential).** Regularly observed in open water off-shore of the terrestrial study area while foraging. May occur in the marine study area while foraging. Suitable nesting habitat is not present in the study area for this species.
Black turnstone *Arenaria melanocephala*	--	--	BCC	Winters in coastal areas with rocky shorelines, jetties, and piers. Breeds in sparsely vegetated coastal meadows of the arctic tundra.	**Moderate (No nesting potential).** May be observed offshore of the terrestrial study area while wintering in the San Francisco Bay Area.
Tricolored blackbird *Agelaius tricolor* (nesting colony)	--	CT, CSC	BCC	Nests in dense colonies within sloughs, swamps, and marshes where tall aquatic vegetation is present. Nests can extend into upland scrub habitat on colony fringes.	**Low (No nesting potential).** No suitable nesting or foraging habitat is present in the study area. May occur on a transient basis during migration or while visiting Lake Merced, east of the study area.
Western burrowing owl *Athene cunicularia* (burrow sites and some wintering grounds)	--	CSC	BCC	Open grasslands with low or no vegetation where existing rodent burrows occur for occupation.	**High (No nesting potential).** Documented overwintering within the riprap revetment across from the Oceanside Treatment Plant within the project area and beneath the staircase and walkway at Noriega Street and the Great Highway, north of the project area. No suitable nesting or foraging habitat is present in the study area.
Oak titmouse *Baeolophus inornatus*	--	--	BCC	Open, dry oak woodlands.	**Low (No nesting potential).** Few oak trees may be present within the San Francisco Zoo to support this species foraging and nesting in the vicinity of the study area.

Table F-2 Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Other	Habitat Description	Potential to Occur in the Study Area
OTHER SPECIAL-STATUS AND SENSITIVE SPECIES (CONT.)					
BIRDS (CONT.)					
Costa's hummingbird *Calypte costae*	--	--	BCC	Occupy chaparral and sage scrub within the southern California coast of the Sonoran and Mojave deserts.	**Low (Unlikely to nest).** The project study area is north of the understood range for this species. May occur on a transient basis but is not expected.
Lawrence's goldfinch *Carduelis lawrencei*	--	--	BCC	Open woodlands, chaparral near fields for foraging seeds.	**Low (Unlikely to nest).** Uncommon to San Francisco. Suitable nesting habitat is not present in the study area and limited foraging habitat is present. Could occur on a transient basis.
Wrentit *Chamaea fasciata*	--	--	BCC	Dense coastal scrub and chaparral of the west coast. Inland habitat is dense shrubland and thickets.	**Low (Unlikely to nest).** Suitable dense coastal scrub nesting and foraging habitat is not present in the study area. May be extirpated from San Francisco.
Bonaparte's gull *Chroicocephalus philadelphia*	--	--	*	Migrate in flocks across North America. Nest in trees of the boreal forest.	**Low (No nesting potential).** May be present on Ocean Beach or off shore of the terrestrial study area during migration or periods of non-breeding.
Black swift *Cypseloides niger* (nesting)	--	CSC	BCC	Breeds in areas with cliff faces, on coasts or inland canyons. Nests are in sheltered crevices or ledges under overhangs near water, such as a seep or waterfall.	**Low (Unlikely to nest).** May occur over the terrestrial study area while foraging. Breeding habitat for this species is not present in the study area.
Northern fulmar *Fulmarus glacialis*	--	--	*	Nest in colonies on cliffs in the North Pacific, North Atlantic, and Arctic Oceans. Spend non-breeding periods at sea.	**Low (No nesting potential).** May be present while wintering offshore of the terrestrial area.
Common loon *Gavia immer*	--	CSC	--	From September to May, fairly common in estuarine and subtidal marine habitats along entire coast, and uncommon on large, deep lakes in valleys and foothills throughout state.	**Low (No nesting potential).** May be present off shore of the terrestrial study area while foraging during non-breeding periods.

Table F-2 Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Other	Habitat Description	Potential to Occur in the Study Area
OTHER SPECIAL-STATUS AND SENSITIVE SPECIES (CONT.)					
BIRDS (CONT.)					
Red-throated loon *Gavia stellata*	--	--	BCC	Breeds in lakes and coastal areas of the alpine tundra. Winters in shallow coastal estuaries.	**Low (No nesting potential).** May be present off shore of the terrestrial study area while foraging during non-breeding periods.
San Francisco common yellowthroat *Geothlypis trichas sinuous*	--	CSC	BCC	Forages in various marsh, riparian and upland habitats. Nests on or near the ground in concealed locations.	**Moderate (Unlikely to nest).** Suitable dense riparian and wetland habitat for nesting is not present in the study area but located within Lake Merced to the east. This species may occur in the study area while foraging.
Black oystercatcher *Haematopus bachmani*	--	--	BCC	Rocky shoes along the Pacific coast from the Aleutian Islands to Baja California.	**Low (Unlikely to nest).** Suitable breeding habitat is not present on Ocean Beach within the study area. This species may be present in the study area when moving between suitable rocky outcrops along the San Francisco Peninsula coastline which do provide foraging and breeding opportunity.
Herring gull *Larus argentatus*	--	--	*	Open water, tidepools, beaches, and human-influenced areas like plowed fields, landfills and picnic areas. Breed near lakes in Alaska, Canada, and parts of the Arctic.	**Moderate (No nesting potential).** Commonly observed on Ocean Beach while wintering; may occur in the terrestrial and marine study areas.
California gull *Larus californicus*	--	--	WL	Colonial nester, sometimes with other bird species. Breeds primarily at lakes and marshes in interior western North America from Canada south to eastern California and Colorado. Birds that breed inland are migratory, most moving to the Pacific coast in winter.	**High (No nesting potential).** Commonly observed on Ocean Beach while wintering. No established nesting colonies are present in the study area.

Table F-2 Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Other	Habitat Description	Potential to Occur in the Study Area
OTHER SPECIAL-STATUS AND SENSITIVE SPECIES (CONT.)					
BIRDS (CONT.)					
Ring-billed gull *Larus delawarensis*	--	--	*	Coastal waters, beaches, and estuaries though commonly observed inland at reservoirs, lakes, landfills and parking lots. Breed across North America above the 40 degree latitude line and below the Arctic.	**High (No nesting potential).** Commonly observed on Ocean Beach while wintering; may occur in the terrestrial and marine study areas.
Short-billed dowitcher *Limnodromus griseus*	--	--	BCC	Saltwater tidal flats, beaches, and salt marshes during migration.	**Low (No nesting potential).** Common winter migrant that could occur along the coastline within the study area during low tide events.
Marbled godwit *Limosa fedoa*	--	--	BCC	Shoreline mudflats and beaches.	**Low (No nesting potential).** Common winter migrant that could occur along the coastline within the study area during low tide events.
Lewis's woodpecker *Melanerpes lewis*	--	--	BCC	Open woodlands.	**Low (No nesting potential).** Uncommon winter migrant to the San Francisco Bay Area. Mature landscaped trees within the San Francisco Zoo may attract this species; however, abundant suitable habitat is not present in the study area.
White-winged scoter *Melanitta fusca*	--	--	*	Shallow intertidal and subtidal areas along the Pacific and Atlantic coasts while wintering. Breeds in boreal forests near lakes.	**Moderate (No nesting potential).** Commonly observed off shore of Ocean Beach while wintering.
Black scoter *Melanitta nigra*	--	--	*	Shallow intertidal and subtidal areas along the Pacific and Atlantic coasts while wintering. Breeds in the boreal forests of Alaska and the North East near lakes.	**High (No nesting potential).** Commonly observed off shore of Ocean Beach while wintering.

Table F-2 Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Other	Habitat Description	Potential to Occur in the Study Area
OTHER SPECIAL-STATUS AND SENSITIVE SPECIES (CONT.)					
BIRDS (CONT.)					
Surf scoter *Melanitta perspicillata*	--	--	*	Shallow intertidal and subtidal areas along the Pacific and Atlantic coasts while wintering. Breeds in the boreal forest and tundra of northern Canada and Alaska.	**High (No nesting potential).** Commonly observed off shore of Ocean Beach while wintering.
Song sparrow *Melospiza melodia*	--	--	BCC	Open woodlands, tidal marshes, freshwater lakes, wetlands, agricultural areas and suburbs.	**High (Potential to nest).** Common to San Francisco. Likely to occur within dense shrub habitat within the San Francisco Zoo, east of the study area.
Alameda song sparrow *Melospiza melodia pusillula*	--	CSC	--	Salt marshes of eastern and south San Francisco Bay.	**Low (No nesting potential).** No suitable saltmarsh vegetation for nesting or foraging is present in the study area; therefore this species is not expected.
San Pablo song sparrow *Melospiza melodia samuelis*	--	CSC	--	Salt marshes of eastern and north San Francisco Bay.	**No Potential (No nesting potential).** No suitable saltmarsh vegetation for nesting or foraging is present in the study area. The study area is outside of the understood range for this species; therefore this species is not expected.
Red-breasted merganser *Mergus serrator*	--	--	*	Common to coastal areas and interior lakes of North America while wintering or during migration. Breed in northern Canada, Alaska, and the Arctic.	**Moderate (No nesting potential).** May be observed offshore of Ocean Beach while wintering.
Northern gannet *Morus bassanus*	--	--	*	Breeds on coastal rocky cliffs and islands offshore of eastern Canada. Overwinters along the Atlantic Coast.	**Low (No nesting potential).** Transient individual may be observed. Uncommon to the Pacific Coast.
Long-billed curlew *Numenius americanus*	--	WL	BCC	Breeds in upland shortgrass prairies and wet meadows in northeastern California in gravelly soils. Winter visitor to the San Francisco Bay Area.	**Moderate (No nesting potential).** Common winter migrant to Ocean Beach. Likely to be present while foraging during low tide events within the terrestrial study area.

Table F-2 Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area (Continued)

Common Name ***Scientific Name***	**Federal Status**	**State Status**	**Other**	**Habitat Description**	**Potential to Occur in the Study Area**
OTHER SPECIAL-STATUS AND SENSITIVE SPECIES (CONT.)					
BIRDS (CONT.)					
Whimbrel *Numenius phaeopus*	--	--	BCC	Saltwater tidal flats, beaches, and salt marshes during migration.	**Moderate (No nesting potential).** Common winter migrant to Ocean Beach. Likely to be present while foraging during low tide events within the terrestrial study area.
Double-crested cormorant *Phalacrocorax auritus*	--	WL	--	Rookery breeder in coastal areas and inland lakes in fresh, saline, and estuarine waters.	**Present (Potential to nest).** Common forager in waters offshore of the terrestrial study area and within Lake Merced, where a breeding rookery is established in North Lake Merced across Skyline Boulevard from the Pomeroy Recreation and Rehabilitation Center, east of the study area. May occur within the marine study area
Red phalarope *Phalaropus fulicarius*	--	--	*	Winter at sea within the Pacific Ocean off the California coast. Breed in the Arctic.	**Moderate (No nesting potential).** May be observed offshore of the terrestrial study area.
Red-necked phalarope *Phalaropus lobatus*	--	--	*	Winter at sea within the Pacific Ocean off the California coast. Breed in the Arctic.	**Moderate (No nesting potential).** May occur on a transient basis during migration.
Nuttall's woodpecker *Picoides nuttallii*	--	--	BCC	Oak and riparian woodlands.	**Low (No nesting potential).** No suitable nesting or foraging habitat is present in the study area. Few oaks may be present in the San Francisco Zoo to attract this species but otherwise this species is not expected.
Spotted towhee *Pipilo maculatus clementae*	--	--	BCC	Dense, dry thickets and shrubby areas, forest edges, and chaparral. Nests on or near the ground.	**Low (Unlikely to nest).** Suitable dense coastal scrub nesting and foraging habitat is limited to shrubby areas within the San Francisco Zoo, east of the study area.
Pink-footed shearwater *Puffinus creatopus*	--	--	BCC	Most commonly observed in flight over or in waters off the west coast of North America from May to November. Nest on islands off coast of Chile.	**Low (No nesting potential).** Individuals may be seen foraging offshore of the terrestrial study area.

Table F-2 Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area (Continued)

Common Name ***Scientific Name***	**Federal Status**	**State Status**	**Other**	**Habitat Description**	**Potential to Occur in the Study Area**
OTHER SPECIAL-STATUS AND SENSITIVE SPECIES (CONT.)					
BIRDS (CONT.)					
Black-vented shearwater *Puffinus opisthomelas*	--	--	BCC	Coastal waters from Monterey Bay to northwestern Mexico, where they nest on offshore islands. Typically stay within a few miles of shore.	**Low (No nesting potential).** Uncommon to the waters north of Monterey Bay. May occur on a transient basis in waters offshore of the terrestrial study area.
Rufous hummingbird *Selasphorus rufus*	--	--	BCC	Forest openings, meadows, yards and parks.	**Low (No nesting potential).** Does not nest locally; may occur during migration and forage within the study area. May be attracted to the landscaped environment of the San Francisco Zoo, east of the study area.
Allen's hummingbird *Selasphorus sasin*	--	--	BCC	Brush and woodlands along the California coast.	**Moderate (Potential to nest).** May forage and nest within the landscaped trees and shrubs of the San Francisco Zoo or east of the study area at Lake Merced.
Parasitic jaeger *Stercorarius parasiticus*	--	--	*	Offshore waters of the Pacific Ocean or coastal bays during migration or while wintering. Breeds in the Arctic.	**Low (No nesting potential).** May occur during migration or wintering offshore of the terrestrial study area while foraging.
Pomarine jaeger *Stercorarius pomarinus*	--	--	*	Offshore waters of the Pacific Ocean during migration or while wintering. Breeds in the Arctic.	**Low (No nesting potential).** May occur during migration or wintering offshore of the terrestrial study area while foraging.
Common tern *Sterna hirundo*	--	--	*	Ocean waters, lakes, bays and beaches along the Pacific coast during migration to breeding areas in central Canada.	**Low (No nesting potential).** May occur during migration offshore of the terrestrial study area while foraging.
Willet *Tringa semipalmata*	--	--	BCC	Common to open beaches, bay shorelines, marshes, mudflats, and rocky coasts. Nest at inland marshes, prairies with ponded water and fields.	**Moderate (No nesting potential).** Does not nest locally. Likely to be present while foraging during low tide events within the terrestrial study area.

Table F-2 Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Other	Habitat Description	Potential to Occur in the Study Area
OTHER SPECIAL-STATUS AND SENSITIVE SPECIES (CONT.)					
MAMMALS (CONT.)					
Common murre *Uria aalge*	--	--	*	Nest in colonies on steep rocky cliffs in few areas along the coast of California, Oregon, Washington and Alaska. One breeding colony is located offshore of the San Francisco peninsula.	**Moderate (No nesting potential).** Suitable rocky habitat for this species is not found within the study area; however, this species is common offshore of Ocean Beach due to the location of the nearby breeding colony. Likely to occur within the marine study area.
MAMMALS					
Townsend's big-eared bat *Corynorhinus townsendii* (maternity roosts)	--	CSC	WBWG: High	Throughout California in a wide variety of habitats. Most common in mesic sites. Roosts in the open, hanging from walls and ceilings of rocky areas with caves or tunnels. Roosting sites limited. Extremely sensitive to human disturbance.	**Low (Unlikely to establish maternity roosts).** Suitable roosting habitat for this species is not available within the study area. May be present intermittently while foraging.
Silver-haired bat *Lasionycteris* (maternity roosts)	--	--	WBWG: Medium	Roosts in hollow trees, snags, buildings, rock crevices, caves, and under bark. Primarily a forest dweller, feeding over streams, ponds, and open brushy areas.	**Moderate (Potential to establish maternity roosts).** Suitable roosting habitat for this species is available in the matures trees around the San Francisco Zoo. May forage over the disturbed dune mat vegetation community of the project area. Detected at Fort Funston during acoustic monitoring between 2004 and 2005.
Western red bat *Lasiurus blossevillii* (maternity roosts)	--	CSC	WBWG: High	Roosts primarily in trees, 2-40 feet above ground, from sea level up through mixed conifer forests. Prefers habitat edges and mosaics with trees that are protected from above and open below with open areas for foraging.	**Moderate (Potential to establish maternity roosts).** Suitable roosting habitat for this species is available in the matures trees around the San Francisco Zoo and along the west shoreline of Lake Merced, east of the study area. May forage over the dune vegetation communities of the project area. Detected at Fort Funston during acoustic monitoring between 2004 and 2005.

Table F-2 Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Other	Habitat Description	Potential to Occur in the Study Area
OTHER SPECIAL-STATUS AND SENSITIVE SPECIES (CONT.)					
MAMMALS (CONT.)					
Hoary bat *Lasiurus cinereus* (maternity roosts)	--	--	WBWG: Medium	Prefers open habitats or habitat mosaics, with access to trees for cover and open areas or habitat edges for feeding. Roosts in dense foliage of medium to large trees. Feeds primarily on moths; requires water.	**Moderate (Potential to establish maternity roosts).** Suitable roosting habitat for this species is available in the matures trees around the San Francisco Zoo and along the west shoreline of Lake Merced, east of the study area. May forage over the dune vegetation communities of the project area. Detected at Fort Funston during acoustic monitoring between 2004 and 2005.
Little brown bat *Myotis lucifugus* (maternity roosts)	--	--	WBWG: Medium	Day roosts located in buildings, trees, under rocks or wood, or occasionally in caves. Nursery roosts typically established in buildings, but also in other locations with suitable temperatures.	**Moderate (Potential to establish maternity roosts).** Suitable day and nursery roost habitat located around the San Francisco Zoo, east of the study area. May forage over the dune vegetation communities of the project area. Detected at Fort Funston during acoustic monitoring between 2004 and 2005.
Fringed myotis *Myotis thysanodes* (maternity roosts)	--	--	WBWG: High	Most common in drier woodlands, they may roost in caves, mines, buildings, and crevices.	**Moderate (Potential to establish maternity roosts).** Suitable roosting habitat for this species is available in the matures trees and buildings of the San Francisco Zoo and along the west shoreline of Lake Merced, east of the study area. May forage over the dune vegetation communities of the project area. Detected at Fort Funston during acoustic monitoring between 2004 and 2005.
American badger *Taxidea taxus*	--	CSC	--	Open grasslands with loose, friable soils.	**No Potential.** No suitable habitat present on site.
Point Reyes jumping mouse *Zapus trinotatus orarius*	--	CSC	--	Upland areas of bunch grass in marshes in Point Reyes.	**No Potential.** Study area is south of the known range for this species. No suitable habitat is present on site.

Table F-2 **Special-Status Animal Species and Other Sensitive Animal Species Identified for Conservation Concern that may occur in the Terrestrial Study Area (Continued)**

NOTES:

The project study area for terrestrial biological resources includes the project disturbance area or footprint (project area) and a 15 to 50-foot buffer.

The “Potential for Effect” category is defined as follows:

Present = Species was observed during reconnaissance or focused surveys of the project area.

High = Species is expected to occur, habitat meets species requirements and is of moderate or high quality, and the study area is within the known species range.

Moderate = Habitat is marginally suitable (i.e. of low or moderate quality) or the study area is within the known range of the species, even though the species was not observed during biological surveys.

Low = Habitat does not meet species requirements as currently understood in the scientific community or the site is not within a species' geographic range.

No Potential = Habitat does not meet species requirements or the species is presumed to be extirpated from the project area or region based on the best scientific information available.

FESA = Federal Endangered Species Act, CESA = California Endangered Species Act, CNDDB = California Natural Diversity Database

Federal Status: U.S. Fish and Wildlife Service (USFWS)

FE = Listed as “endangered” under the FESA

FT = Listed as “threatened” under the FESA

FPD = Proposed delisted

FD = Delisted

State Status: California Department of Fish and Wildlife (CDFW)

CE = Listed as “endangered” under the CESA

CT = Listed as “threatened” under the CESA

CD = Delisted

CSC = CDFW designated “species of special concern”

CFP = CDFW designated “fully protected”

SCE = CDFW designated “candidate endangered”

SCT = CDFW designated “candidate threatened”

WL = CDFW designated “watch list”

Other Category Recognized by Federal, State or Other Conservation Groups which does not designate “special-status” but is as noted:

BCC = Bird of Conservation Concern identified by USFWS (2008) as a species, subspecies, or populations of migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the FESA.

* = Bird species identified by USFWS as priority concern for potential susceptibilities in offshore areas for certain development activities

Western Bat Working Group (WBWG)

WBWG-Low = Stable population

WBWG-Medium = Need more information about the species, possible threats, and protective actions to implement.

WBWG-High = Imperiled or at high risk of imperilment.

Table F-3 Special-Status Fish and Marine Mammal Species that may occur in the Pacific Ocean within the Study Area

Common Name *Scientific Name*	Federal Status	State Status	Habitat Description	Potential to Occur in the Study Area	Time Period Present in Study Area Waters
FISH					
Sacramento River winter-run ESU Chinook salmon *Oncorhynchus tshawytscha*	FE/-	CE	Anadromous and semelparous. As adults they migrate from a marine environment into the fresh water streams and rivers of their birth (anadromous) where they spawn and die (semelparous).	**Low.** Chinook salmon typically enter the Sacramento River from November to June and spawn from late-April to mid-August, with a peak from May to June. They inhabit nearshore coastal waters of Central California throughout the year, but especially during migration periods.	Adults - November and December Juveniles – fall and winter
Central Valley spring-run ESU Chinook salmon *O. tshawytscha*	FT/-	CT	Ocean waters, Sacramento and San Joaquin Rivers; Migrates from ocean through San Francisco Bay-Delta to freshwater spawning grounds	**Low.** Chinook salmon typically enter the Sacramento River from November to June and spawn December to April. They inhabit nearshore coastal waters of Central California throughout the year, but especially during migration periods.	Adults - late winter to spring Juveniles - fall though spring
Central Valley fall-run/late fall-run ESU Chinook salmon *O. tshawytscha*.	FSC/-	-	Ocean waters, Sacramento and San Joaquin Rivers; Migrates from Ocean through San Francisco Bay-Delta to freshwater spawning grounds	**Low.** No foraging of spawning habitat for this species is present. No streams supporting spawning runs are present within or in the vicinity of the project site. There is a low potential for incidental occurrence of this species if individuals stray from migration routes.	Adults - June through September Juveniles - winter through summer
Central Valley DPS steelhead *O. Mykiss*	FT/-	-	Steelhead are anadromous and can spend up to 7 years in fresh water prior to smoltification, and then spend up to 3 years in salt water prior to first spawning.	**Low.** No foraging or spawning habitat for this species is present. No streams supporting spawning runs are present within or in the vicinity of the marine study area. There is a low potential for incidental occurrence of this species if individuals stray from migration routes.	Adults - winter and spring Juveniles - year-round

Table F-3 Special-Status Fish and Marine Mammal Species that may occur in the Pacific Ocean within the Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Habitat Description	Potential to Occur in the Study Area	Time Period Present in Study Area Waters
FISH (CONT.)					
Central California coast DPS steelhead *O. mykiss*	FT/-	CSC	Steelhead are anadromous and can spend up to 7 years in fresh water prior to smoltification, and then spend up to 3 years in salt water prior to first spawning.	**Low.** No foraging or spawning habitat for this species is present. No streams supporting spawning runs are present within or in the vicinity of the marine study area.	Adults - winter Juveniles – year-round
Central California ESU *O. kisutch*	FE		Spend approximately the first half of their life cycle rearing and feeding in streams and small freshwater tributaries with stable gravel substrates. The remainder of the life cycle is spent foraging in estuarine and marine waters of the Pacific Ocean.	**Low.** Historically, runs were common in San Francisco Bay tributaries. Current runs in the Russian River to the north and in Waddell Creek, Scott Creek, San Lorenzo River, Soquel Creek, and Aptos Cree to the south.	May potentially occur in the waters adjacent to the marine study area during migration.
Green Sturgeon (Southern DPS) *Acipenser medirostris*	FT/-	CSC	Marine and estuarine environments and Sacramento River; All of San Francisco Bay-Delta	**Low.** There is little data on green sturgeon presence in coastal waters. This species may forage in or near the study area but its distribution in ocean waters is essentially unknown. Spawning only occurs in the upper Sacramento River watershed for the southern DPS, but fish are known to frequent coastal waters of less than 110 meters deep along the Pacific Coast.	Year-round
Longfin smelt *Spirinchus thaleichthys*	FC/-	CT	Anadromous estuarine species occupying the middle or bottom of water column in salinities between 15-30 ppt.	**Low.** This species is documented to inhabit the deep channels of Central San Francisco Bay for most of the year. Seasonally observed within the offshore environment including potentially in the waters adjacent to the project site.	Year-round

Table F-3 Special-Status Fish and Marine Mammal Species that may occur in the Pacific Ocean within the Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Habitat Description	Potential to Occur in the Study Area	Time Period Present in Study Area Waters
MARINE MAMMALS					
California Sea Lion *Zalophus californianus*	MMPA	--	Coastal waters off California, ranges from the Farallon Islands off San Francisco to the San Benito Islands off Baja California.	**Moderate**. Common within San Francisco Bay and nearshore coastal environment.	Seasonal
Steller Sea Lion *Eumetopias jubatus*	FT, MMPA	--	Ranges from Alaska to southern California, and occasionally breeds along the California coast.	**Low.** Occasionally observed on Seal Rocks opposite the Cliff House in San Francisco.	Seasonal
Harbor Seal *Phoca vitulina richardii*	MMPA	--	Common along the California coast and within San Francisco Bay.	**Moderate**. Common within San Francisco Bay and nearshore coastal environment.	Year-round
Northern Fur Seal *Callorhinus ursinus*	MMPA	--	Usually come ashore in California only when debilitated, however, few individuals observed on Año Nuevo Island.	**Low**. Occur off of central California during winter following migration from northern breeding grounds.	Seasonal
Northern Elephant Seal *Mirounga angustirostris*	MMPA	--	Usually observed offshore swimming and foraging and only come ashore when debilitated or at one of the established rookeries.	**Low.** Nearby rookeries are on beaches at Año Nuevo State Park and Southeast Farallon Islands.	Year-round
Guadalupe Fur Seal *Arctocephalus townsendi*	FT, MMPA	CT	Breed along the eastern coast of Guadalupe Island, approximately 200 Kilometers west of Baja California. In addition, individuals have been sighted in the southern California Channel Islands, including two males who established territories on San Nicolas Island.	**Low.** Guadalupe fur seals have been reported on other southern California islands, and the Farallon Islands off northern California with increasing regularity since the 1980s.	Seasonal

Table F-3 Special-Status Fish and Marine Mammal Species that may occur in the Pacific Ocean within the Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Habitat Description	Potential to Occur in the Study Area	Time Period Present in Study Area Waters
MARINE MAMMALS (CONT.)					
Harbor Porpoise *Phocoena phocoena*	MMPA	--	Common along the California coast and occasionally observed within San Francisco Bay.	**Moderate**. Common within San Francisco Bay and nearshore coastal environment.	Year-round
Risso's Dolphin *Grampus griseus*	MMPA	--	Generally found in waters greater than 1,000m in depth and seaward of the continental shelf and slopes, occasionally sighted along the central California coast.	**Low.** Typically found within waters deeper than found within the marine study area.	Year-round
Common Dolphin – Short-beaked *Delphinus delphis*	MMPA	--	A more pelagic species than the long-beaked common dolphin, ranges from British Columbia to Ecuador.	**Low**. Abundant off the coast of southern California and the Baja peninsula, rare in northern California.	Year-round
Dall's Porpoise *Phocoenoides dalli*	MMPA	--	Year-round residents of the north Pacific waters of Alaska, but have been observed as far south as Baja California.	**Low**. Uncommon in coastal California waters.	Year-round
Bottlenose Dolphin *Tursiops truncatus*	MMPA	--	Includes coastal and offshore populations along the Pacific coast of North America.	**Low**. Rare within the coastal waters of northern California.	Year-round
Pacific White-sided Dolphin *Lagenorhynchus obliquidens*	MMPA	--	Occurs in the Pacific from Alaska to Baja California. In southern California observed in schools up to 1,000 individuals.	**Low**. More common in Pacific waters north of California.	Year-round
Northern Right Whale Dolphin *Lissodelphis borealis*	MMPA	--	Deep, cold temperate waters over the continental shelf and slope from the Bering Sea to southern California along the Pacific Coast. Groups of 200 individuals are common along the southern California coast.	**Low**. More common in southern California, typically found in waters deeper than present within the study area.	Year-round

Table F-3 Special-Status Fish and Marine Mammal Species that may occur in the Pacific Ocean within the Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Habitat Description	Potential to Occur in the Study Area	Time Period Present in Study Area Waters
MARINE MAMMALS (CONT.)					
Minke Whale *Balaenoptera acutorostrata*	MMPA	--	Occur from Alaska to Baja California.	**Low**. Primarily confined to northern Pacific waters.	Year-round
Blue Whale *Balaenoptera musculus*	FE, MMPA	--	Blue whales feed only on krill and occur along the California coast between June and October, during times of high krill abundance. Blue whales begin to migrate south during November.	**Low**. Typically confined to ocean waters deeper than found within the marine study area.	Seasonal
Humpback Whale (Central American DPS) *Megaptera novaeangeliae*	FE, MMPA	--	Cosmopolitan species comprised of distinct feeding groups. Whales migrate from winter calving and mating areas to California coast in summer and fall period.	**Moderate.** Presence and occurrence along the California coast confined to summer period; May through September.	Seasonal
Humpback Whale (Mexico DPS) *Megaptera novaeangliae*	FT, MMPA	--	Most humpbacks that feed in California and Oregon waters in summer originate from the threatened Mexico DPS, while a much smaller fraction originate from the endangered Central American DPS.	**Moderate**. Presence and occurrence along the California coast confined to summer period; May through September.	Seasonal
Fin Whale *Balaenoptera physalus*	FE, MMPA	--	More common farther from shore; occasionally encountered during the summer months in close proximity to the California coast.	**Low**. Typically confined to ocean waters deeper than found within the marine study area.	Seasonal
Sperm Whale *Physeter macrocephalus*	FE, MMPA	--	Occur in many open oceans; live at the surface of the ocean but dive deeply to catch giant squid.	**Low**. Rarely encountered along the California coast.	Seasonal

Table F-3 Special-Status Fish and Marine Mammal Species that may occur in the Pacific Ocean within the Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Habitat Description	Potential to Occur in the Study Area	Time Period Present in Study Area Waters
MARINE MAMMALS (CONT.)					
Gray Whale (Eastern North Pacific DPS) *Eschrichtius robustus*	FDR, MMPA	--	Gray whales are found mainly in shallow coastal waters in the North Pacific Ocean. Most commonly encountered great whale along the California coast.	**Moderate**. Occurrence along the California coast typically confined to the winter migration period; most commonly December through February.	Seasonal
Killer Whale *Orcinus orca (Southern Resident DPS)*	FE, MMPA	--	Transient species observed throughout coastal California waters, ranging from Alaska to Costa Rica.	**Moderate**. Presence and occurrence can be common but unpredictable.	Year-round
North Pacific Right Whale *Eubalaena glacialis*	FE, MMPA	--	Seasonally migratory; inhabit colder waters for feeding, and then migrate to warmer waters for breeding and calving. Found from Alaska to California, herds containing 2,000 individuals have been observed off the southern California coast.	**Low**. Typically confined to ocean waters deeper than found within the marine study area.	Seasonal
Sei Whale *Balaenoptera borealis*	FE, MMPA	--	Observed generally in deep water habitats including along the edge of the continental shelf, over the continental slope, and in the open ocean.	**Low**. Typically confined to ocean waters deeper than found within the marine study area.	Seasonal
Short-finned Pilot Whale *Globicephala macrorhynchus*	MMPA	--	Found primarily in deep waters in warmer tropical and temperate waters, from Alaska to Peru. Forage in areas with high densities of squid, fairly common in southern California waters.	**Low**. Typically confined to ocean waters deeper than found within the marine study area.	Year-round

Table F-3 Special-Status Fish and Marine Mammal Species that may occur in the Pacific Ocean within the Study Area (Continued)

Common Name *Scientific Name*	Federal Status	State Status	Habitat Description	Potential to Occur in the Study Area	Time Period Present in Study Area Waters
MARINE MAMMALS (CONT.)					
Baird's Beaked Whale *Berardius bairdii*	MMPA	--	Inhabit deep offshore waters in the North Pacific, from Alaska to Monterey, California.	**Low**. Fairly abundant off central California from June to October. However, typically confined to ocean waters deeper than found within the marine study area.	Seasonal
Cuvier's Beaked Whale *Ziphius cavirostris*	MMPA	--	Deep pelagic waters (usually greater than 1,000m deep) of the continental shelf and slope, from Alaska to Baja California. Seasonality and migration patterns are unknown.	**Low**. Typically confined to ocean waters deeper than found within the marine study area.	Seasonality unknown

NOTES:

The "Potential for Occurrence within the Project Area" category is defined as follows:

High = Suitable foraging or spawning/rookeries/birthing habitat is present and/or the species has been documented to be present throughout the year and/or in substantial numbers.

Moderate = Suitable foraging or spawning//rookeries/birthing habitat is present and/or the species has been documented to be present for part of the year

Low = Suitable foraging or spawning/rookeries/birthing habitat is present, but the species has either not been documented to be present or if present, the presence is infrequent.

No Potential = Suitable foraging or spawning/rookeries/birthing habitat is not known to be present and the species has not been documented to occur.

FESA = Federal Endangered Species Act, MMPA = Marine Mammal Protection Act, CESA = California Endangered Species Act

Federal: National Marine Fisheries Service (NMFS)
- FE – Listed as "endangered" under FESA
- FT = Listed as "threatened" under the FESA
- FC = Candidate for listing under the FESA
- FDR = Federally Delisted
- MMPA = Marine Mammal Protection Act

State: California Department of Fish and Wildlife (CDFW)
- CE – Listed as "endangered" under the CESA
- CT = Listed as "threatened" under the CESA
- CFP = Fully protected species in California
- CSC = CDFW designated "species of special concern"

SOURCES: NOAA, 2019; NOAA, 2015; NOAA, 2020; SFPUC, April 2014; Huff, D., Lindley, S., Ranking, P, Mora, E., 2011.

Table F-4 California Coast Fish Species Managed Under the Magnuson-Stevens Fisheries Conservation Act

Fisheries Management Plan	Common Name	Scientific Name	Life Stages Present	Potential to Occur in Study Area
Coastal Pelagic	Northern anchovy	*Engraulis mordax*	L, J, A[1]	Moderate
	Pacific sardine	*Sardinops sagax*	L, J, A[1]	Moderate
	Jack mackerel	*Trachurus symmetricus*	J, A[1]	Low
	Pacific mackerel	*Scomber japonicus*	L, J, A[1]	Low
	Pacific herring	*Clupea pallasi*	L, J, A	Low
	Market squid	*Doryteuthis (Loligo) opalescens*	L, J, A[1]	Low
Pacific Groundfish	English sole	*Parophrys vetulus*	L, J[2]	Moderate
	Sand sole	*Psettichthys melanostictus*	L, J, A[1]	Moderate
	Rock sole	*Pleruonectes bilineatus*	J, A	Moderate
	Butter sole	*Pleuronectes isolepsis*	J, A	Moderate
	Pacific sanddab	*Citharichthys sordidus*	L, J, A[1]	Moderate
	Starry flounder	*Platichthys stellatus*	L, J, A[3]	Moderate
	Diamond turbot	*Hypsopsetta guttulata*	A	Moderate
	Ratfish	*Hydrolagus colliei*	J, A	Moderate
	Lingcod	*Ophiodon elongatus*	L, J, A	Low
	Brown rockfish	*Sebastes auriculatus*	L, J, A	Low
	Kelp rockfish	*Sebastes atrovirens*	L, J, A	Low
	Aurora rockfish	*Sebastes aurora*	L	Low
	Gopher rockfish	*Sebastes carnatus*	L, J, A	Low
	Splitnose rockfish	*Sebastes diploproa*	L, J	Low
	Yellowtail rockfish	*Sebastes flavidus*	A	Low
	Shortbelly rockfish	*Sebastes jordani*	L, J	Low
	Black rockfish	*Sebastes melanops*	L, J, A	Low
	Black and yellow rockfish	*Sebastes chrysomelas*	L, J, A	Very Low
	Blue rockfish	*Sebastes mystinus*	L, J, A	Low
	Boccacio	*Sebastes paucispinis*	L, J, A	Low
	Grass rockfish	*Sebastes rastrelliger*	L, J, A	Low
	Stripetail rockfish	*Sebastes saxicola*	L, J	Low
	Juvenile & larval rockfish	*Sebastes spp.*	J, L	Low
	Leopard shark	*Triakis semifasciata*	J, A	Low-Moderate
	Spiny dogfish	*Squalus acanthias*	A, J,	Low-Moderate
	Soupfin shark	*Galeorhinus zyopterus*	J, A	Low-Moderate
	Big skate	*Raja binoculata*	J, A	Low-Moderate
	California skate	*Raja inornata*	J, A	Low-Moderate
	Longnose skate	*Raja rhina*	J, A	Low-Moderate
	Cabezon	*Scorpaenichthys marmoratus*	L, J, A	Low-Moderate

Table F-4 California Coast Fish Species Managed Under the Magnuson-Stevens Fisheries Conservation Act (Continued)

Fisheries Management Plan	Common Name	Scientific Name	Life Stages Present	Potential to Occur in Study Area
Pacific Coast Salmon	Chinook salmon	*Oncorhynchus tshawytscha*	J, A	Low, during migration
	Coho salmon	*Oncorhynchus kisutch*	J, A	Low, during migration
Highly Migratory Species	Common thresher shark	*Alopias vulpinus*	J, A	Low
	Shortfin mako shark	*Isurus oxyrinchus*	J, A	Low, Present in waters deeper than 600 feet
	Albacore tuna	*Thunnus alalunga*	J, A	Low
	Northern bluefin tuna	*Thunnus orientalis*	J	Low, Present in waters deeper than 600 feet

NOTES: Life Stages- A = Adult, J = Juvenile, L = Larvae

SOURCES: Tenera, 2014; Boehlert & Mundy, 1987; PFMC, 2005; Allen, 2014; NOAA, 2014a; NOAA, 2016b; Lenarz, 1980; Miller and Shanks, 2004; SIMoN, 2016c; CDFG, 2001; CDFW, 2016; Driscoll, 2014; NPS 2021.

F.2 Special-Status Species Descriptions

Detailed summaries of selected special-status plant and animal species with potential to occur in the project study area are presented below.

F.2.1 Special-Status and Otherwise Protected Plants

Most of the special-status plant species identified in Table F-1 were determined to have no potential or low potential to occur in the study area. One special-status plant, San Francisco spineflower, was determined to have a moderate potential to occur in the terrestrial study area. This species was identified south of the terrestrial study area during rare plant surveys performed in 2019 and 2020 in support of the biological resources assessment.[9] A detailed description of this species, its suitable habitat, and presence proximate to the terrestrial study area are provided below.

SAN FRANCISCO SPINEFLOWER

San Francisco spineflower (*Chorizanthe cuspidata cuspidata*) is an annual herb with a California Rare Plant Rank of 1B.2 which occupies sandy soils in coastal dunes, coastal dune scrub, coastal bluff scrub, and coastal prairie. Its current range includes Marin, San Francisco, San Mateo, and Sonoma counties.[10] This species is known to occur within dune mat vegetation communities along the coast south of the terrestrial study area into Fort Funston where suitable habitat is present.[11,12] San Francisco spineflower plants were documented

9 BioMaAS, 2021. Ocean Beach Climate Change Adaptation Project Biological Resources Assessment, prepared for the San Francisco Public Utilities Commission, September 2021.

10 Calflora: Information on California plants for education, research and conservation, with data contributed by public and private institutions and individuals, including the Consortium of California Herbaria. [web application]. 2020. Berkeley, California: The Calflora Database [a non-profit organization]. Available: https://www.calflora.org/ Accessed: Jun 17, 2020.

11 BioMaAS, 2021. Ocean Beach Climate Change Adaptation Project Biological Resources Assessment, prepared for the San Francisco Public Utilities Commission, September 2021.

12 National Park Service. 1997-2018. Rare Plants of Fort Funston – North. Unpublished map of special-status plants and CRPR 3 and 4 plant species created by Michael Chasse, National Park Service, 1997-2018; draft not for public use.

south of the terrestrial study area in Fort Funston during rare plant surveys in 2019 and 2020 within gaps in dune mat vegetation with loose sandy soils and few other plant associates.[13] These same surveys documented spineflower south of the zoo gravel parking lot in disturbed dune scrub vegetation and higher quality dune scrub vegetation dominated by native species. Neither of these locations are within areas to be disturbed by the project. As San Francisco spineflower is an annual species, abundance is variable from year to year. Established populations rely on seed bank stores in the soil resulting in predictable identification of micro populations in any given year. While suitable dune mat vegetation with sandy soils is present throughout much of the study area, San Francisco spineflower has not been documented within the project areas or the 15 to 50-foot buffer that comprises the terrestrial study area.

F.2.2 Special-Status Terrestrial Animals and Other Sensitive Species

Many of the special-status terrestrial animals or other sensitive species identified in Table F-2 have no potential to occur in the terrestrial study area or a low potential to occur in the terrestrial study area due to the absence of suitable habitat that is required by the animal species or necessary for their survival. Several special-status birds are known to occupy the study area periodically throughout the year, including western snowy plover, bank swallow (*Riparia riparia*), San Francisco common yellowthroat (*Geothlypis trichas sinuosa*), and western burrowing owl (*Athene cunicularia hypugaea*). Some of these species, along with other resident and migratory birds, such as double-crested cormorant (*Phalacrocorax auritus*), and Cooper's hawk (*Accipiter cooperi*), also have potential to occupy and nest within the terrestrial study area. Western red bat, and western and Crotch bumble bees were also determined potentially present. Other bats, including silver-haired bat, hoary bat, little brown bat and fringed myotis could also occur. Each of these species is described in detail below.

SPECIAL-STATUS BUMBLE BEES

The Crotch bumble bee (*Bombus crotchii*) and western bumble bee (*Bombus occidentalis*) are candidates for listing as endangered under the California Endangered Species Act. Bumble bees inhabit a wide variety of natural, agricultural, urban, and rural habitats, although species richness tends to peak in flower-rich meadows of forests and subalpine zones.[14] Like most other bumble bees, Crotch bumble bee and western bumble bee have three basic habitat requirements: suitable nesting sites for the colonies, nectar and pollen from floral resources available throughout the duration of the colony period (spring, summer and fall), and suitable overwintering sites for queens. The Crotch bumblebee favors the select food plant families *Fabaceae, Apocynaceae, Asteraceae, Lamiaceae, Hydrophyllacae, Asclepiadaceae* and *Boraginaceae* and the western bumblebee favors *Melilotus, Cirsium, Trifolium, Centaurea, Chrysothamnus* and *Eriogonum* though has been documented visiting a wide variety of flowering plants. Most bumble bees nest in the ground in cavities such as abandoned rodent burrows, holes in building foundations, or stacks of firewood.[15] The Crotch bumble bee is nearly endemic to California, historically ranging across southern California, from the coast and coastal ranges, through the Central Valley, and to the adjacent foothills. The listing petition indicates the Crotch bumble bee's range declined 25 percent relative to its historical range in recent years, with this decline particularly pronounced in the center of its historical range, the Central

[13] BioMaAS, 2021. Ocean Beach Climate Change Adaptation Project Biological Resources Assessment, prepared for the San Francisco Public Utilities Commission, September 2021.

[14] Goulson, D. 2010. Bumblebees: Behavior, Ecology, and Conservation. Oxford University Press. 317 pages.

[15] United States Department of Agriculture, 2012. Bumble Bees of the Western United States.

Valley.[16] The listing petition for western bumble bee considers that approximately 20 records describe this species' current distribution in the state. In California, western bumble bee populations are now largely restricted to high elevation sites in the Sierra Nevada, though there have been a few observations of this species near the coast.[17,18]

Detailed surveys have not been performed to describe the bumble bee fauna in the project region. The California Natural Diversity Database documents no occurrence records of Crotch bumble bee within 5 miles of the project study area.[19] The same database documents eight records of western bumble bee within five miles of the project study area dating from 1954 to 1998, each occurrence record presumed extant.[20] The bumble bee identification sites conceivably provide similar habitat conditions as when records originated as they each occur within vegetated parks or open space areas of the San Francisco peninsula which have been protected from development. Suitable foraging and burrowing habitat is available in the study area for the Crotch bumble bee and the western bumble bee. Potential forage plants are present in the study area and burrows and natural expansion cracks may support bumble bee nesting. Both species are exceedingly uncommon and based on their rarity and range declines, are not expected in the project area. The Crotch bumble bee and western bumble bee, while included in the special-status species discussion here, are considered to have a low potential to occur within the terrestrial study area and are not discussed further in the analysis.

SPECIAL-STATUS BIRDS

WESTERN SNOWY PLOVER

Migratory western snowy plover (*Charadrius nivosus nivosus*) is a federally threatened species and California species of special concern. The coastal population breeds along the Pacific coast from southern Washington to southern Baja California, Mexico, with the majority of birds breeding along the California coast. Nesting season runs from mid-March through mid-September. At beaches, it forages above and below the mean high-water line, gathering food from sand surface, kelp, marine mammal carcasses, or low foredune vegetation.[21] On Pacific coast beaches, plovers are thought to feed on mole crabs (*Emerita analoga*), crabs (*Pachygrapsus crassipes*), polychaetes, amphipods, sand hoppers (*Orchestoidea*), tanadacians (*Leptochelia dubia*), flies, beetles, clams, and ostracods.[22]

This species winters on Ocean Beach, typically present between July and May, but does not nest in the study area. Snowy plover presence on Ocean Beach is highest between January and March. The National Park

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16 California Department of Fish and Wildlife, 2019. Evaluation of the Petition from the Xerces Society, Defenders of Wildlife, and the Center for Food Safety to List Four Species of Bumble Bees as Endangered Under the California Endangered Species Act. Report to the Fish and Game Commission, April 4, 2019.

17 Ibid

18 The Xerces Society for Invertebrate Conservation, 2018. A Petition to the State of California Fish and Game Commission to List The Crotch bumble bee (Bombus crotchii), Franklin's bumble bee (Bombus franklini), Suckley cuckoo bumble bee (Bombus suckleyi), and western bumble bee (Bombus occidentalis occidentalis) as Endangered under the California Endangered Species Act. Submitted by The Xerces Society for Invertebrate Conservation, Defenders of Wildlife, Center for Food Safety, October 2018.

19 California Department of Fish and Wildlife, California Natural Diversity Database (CNDDB) Rarefind version 5 query of the San Francisco North and San Francisco South USGS 7.5-minute topographic quadrangles, Commercial Version, accessed May 29, 2020.

20 Ibid.

21 Page, G.W., J.S. Warriner, J.C. Warriner, and P.W.C. Paton. 1995. Snowy plover (*Charadrius alexandrinus*). Pages 1-24, A. Poole and F. Gill, eds., In: The Birds of North America, No. 154. The Academy of Natural Sciences, Philadelphia, PA, and the American Ornithologists' Union, Washington, D.C

22 Ibid.

Service established a Snowy Plover Protection Area on Ocean Beach in 2008 to provide a protection zone for overwintering birds; the protection area is located on Ocean Beach between Stairwell 21 and Sloat Boulevard.[23] Plovers are not uniformly distributed along Ocean Beach; rather, they tend to be concentrated in three sectors: between Lincoln Way and Judah Street, between Noriega and Pacheco Streets, and between Pacheco and Rivera Streets, all north of the South Ocean Beach project area.[24] Only the access route to the North Ocean Beach project area overlaps with the designated protection area. Snowy plovers will rest in shallow depressions of the beach where they are protected from the wind and forage on invertebrates in the wrack of the tide line to build up fat reserves for breeding.

Biological monitoring for western snowy plover has been implemented as a condition of the coastal development permits for the South Ocean Beach Bluff Repair Project (2016) and the South Ocean Beach Sand Backpass Project (2018) which each involved equipment access and sand excavation on North Ocean Beach in the same locations that would be used under the project. Biologists implementing snowy plover protection measures during seasonal monitoring of excavation activity in 2016 and 2018did not observe the species in the sand excavation area or along the equipment access route.[25,26] While the north boundary of the species' protection area extends into the North Ocean Beach sand excavation area, snowy plover appear to prefer portions of the protected area further south of Stairwell 21 (i.e. south of Lincoln Blvd). Biologists' observations of western snowy plover behavior south of the sand excavation area note that birds were typically foraging and confined to wetted sand where they appeared unaffected by excavation activity or equipment access.

BANK SWALLOW

Bank swallow (*Riparia riparia*) is a California threatened species which seasonally inhabit California to breed and rear young before returning to Central and South America. This species is an aerial forager of primarily flying or jumping insects that occur over grasslands, wetlands, and open waters of rivers, streams, ponds, and lakes. In California, active bank swallow nesting is concentrated between April 1 and August 1, where groups of swallows create burrows in vertical banks or bluffs with sandy substrate of rivers or in coastal areas as a colony to incubate eggs and rear their young. Bank swallow burrow nest locations can be seen as small holes (two to four inches in diameter) in the cliff face. During breeding when young are being fed, feeding sites are usually within approximately 150-650 feet of the colony;[27] therefore, bank swallows are expected to forage throughout the study area and occur while flying to forage over Lake Merced.

A bank swallow breeding colony has been using the bluffs above Ocean Beach within and south of the study area into Fort Funston since 1905.[28] This location hosts one of only a few remaining coastal bank swallow breeding colonies in California.[29] The section of bluffs historically used by bank swallow for breeding and rearing young consists of a 0.5-mile span of bluff face, with the north boundary located west of the

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23 National Park Service, 2006. Protecting the Snowy Plover, NU.S. Department of the Interior, Golden Gate National Recreation Area, October, 2006.

24 BioMaAS, 2021. Ocean Beach Climate Change Adaptation Project Biological Resources Assessment, prepared for the San Francisco Public Utilities Commission, September 2021.

25 Monitoring Report Summary; South Ocean Beach Bluff Repair, San Francisco, California. 2016. Letter to YinLan Zhang, Bureau of Environmental Management, San Francisco Public Utilities Commission, from Bill Stagnaro, BioMaAS, Inc. March 4, 2016.

26 2018 Monitoring Report Summary; South Ocean Beach Sand Backpass, San Francisco, California. 2018. Letter to JT Mates-Muchin, Bureau of Environmental Management, San Francisco Public Utilities Commission, from Bill Stagnaro, BioMaAS, Inc. June 28, 2018.

27 Bank Swallow Technical Advisory Committee (BSTAC), 2013. Bank Swallow (Riparia riparia) Conservation Strategy for the Sacramento River Watershed, California, Version 1.0 [www.sacramentoriver.org/bans/] Accessed September 4, 2015.

28 National Park Service, 2007. Bank Swallow Monitoring at Fort Funston, Golden Gate National Recreation Area 1993-2006. March 23, 2007.

29 Laymon, S.A., B.A. Garrison, and J.M. Humphrey. 1987. Historic and current status of the bank swallow in California. Report to the State of California Department of Fish and Game, Admin Report 88-2.

Oceanside Treatment Plant above the 2010 rock revetment, within the South Ocean Beach project area.[30] The National Park Service has been tracking the bank swallow colony abundance and nesting locations in these bluffs since 1993 with a consistent burrow count methodology utilized by monitors since 2000.[31] The park service has designated monitoring areas within the bluff span historically occupied by the colony during nesting season to track their use and abundance from year to year (see Figure 4.6-3 in EIR Section 4.6, Biological Resources).These monitoring areas, from north to the south include Area A, Area B – Revetment, Area 1 – North End to Gap, Area 2 – Gap to Gunmount, Area 3 – Gunmount to Panama Point, and Area 4 – Panama Point to Beach Access; Area A and Area B – Revetment, are located within the project area.[32,33] In 2019, nesting was documented for the first time at Phillip Burton Memorial Beach, one mile south of the project area boundary with Fort Funston and outside of the park service monitoring locations.[34] The park service documented bank swallow nesting at this location again in 2020 and 2021.[35,36]

Since park service monitoring began, the location where bank swallows establish a majority of their burrow nests in a given year has routinely shifted within the monitoring areas depending on where the most suitable habitat for nesting is located. Bluff erosion, accessibility of burrows to predators, or parasite infestation in burrows from a previous season can be factors which influence where the colony decides to nest. The rock revetment shoreline armoring within the project area has slowed bluff erosion at this location allowing the vertical bluff face to persist, a feature preferred by this species for burrow placement due to the protection the vertical plane provides from predators. The park service monitors have documented the bluffs above the rock revetment (area B) as hosting the greatest number of the colony's burrows between 2011 and 2019.[37] Although area B had been favored (2011 to 2018), the park service monitoring data documents bank swallow preference for other portions of coastal bluffs within the larger colony for years at a time; area 3 hosted the greatest number of the colony's burrows between 2001 and 2004, and area 1 hosted the most burrows between 2005 and 2010.[38] In 2019, bank swallows also nested in the bluffs above Phillip Burton Memorial Beach, outside of the boundaries of the historical nesting location, at the border of San Francisco and San Mateo counties.[39] In 2020, the Fort Funston bank swallow exclusively nested above Phillip Burton Memorial Beach marking the first time since the park service began monitoring that bank swallows did not nest within the boundaries of the Golden Gate National Recreation Area.[40] Monitoring updates on bank swallow nesting provided by the park service in June and November 2021 indicated that bank swallows did not nest within the historical nesting location in 2021 (including the project area bluffs) but rather continued to nest above Phillip Burton Memorial Beach.[41,42]

Burrow abundance within the boundaries of the historical nesting location (monitoring areas A, B and 1 through 4) has declined overall since 2007 (294 burrows recorded), with the lowest burrow count recorded in

30 National Park Service, 2019. Bank Swallow Monitoring at Fort Funston, GGNRA, 2019 NPS Report.
31 Ibid.
32 National Park Service, 2019. Bank Swallow Monitoring at Fort Funston, GGNRA, 2019 NPS Report.
33 National Park Service, 2020. 2020 Bank Swallow Summary Report.
34 National Park Service, 2019. Bank Swallow Monitoring at Fort Funston, GGNRA, 2019 NPS Report.
35 National Park Service, 2020. 2020 Bank Swallow Summary Report.
36 National Park Service, 2021. Bank Swallow Monitoring Update, June 2021.
37 National Park Service, 2019. Bank Swallow Monitoring at Fort Funston, GGNRA, 2019 NPS Report.
38 Ibid.
39 National Park Service, 2020. 2020 Bank Swallow Summary Report.
40 Ibid.
41 National Park Service, 2021. Bank Swallow Monitoring Update, June 2021.
42 National Park Service, 2021, Email from Bill Merkel (NPS) to Jonathan Mates-Muchin (SFPUC) re: Bank Swallow Nesting 2021. November 17, 2021.

2019 (88 burrows) until no active burrow nests were recorded in 2020.[43,44] The park service monitors estimated 44 burrows were in use in the bluffs above Phillip Burton Memorial Beach in 2020 and 41 burrows in use at this same location in June 2021.[45,46] During a field visit performed in support of the project's biological resources assessment in June 2019, the biologist detected 36 suitable burrows, 20 collapsed burrows and two active bank swallow burrow nest sites in area B within the project area.[47]

SAN FRANCISCO COMMON YELLOWTHROAT

San Francisco common yellowthroat (*Geothlypis trichas sinuosa*) is a California species of special concern and a bird of conservation concern. The current species range includes four main areas: coastal riparian and wetland areas of western Marin County, the tidal marsh system of San Pablo Bay, the tidal marsh system of southern San Francisco Bay, and coastal riparian and wetland areas in San Mateo County. Isolated resident populations also exist, including a breeding population at Lake Merced where they nest in periphery riparian wetland vegetation. Bulky, open nest cups are built on tussocks, bulrushes or sedges.[48] There is not suitable breeding habitat in the terrestrial study area; however, the marsh vegetation along the edge of South Lake Merced at the Skyline Boulevard/Great Highway intersection east of the terrestrial study area may provide suitable nesting habitat for this species and individuals may occur in the study area during breeding season while foraging.

WESTERN BURROWING OWL

The western burrowing owl (*Athene cunicularia hypugaea*) is listed as a California species of special concern and considered a bird of conservation concern. Western burrowing owls are relatively small, semicolonial owls, and are mostly residents of open dry grasslands and desert areas. They occupy burrows for both breeding and roosting. They use burrows excavated by ground squirrels and other small mammals and will use human-made burrows and cavities. Where the number and availability of natural burrows is limited, owls may occupy human-made burrows such as drainage culverts, cavities under piles of rubble, discarded pipe, and other tunnel-like structures.[49] Burrowing owls hunt from perches and are opportunistic feeders. They consume arthropods, small mammals (e.g., meadow voles), birds, amphibians, and reptiles. Insects are often taken during the day, while small mammals are taken at night.[50] Western burrowing owl are not expected to breed in the study area; however, they have been recorded overwintering at Ocean Beach. One individual has been present in the riprap west of the Great Highway, across from the Oceanside Treatment Plant within the study area. This individual has been documented by members of the Golden Gate Audubon Society repeatedly flying from the riprap, in late afternoon and head directly south-southeast over toward the Lake Merced area.[51] A second burrowing owl individual has been recorded

43 National Park Service, 2019. Bank Swallow Monitoring at Fort Funston, GGNRA, 2019 NPS Report.
44 National Park Service, 2020. 2020 Bank Swallow Summary Report.
45 Ibid.
46 National Park Service, 2021. Bank Swallow Monitoring Update, June 2021.
47 BioMaAS, 2021. Ocean Beach Climate Change Adaptation Project Biological Resources Assessment, prepared for the San Francisco Public Utilities Commission, September 2021.
48 Erlich, P.R., David S. Dobkin, and D. Wheye, 1988. The Birder's Handbook: A Field Guide to the Natural History of North American Birds, Simon and Schuster: NY.
49 Zeiner, D.C., W.F. Laudenslayer, Jr., K.E. Mayer, and M. White, eds. 1990. California's Wildlife, Volume II.
50 Ibid.
51 Personal communication with Audubon Citizen Scientist Jane Hart, 2017. Ms. Hart monitored these owls from 2014-2016.

beneath the staircase and walkway of the Great Highway at Noriega Street, approximately 1.1 mile north of the South Ocean Beach project area.[52]

CALIFORNIA BROWN PELICAN

California brown pelican (*Pelecanus occidentalis californicus*) is a California fully protected species which occur in estuarine, marine subtidal, and marine pelagic waters throughout coastal California. Important habitat for pelicans during the nonbreeding season includes roosting and resting areas, such as offshore rocks, islands, sandbars, breakwaters, and pilings. Nesting and communal roost sites are protected by CDFW. Suitable areas need to be free of disturbances, including regular human activity. This species rests temporarily on the water or isolated rocks, but roosting requires a dry location near food and a buffer from predators and humans. There are no communal roost sites within the terrestrial or marine study areas. The California brown pelican is a common post-breeding resident (May through November) of the Bay Area region. This specie's breeding range is limited to the Channel Islands south to central Mexico. Brown pelican presence within the marine study area would be limited to foraging in open waters of the Pacific Ocean.

OTHER RESIDENT AND MIGRATORY BIRDS

Although many native birds are not considered to be special-status species, their nests are protected by the Migratory Bird Treaty Act and the California Fish and Game Code. Several migratory birds that do not have special-species status could nest in trees and shrubs and on buildings within the study area. Several raptors are known to nest in San Francisco in suitable habitat, which is present in mature trees of the study area bordering Zoo Road. These species may include red-tailed hawk (*Buteo jamaicensis*), red shouldered hawk (*B. lineatus*), American kestrel (*Falco sparverius*), Cooper's hawk (*Accipiter cooperi*), and great horned owl (*Bubo virginianus*). Double-crested cormorants have nested in eucalyptus groves on the western side of South Lake Merced and on the northwest edge of North Lake Merced since at least 1997.[53] Nesting activity at the North Lake rookery was observed during surveys performed for the biological resources assessment. The rookery is located across Skyline Boulevard from the Pomeroy Recreation and Rehabilitation Center, east of the terrestrial study area.[54] This species forages in the Pacific Ocean and Lake Merced and is regularly observed offshore of South Ocean Beach. The study area also hosts many native passerine birds during the breeding season, such as black phoebe (*Sayornis nigricans*), pygmy nuthatch (*Sitta pygmaea*), house finch, and Anna's hummingbird (*Calypte anna*).[55] While whimbrel, long-billed curlew (*Numenius americanus*), sanderling, western sandpiper, willet and marbled godwit do not nest on beaches and intertidal areas of the San Francisco peninsula, these shorebirds frequent such habitat zones on Ocean Beach for foraging during migration or overwintering within the study area.[56] California gull will also forage on study area beaches; established breeding colonies for this species are not present in the terrestrial study area. Many seabirds have at least a moderate potential to occur in the marine study area, including Clark's grebe (*Aechmophorus clarkia),* black turnstone *(Arenaria melanocephala),* Herring gull *(Larus argentatus),* ring-billed gull *(Larus delawarensis),* white-winged scoter *(Melanitta fusca),* black scoter *(Melanitta nigra),* surf scoter *(Melanitta*

[52] BioMaAS, 2021. Ocean Beach Climate Change Adaptation Project Biological Resources Assessment, prepared for the San Francisco Public Utilities Commission, September 2021.
[53] EIP (EIP Associates). 2000. Survey results for California red-legged frogs, Lake Merced, San Francisco County, California. Prepared for San Francisco Recreation and Parks Dept., Natural Areas Program.
[54] BioMaAS, 2021. Ocean Beach Climate Change Adaptation Project Biological Resources Assessment, prepared for the San Francisco Public Utilities Commission, February 2021.
[55] San Francisco Field Ornithologists, 2003. Draft San Francisco Breeding Bird Atlas.
[56] Gulf of the Farallones National Marine Sanctuary (GFNMS) and Farallones Marine Sanctuary Association (FMSA), 2006. Beach Watch 2006 Annual Report.

perspicillata), red breasted merganser *(Mergus serrator),* red phalarope *(Phalaropus fulicarius),* red-necked phalarope *(Phalaropus lobatus),* and common murre *(Uria aalge)*; none of these species breed locally. The Migratory Bird Treaty Act and California Fish and Game Code protect raptors, most native migratory birds, and resident breeding birds that would occur and/or nest in the terrestrial study area.

SPECIAL-STATUS BATS

WESTERN RED BAT

Western red bat (*Lasiurus blossevillii*) is a California species of special concern. This species is typically solitary, roosting primarily in the foliage of trees or shrubs. Day roosts are commonly in edge habitats adjacent to streams or open fields, in orchards, and sometimes in urban areas. This bat may also occasionally use caves. The National Park Service detected western red bat vocalizations during acoustic monitoring at Fort Funston between 2004 and 2005.[57] Trees and shrubs of the terrestrial study area near the zoo and within Fort Funston adjacent open space for foraging insects provide suitable habitat for this species.

OTHER BAT SPECIES

Several bat species without special federal or state protective status have potential to forage and roost within suitable habitat of the study area. These species include silver-haired bat (*Lasionycteris noctivagans*), hoary bat (*Lasiurus cinereus*), little brown bat (*Myotis lucifugus*), and fringed myotis (*Myotis thysanodes*), each detected during acoustic monitoring performed at Fort Funston between 2004 and 2005, south of the study area.[58] While these individuals are not considered a sensitive resource afforded protection under the federal or California endangered species acts, their maternity roosts are protected under California Fish and Game Code and CEQA as wildlife nursery sites. Silver-haired bats establish maternity roosts almost exclusively in trees, utilizing hollows, cavities excavated by birds or under loose bark. Hoary bat is the most widespread bat in North America and can be found throughout California where suitable foraging and roosting habitat is present. Hoary bats generally roost in dense foliage of medium to large trees. Little brown bat is also common in North America and California and breeding females establish communal maternity roosts or colonies. This species may also establish roosts in tree cavities but will use caves and even human-occupied structures. Fringed myotis is widespread throughout western North America and establishes roosts in crevices in buildings, underground mines, rocks, cliff faces, bridges, and large trees and snags.

F.2.3 Special-Status Marine Species

SPECIAL-STATUS FISH

CHINOOK SALMON

The Chinook salmon (*Oncorhynchus tshawytscha*) that inhabit the San Francisco Bay are comprised of three distinct races: winter-run, spring-run, and fall/late fall-run.[59] These races are distinguished by the seasonal differences in adult upstream migration, spawning, and juvenile downstream migration. Chinook salmon are anadromous fish, spending three to five years at sea before returning to fresh water to spawn. These fish

57 Fellers, Gary M. 2005. Acoustic Inventory and Monitoring of Bats at Golden Gate National Recreation Area. USGS.
58 Fellers, Gary M. 2005. Acoustic Inventory and Monitoring of Bats at Golden Gate National Recreation Area. USGS.
59 These races are referred to as Evolutionarily Significant Units.

pass through San Francisco Bay waters to reach their upstream spawning grounds. In addition, juvenile salmon migrate through the bay en route to the Pacific Ocean.

Sacramento River winter-run Chinook salmon, listed as endangered under the federal and state endangered species acts, migrate through the San Francisco Bay from December through July with a peak in March.[60] Central Valley spring-run Chinook, listed as threatened under the federal and state endangered species acts, migrate to the Sacramento River from March to September with a peak spawning period between late August and October.[61] The Central Valley fall/late fall-run Chinook salmon is a California species of special concern.

Upon entry into the ocean, Chinook salmon tend to stay along the continental shelf of the California and Oregon coast, but migration may continue to higher latitudes. They stay at depths that are typically in the range of 65 to 150 feet although the range can vary from 0 to 328 feet (0 to 100 meters) depending on the season.[62] As they grow larger and mature into adults, fish becomes a dominant part of their diet. Adult Chinook salmon spend one to five years in the ocean before returning to their natal stream to spawn; therefore they depend on the nearshore and estuarine environments for spawning habitat.[63]

Chinook salmon may use the marine study area for foraging, or simply as passage during migration and dispersal. Individuals or aggregations of various evolutionary significant units would only be expected to occur temporarily (or perhaps intermittently) and are not expected to reside permanently in the offshore marine environment. The nearshore areas provide forage opportunities contributing to the growth and successful survival of the species.[64]

STEELHEAD

Similar to Chinook salmon, steelhead (*O. mykiss*) within California are subdivided into distinct population segments based on their life history. Along the central California coast, both the federally threatened Central California Coast steelhead and federally threatened California Central Valley steelhead may use the open water habitat adjacent to the project study area as a migratory corridor from the Pacific Ocean to spawning habitat.

The ocean phase of steelhead is not well studied, and poorly understood. Studies of other salmonid species in the ocean environments have found specimens of steelhead, and therefore it is believed the species does not congregate in large schools like other Pacific salmon of the genus *Oncorhynchus*.[65] Some anadromous salmonids have been found in coastal waters relatively close to their natal rivers, while others may range widely in the North Pacific.[66] Adults feed on aquatic and terrestrial insects, mollusks, crustaceans, fish eggs, minnows, and other small fishes (including other trout).

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60 Moyle, P.B., Inland Fishes of California, University of California Press, Berkeley and Los Angeles, CA, 2002.

61 Ibid.

62 California Department of Fish and Wildlife, Inland and Anadromous Fisheries: Chinook Species Account, 2016a.

63 National Marine Fisheries Service, Final Coastal Multispecies Recovery Plan: California coastal Chinook Salmon; Northern California Steelhead; Central California Coast Steelhead. October. West Coast Region, Santa Rosa, California, 2016b.

64 National Oceanic and Atmospheric Administration, National Ocean Service. Monterey Bay Notational Marine Sanctuary Site Characterization, Various authors, 2014, Available: *http://montereybay.noaa.gov/sitechar/welcome.html*.

65 National Marine Fisheries Service, South-central California Coast Steelhead Recovery Plan, West Coast Region, California Coastal Area Office, Long Beach, California, 2013.

66 National Marine Fisheries Service, Final Coastal Multispecies Recovery Plan: California coastal Chinook Salmon; Northern California Steelhead; Central California Coast Steelhead. October. West Coast Region, Santa Rosa, California, 2016b.

While central California coast steelhead are known to occur within multiple coastal and San Francisco Bay streams, none are in proximity to the marine study area. Central Valley steelhead only spawn in the Sacramento and San Joaquin River watersheds. As such, any occurrence of these populations within the project study area would be temporary, and only occur as steelhead move through the open water habitat adjacent to the project site during migration between the Pacific Ocean and freshwater spawning grounds.

COHO SALMON

The California Coastal Coho salmon run is listed as endangered under the federal and state endangered species acts. Coho are typically associated with small to moderately sized coastal streams characterized by heavily forested watersheds; perennially flowing reaches of cool, high-quality water; dense riparian canopy; deep pools with abundant overhead cover; in-stream cover consisting of large, stable woody debris and undercut banks; and gravel or cobble substrates.[67]

In contrast to the life history patterns of other anadromous salmonids, Coho salmon in California generally exhibit a relatively simple 3-year life cycle. Adult salmon typically begin the freshwater migration from the ocean to their natal streams after heavy late-fall or winter rains breach the sand bars at the mouths of coastal streams. Migration continues into March, but generally peaks in December and January, with spawning occurring shortly after returning to the freshwater spawning ground. Female Coho salmon choose spawning sites usually near the head of a riffle, just below a pool, where water changes from a laminar to a turbulent flow and there is small to medium gravel substrate. The flow characteristics of the *redd* (spawning nest) location usually ensure good aeration of eggs and embryos and flushing of waste products. Coho salmon may spawn in more than one redd and with more than one partner.[68]

After eggs hatch, the fry gradually transition from shallow water along stream margins to deep pools. Preferred rearing habitat has little or no turbidity and abundant cover, with sustained invertebrate forage production. In the spring, as yearlings, juvenile Coho salmon undergo a physiological process, or smoltification, which prepares them for living in the marine environment. They begin to migrate downstream to the ocean during late March and early April, and out-migration usually peaks in mid-May, if conditions are favorable.[69]

After entering the ocean, the immature salmon initially remain close to their natal stream. Eventually, they move north along the coast along the continental shelf, congregating in schools. During this time, they are primarily piscivorous, foraging on small fish and marine invertebrates.[70] The amount of time spent in the ocean environment is variable, but most remain for 2 years and some return to their natal streams after the first year.[71]

California stocks typically remain in coastal water near their natal stream for at least the first summer; although, depending on annual and seasonal changes in oceanographic conditions, they may instead migrate northward into offshore waters of the Pacific Ocean after only spending a few weeks in coastal waters. These movements are influenced by ocean currents and the strength of the coastal upwelling. With

67 Moyle, P.B., Inland Fishes of California, University of California Press, Berkeley and Los Angeles, CA, 2002.
68 California Department of Fish and Wildlife, Inland and Anadromous Fisheries: Coho Species Account, 2016c.
69 Ibid.
70 National Oceanic and Atmospheric Administration, National Ocean Service (NOS), Monterey Bay Notational Marine Sanctuary Site Characterization, various authors, 2014.
71 California Department of Fish and Wildlife, Inland and Anadromous Fisheries: Coho Species Account, 2016c.

weak upwelling, Coho salmon concentrate in upwelling zones closer to the shore and in association with submarine canyons. Generally, the majority of juvenile salmon are found within 23 miles of the coast. The highest concentrations appear to be found in more productive waters of the continental shelf, outside of the marine study area. Coho salmon rarely use areas where sea surface temperature exceeds 59 degrees Fahrenheit (°F); they are generally found in the uppermost 32 feet (10 meters) of the water column. When juveniles first enter marine waters their primary diet includes marine invertebrates, such as copepods, euphausiids, amphipods, and carb larvae. Sub-adults and adults consume primarily fishes, including capelin, northern anchovy, clupeids (e.g., herring, shad, and menhadens), and osmerids (e.g., smelt).[72] These conditions are similar to those found offshore of the project site and may support juveniles, sub-adults, and adults for short periods of time.

GREEN STURGEON

The federally threatened, southern distinct population segments of North American green sturgeon (*Acipenser medirostris*) are the most widely distributed member of the sturgeon family and the most marine-oriented of the sturgeon species, entering rivers only to spawn. Within bays and estuaries, sufficient water flow is required to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds. Green sturgeon migrating between the Pacific Ocean and spawning habitat in the Sacramento River watershed rarely travel south of the San Francisco Bay Bridge. Typically, adults take a more direct route from San Pablo Bay, passing through Raccoon Strait adjacent to Angel Island, and out the Golden Gate Bridge.[73]

In the marine environment, sub-adults and adults occupy water to a depth of 360 feet (110 meters), and congregate in coastal bays and estuaries of continental U.S. during the summer and fall. In winter and spring, they are found in aggregations in British Columbia, Canada.[74] Little is known about the feeding of the green sturgeon in marine environments. They likely feed on benthic invertebrates, including shrimp, mollusk, amphipods, and small fish.[75] So while sturgeon do have the potential to occur year-round within the project area, their presence is likely to be temporary during migration between freshwater spawning habitat and the Pacific Ocean.

SPECIAL-STATUS MARINE REPTILES

LEATHERBACK SEA TURTLE

Leatherback sea turtles are listed as endangered under the federal Endangered Species Act and is a candidate for listing under the California Endangered Species Act. They are able to use a wide variety of marine ecosystems through a number of species-specific physiological, anatomical, and behavioral adaptations. Typically, they are associated with continental shelf habitat and pelagic environments.[76] They are able to use areas that are much colder than those in which other sea turtles are capable of surviving, but

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72 Pacific Fishery Management Council, Appendix A to the Pacific Coast Fishery Management Plan: Identification and Description of Essential Fish Habitat, Adverse Impacts, and Recommended Conservation Measures for Salmon, September 2014.

73 Kelly, J.T, A.P Klimley, and C.E. Crocker, Movements of green sturgeon, *Acipenser medirostris*, in the San Francisco Bay Estuary, Environmental Biology of Fishes, 2007.

74 National Marine Fisheries, Federal Recovery Outline North American Green Sturgeon Southern Distinct Population Segment, Southwest Region, 2010.

75 National Marine Fisheries Service, Recovery Plan for the Southern Distinct Population Segment of North American Green Sturgeon (*Acipenser medirostris*), 2018.

76 National Marine Fisheries Service and U.S. Fish and Wildlife Service, Recovery Plan for the U.S. Pacific Populations of the Leatherback Turtle (*Dermochelys coriacea*), 1998.

must have access to large amounts of food to meet their energetic demands. They are associated with areas of high productivity where they have access to food resources, including gelatinous organisms (jellyfish, particularly medusa, siphonophores, and true jellyfish), but also crustaceans, vertebrates, and plants and tunicates (salps and pyrosomas) found in temperate and boreal latitudes.[77] Specific to California, leatherbacks target dense aggregations of coast brown sea nettle (*Chrysaora fuscescens*) during the summer and fall, but also consume moon jellies (*Aurelia labiate*).[78]

Nesting occurs primarily on beaches of tropical and subtropical climates; in the Pacific Ocean, nesting also occur on beaches of Mexico and Costa Rica, with rare nesting events from the Gulf of California. Nesting beaches have a wide variety of characteristics, and are generally associated with deep water and strong waves and current. The species is also known to nest in areas with shallow water and mud banks. Suitable substrates are generally free of rock, coral, or other abrasive substrates, and typically include coarse-grained sand. However, leatherback sea turtles that occur in the Pacific west coast of the U.S. originate from the western Pacific beaches.

The foraging behavior of the species had been studied in Central California waters, and it was found that leatherback sea turtles dove less than 328 feet and spent most of the time in shallower water (262 feet or less).[79] Leatherback sea turtles are most common along the California coast between July and October and thus may be seasonally present within the subtidal waters of the marine study area.

SPECIAL-STATUS MARINE MAMMALS

A number of species of marine mammals are found offshore of Ocean Beach; however, only Pacific harbor seals, California sea lions, harbor porpoises, and recently, the bottlenose dolphin (*Tursiops truncates*) are sighted year-round. Other marine mammal species that have been occasionally or rarely seen offshore of the project area include the gray whale (*Eschrichtius robustu*s), individual humpback whales (*Megaptera novaeangliae*), the northern elephant seal (*Mirounga angustirostris*), the Guadalupe fur seal (*Arctocephalus townsendi*), and the northern fur seal (*Callorhinus ursinus*).

Many other cetacean species utilize the open waters off the coast of central California as a migration corridor, including: blue whale (*Balaenoptera musculus*), killer whale (*Orcinus orca*), minke whale (*Balaenoptera acutorostrata*), Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), Risso's dolphin (*Grampus griseus*), long-beaked common dolphin (*Delphinus capensis*), bottlenose dolphin (*Tursiops truncatus*), and Dall's porpoise (*Phocoenoides dalli*).[80] However, none of the large cetacean species listed above are likely to occur within the marine study area, given its proximity to the shoreline. Additionally, no known rookeries or haul-outs are present within the marine environment adjacent to the project site.

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77 National Marine Fisheries Service and U.S. Fish and Wildlife Service, Leatherback Sea Turtle (*Dermochelys coriacea*) 5-Year Review: Summary and Evaluation, 2013.

78 National Marine Fisheries Service, Final Biological Report: Final Rule to Revise the Critical Habitat Designation for Leatherback Sea Turtles, January 2012.

79 National Marine Fisheries Service and U.S. Fish and Wildlife Service, Leatherback Sea Turtle (*Dermochelys coriacea*) 5-Year Review: Summary and Evaluation, 2013.

80 U.S. Army Corps of Engineers, Coastal Regional Sediment Management Plan for the Santa Cruz Littoral Cell, Pillar Point to Moss Landing, Prepared for the California Coastal Sediment Management Workgroup, September 2015.

MANAGED U.S. FISHERIES SPECIES

Under the Magnuson-Stevens Act (see Regulatory Framework, Magnuson-Stevens Fishery Conservation and Management Act), as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-297), National Marine Fisheries Service, Fishery Management Councils, and federal agencies are required to cooperatively protect essential fish habitat for commercially important fish species such as Pacific coast groundfish, Pacific salmon, highly migratory species, and coastal pelagic fish and squid. As defined by the U.S. Congress, essential fish habitat includes "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Fish species present along the central California coast, including the marine study area, that are included in Fishery Management Plans prepared by regional Fishery Management Councils under the Magnuson-Stevens Act are listed in Table F-4.

Special-status Animal Occurrence

Opler's longhorn moth
incredible harvestman
obscure bumble bee
western bumble bee
Tomales isopod
San Bruno elfin butterfly
sandy beach tiger beetle
Townsend's big-eared bat
monarch butterfly overwintering population
California giant salamander
Stage's butterfly
western pond turtle
North American porcupine
tidewater goby
Bay checkerspot butterfly
American peregrine falcon
saltmarsh common yellowthroat
San Francisco damselfly
Western red bat
hoary bat
California black rail
bumblebee scarab beetle
hardhead
double-crested cormorant
Mission blue butterfly
California red-legged frog
bank swallow
callippe silverspot butterfly
longfin smelt
American badger
San Francisco gartersake
San Francisco Bay Area leaf-cutter bee
Marin hesperian
Point Reyes jumping mouse

Special-status Plant Occurrence

bent-flowered fiddleneck
Francisco manzanita
San Bruno Mountain manzanita
Presidio manzanita
Montara manzanita
Pacific manzanita
marsh sandwort
alkali milk-vetch
coastal bluff morning-glory
bristly sedge
Point Reyes salty bird's beak
San Francisco Bay spineflower
robust spineflower
Franciscan thistle
Mt. Tamalpais thistle
compact cobwebby thistle
Presidio clarkia
round-headed Chinese-houses
San Francisco collinsia
Marin checker lily
fragrant fritillary
blue coast gilia
dark-eyed gilia
San Francisco gumplant
congested-headed hayfield tarplant
short-leaved evax
Marin western flax
water star-grass
Kellogg's Horkelia
Point Reyes Horkelia
island tube lichen
beach layia
rose leptosiphon
San Francisco lessingia
marsh microseris
northern curly-leaved monardella
Choris' popcornflower
San Francisco popcornflower
Oregon Polemonium
Adobe sanicle
chaparral ragwort
Scouler's catchfly
San Francisco campion
two-forked clover
San Francisco owl's clover
coastal triquetrella

SOURCE: CDFW, 2020; CNDDB data accessed July 2020

Ocean Beach Climate Change Adaptation Project

Figure F-1
CNDDB Special-status and Sensitive Plant and Animal Occurrences within 5-miles of the Project Study Areas

ESA

F2 BIOLOGICAL RESOURCES ASSESSMENT

Biological Resources Assessment

FOR

Ocean Beach Climate Change Adaptation Project, San Francisco, California

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San Francisco Public Utilities Commission
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Biological Resources Assessment

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Acronym List

CCC	California Coastal Commission
CDFW	California Department of Fish and Wildlife's
CDP	Coastal Development Permit
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CNDDB	California Natural Diversity Data Base
CNPS	California Native Plant Society
CRPR	California Rare Plant Rank
DPS	Distinct Population Segment
ESA	(Federal) Endangered Species Act
EFH	Essential Fish Habitat
FAC	Facultative species
FACW	Facultative wet
FMP	Fishery Management Plan
GGNRA	Golden Gate National Recreation Area
GPS	Global Positioning System
HAPC	Habitat Areas of Particular Concern
HSP	Habitat Suitability Probability
IPaC	Information for Planning and Consultation
IUCN	International Union for Conservation of Nature
MMPA	Marine Mammal Protection Act
NFMP	Nearshore Fishery Management Plan
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWI	National Wetlands Inventory
OHWM	Ordinary High Water Mark
PRGC	Pacific Rod and Gun Club
RWQCB	Regional Water Quality Control Board
SFPUC	San Francisco Public Utilities Commission
SLC	State Land Commission
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WBWG	Western Bat Working Group

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Executive Summary

This Biological Resources Assessment describes biological resources of the Ocean Beach Climate Change Adaptation Project (project) Study Area, including vegetation communities and wildlife habitat, special-status plant and animal species with potential to occur, and sensitive natural communities. Subsequent to establishment of the Study Area boundary, the project design progressed, resulting in a smaller project area, therefore, the Study Area for terrestrial biological resources discussed in this report is larger than the project area described and analyzed in the environmental impact report.

Several vegetation alliances in the Study Area are considered sensitive by the California Department of Fish and Wildlife (CDFW) (2019a). These vegetation alliances include: dune mat alliance, the silver dune lupine – mock heather scrub alliance and arroyo willow thickets.

A formal delineation of federal and state jurisdictional wetlands and waters within the Study Area is not included in this assessment; however, results of an aquatic resources delineation performed of the project area, a subset of the Study Area, have been incorporated into this report (ESA, 2021). The Pacific Ocean is located within the project Study Area and Lake Merced is adjacent to the Study Area. These waters are considered other waters of the United States and waters of the State. Biological resources which occur in the Pacific Ocean within 0.5-mile of the Study Area are included in this analysis.

Two special-status plants, San Francisco spineflower (*Chorizanthe cuspidata* var. *cuspidata*; California Rare Plant Rank [CRPR] 1B.2) and San Francisco gumplant (*Grindelia hirsutula* var. *maritima*; CRPR 3.2), are known to occur in the Study Area. Twenty-nine other special-status plants were determined to have a low potential to occur due to lack of suitable habitat and absence during appropriately timed (blooming period) protocol-level surveys in 2019 and 2020.

Special-status[1] animals with potential to occur in the Study Area include the following species:

Table A: Special-Status Wildlife Species with Potential to Occur in the Study Area				
Common Name	Scientific Name	Federal Status	State Status	Other Status
Western bumble bee	*Bombus occidentalis*	--	California Endangered Species Act (CESA): Candidate for listing as Endangered (CE)	XERCES: Imperiled
Pacific lamprey	*Entosphenus tridentatus*	--	California Department of Fish and Wildlife (CDFW): Species of Special Concern (SSC)	American Fisheries Society (AFS): Vulnerable (VU)
Green sturgeon	*Acipenser medirostris*	Federal Endangered Species Act (FESA) Threatened (FT)	CDFW: SSC	AFS:VU, International Union for Conservation of Nature (IUCN): Near Threatened (NT)

1 See Page 9 for definition of special status and sensitive wildlife species.

Table A: Special-Status Wildlife Species with Potential to Occur in the Study Area				
Common Name	Scientific Name	Federal Status	State Status	Other Status
Steelhead	*Oncorhynchus mykiss*	FESA: FT	--	AFS: Threatened (TH)
Coho salmon	*Oncorhynchus kisutch*	FESA: Endangered (FE)	CESA: SE	AFS: TH
Chinook salmon	*Oncorhynchus tshawytscha*	Central Valley spring-run, FESA: FT Sacramento River winter-run, FESA: FE	Central Valley fall /late fall-run, CDFW: SCC Central Valley spring-run, CESA: Threatened (ST) Sacramento River winter-run, CESA: SE	--
Longfin smelt	*Spirinchus thaleichthys*	--	CESA: ST	
Pacific pond turtle	*Actinemys marmorata*	--	CDFW: SSC	IUCN: VU
Western snowy plover	*Charadrius alexandrinus*	FESA: FT	CDFW: SSC	U.S. Fish and Wildlife Service (USFWS): Bird of Conservation Concern (BCC)
Western burrowing owl	*Athene cunicularia hypugea*	--	CDFW: SSC	USFWS: BCC
Olive-sided flycatcher	*Contopus cooperi*	--	CDFW: SSC	--
Bank swallow	*Riparia riparia*	--	CESA: ST CDFW: SSC	--
Saltmarsh common yellowthroat	Geothlypis trichas sinuosa)	--	CDFW: SSC	USFWS: BCC
Western red bat	*Lasiurus blossevillii*	--	CDFW: SSC	Western Bat Working Group (WBWG): High Priority (H)
California sea-lion	*Zalophus californianus*	Marine Mammal Protection Act (MMPA)	--	--
Pacific harbor seal	*Phoca vitulina richardii)*	MMPA	--	--

Introduction

Purpose for the Habitat Assessment

The intent and scope of this assessment is to identify vegetation communities and wildlife habitat present in the Study Area, determine the quality of those communities and habitat types relative to the special-status plant and animal species they may host, and assess the likelihood for those special-status species to occur within the Study Area. Additionally, sensitive natural communities, including potential wetlands and waters of United States and state, are described.

Project Location and Study Area

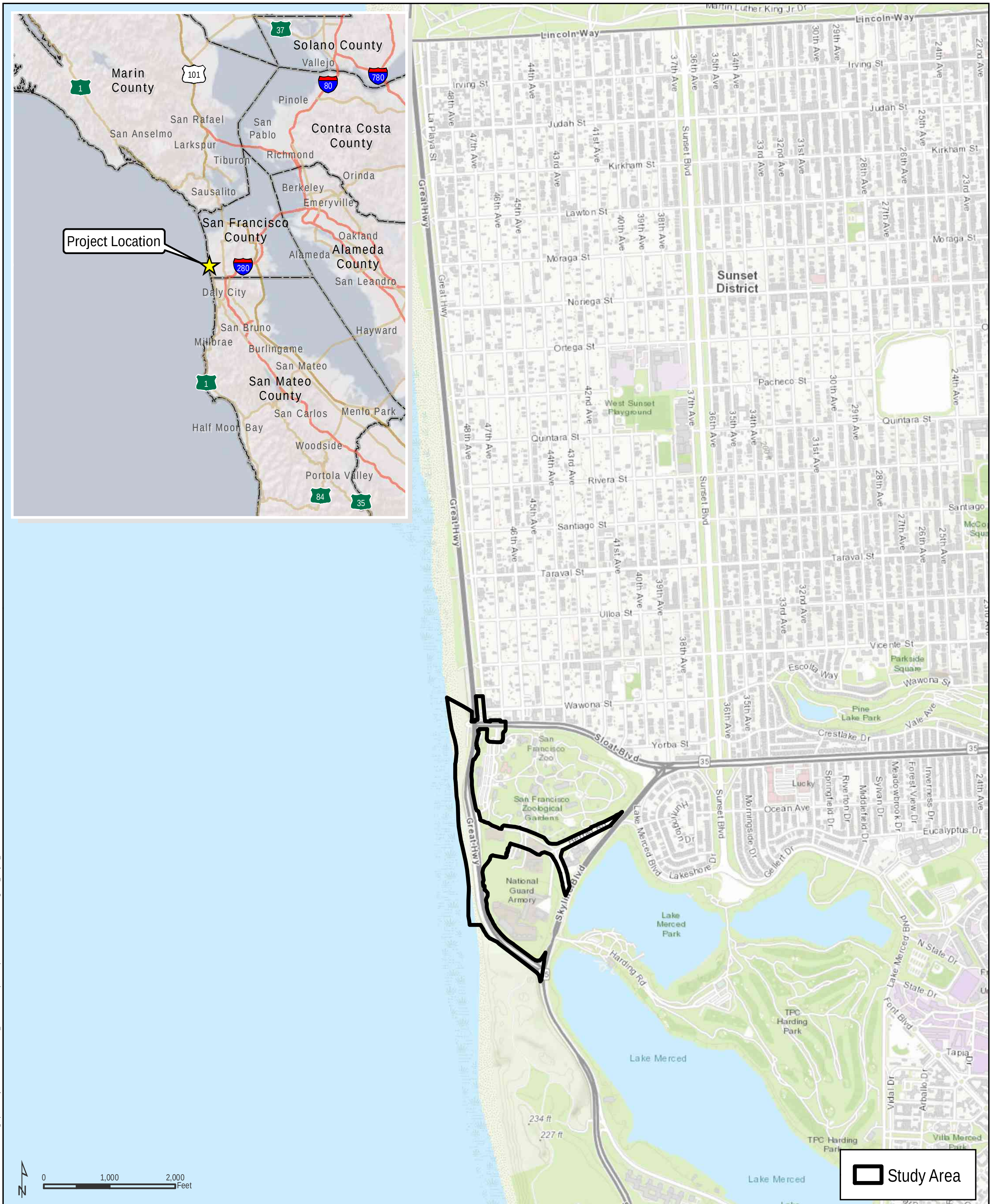
The project is located on the southwest side of San Francisco, as depicted in Figure 1. The project would involve activities on land and within the Pacific Ocean. Accordingly, this document addresses both terrestrial and marine biological resources. The Study Area for purposes of terrestrial biological resources encompasses the limits of potential project disturbance, based upon conceptual project designs, as depicted in Figure 2. Subsequent to establishment of the Study Area boundary and completion of the surveys described herein, the project design has progressed, resulting in a smaller project area which was analyzed in the environmental impact report. The Study Area boundary as described in this report, however, has not been revised. Therefore, the Study Area for terrestrial biological resources encompasses an area larger than the current project site. Figure 2 depicts the Study Area as well as the terrestrial study area analyzed in the environmental impact report. The Study Area for purposes of marine biological resources encompasses the intertidal zone, and tidal and nearshore areas out to about 1/2 mile offshore, also depicted in Figure 2. This same marine study area boundary was analyzed in the environmental impact report.

In addition to the portions of the Study Area that were surveyed for a full season in 2019-2020, additional areas within the zoo were evaluated with biological reconnaissance surveys in the spring 2020. These additional areas include lands adjacent to Zoo Road as shown with hatching on Figures 3C, 3D and 3F, where the zoo was considering future parking improvements. In this report, these areas are included as part of the Study Area. However, where conclusions are different because the analysis was more programmatic (broader) for these areas than the rest of the Study Area, the different conclusions are noted in this report.

Sand would be excavated at North Ocean Beach and trucked to the project site for beach nourishment as part of the project's operations. The North Ocean Beach site was not surveyed as part of this report but is described in the environmental impact report for the project.

Project Description

The City and County of San Francisco (city) is proposing the project to improve the portion of Ocean Beach from Sloat Boulevard to Fort Funston known as "South Ocean Beach." Consistent with requirements of the National Park Service Immediate Action Plan Special Use Permit and Coastal Commission Coastal Development Permit (CDP) #2-15-1357, the project is needed to address shoreline erosion, severe coastal storm and wave hazards, and sea level rise which threaten city infrastructure, coastal access and recreational facilities, and public safety. To address these challenges, the city would incorporate the guiding principles of the Ocean Beach Master Plan and the adopted policies of the Western Shoreline Plan, the city's certified local coastal program, by enacting a combination of *managed retreat, beach nourishment,* and *shoreline armoring* strategies to preserve and enhance public access, coastal recreation, habitat, and scenic resources at South Ocean Beach, while protecting wastewater system infrastructure from damage due to these coastal hazards. Each of these strategies as they pertain to the Project is further discussed in the related subsections below.



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Source: SFPUC 2020, ESRI 2020

FIGURE 1
Project Location

Ocean Beach Climate Change Adaptation Project, San Francisco, CA

SOURCE: SFPUC, 2021

South Ocean Beach Long-term Improvement Project, San Francisco, CA

Figure 2
Study Area and Vicinity

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The major project components fall into the following five categories which are described in detail below:

(1) permanently closing the Great Highway between Sloat and Skyline boulevards and modifying affected intersections and San Francisco Zoo parking access;

(2) removing pavement, rock and sandbag revetments, and rubble and debris from the beach, recontouring the bluff and planting dune vegetation;

(3) improving public access, maintaining coastal parking and continuing to provide restroom facilities;

(4) constructing a buried wall to protect existing sewer system infrastructure; and

(5) conducting periodic beach nourishment.

Great Highway Closure and Intersection Modifications

The city would permanently close the Great Highway between Sloat and Skyline boulevards. A portion of the Great Highway's northbound travel lanes would be retained or reconstructed as a service road. To accommodate the road closure, the city would reconfigure or restripe the intersections at Sloat Boulevard/Great Highway and Skyline Boulevard/Great Highway. In addition, it would reconfigure access to the Oceanside Treatment Plant, Westside Pump Station, and the San Francisco Zoo (zoo).

The zoo is also considering future parking improvements along Zoo Road; while not part of the proposed project, this location is included within the study area. The future parking improvements might be constructed at a later date which has yet to be determined.

Buried Wall

The buried wall (shoreline protection) component of the project would involve the construction of a below-grade wall to protect the Lake Merced Tunnel and related wastewater system facilities from erosion and sea-level rise. The proposed wall would extend from Sloat Boulevard to approximately 3,000 feet to the south. The wall would be set back as far from the shoreline as feasible and generally buried under sand. The slope behind the wall and above the tunnel would be covered with a 4-foot-thick, gently sloping (3:1 horizontal to vertical slope) layer of either soil cement or low-strength concrete (slope stabilization). The wall and slope stabilization would be covered by sand at most times and would be located inland from the existing bluff toe.

Debris and Revetment Removal and Bluff Recontouring and Revegetation

Once the buried wall is in place and the Lake Merced Tunnel is protected, the city would remove the existing shoreline protection structures and debris from the beach and bluff, including rock revetments, rubble, and sandbag revetments. It would then recontour the bluff by placing sand over the wall and slope stabilization to provide a more gradual slope between the proposed service road and multi-use path towards the beach. The city would also install dune vegetation to stabilize the approximately 4-foot thick layer of sand that would be placed over the slope stabilization.

Public Access and Parking Improvements

The project would involve various and substantial changes to public access and recreation opportunities along the South Ocean Beach shoreline including: a new multi-use trail for pedestrian and cyclist access, new stairs to the beach, relocating the bus layover location and a new public parking lot and restroom.

Beach Nourishment

It is anticipated that the recontoured bluff would eventually recede due to erosion, and portions of the wall would no longer be continuously buried without intervention. For the project's beach nourishment component, the city would place sand on the beach and bluff for the life of the project, as needed to keep the buried wall and slope stabilization covered with sand, and to maintain and enhance South Ocean Beach access and scenic quality. The city is considering two potential sand sources under this project. One source is North Ocean Beach (i.e., north of Lincoln Boulevard).[2] Under this option, the city would excavate and truck excess sand from North Ocean Beach to South Ocean Beach (referred to as sand backpass). Dump trucks would use the formalized sand ramp to access the beach to place the sand and then shape it into berms. A second source would be an off-site location beyond the project area. Under this option, the city would purchase or otherwise obtain suitable sand from an off-site location (e.g., vendor), truck the sand to South Ocean Beach, and place it in a manner similar to that described for the sand backpass. A third source is the main shipping channel, which is dredged by the U.S. Army Corps of Engineers (USACE) as part of its ongoing navigation channels maintenance. Under this option, rather than dumping the dredged sand at an existing offshore disposal site, the USACE would pump the sand in a slurry from an offshore barge to the beach where it would be shaped into berms. Sand placements would occur approximately once every four to 10 years, depending upon need.

Methods

Background Research

A literature review and database search for special-status plant and animal species was centered on the San Francisco South 7.5-minute United States Geological Survey (USGS) topographic quadrangle and the six adjacent quadrangles (Point Bonita, San Francisco North, Oakland West, Hunters Point, Montara Mountain, and San Mateo). Information on special-status plants, animals and sensitive vegetation communities was compiled through a review of databases, including CDFW's California Natural Diversity Data Base (CNDDB) (CDFW 2019a), the California Native Plant Society (CNPS) online Inventory of Rare and Endangered Plants of California (CNPS 2019a), the United States Fish and Wildlife Service (USFWS) Sacramento Office's database of listed species (USFWS 2019); National Oceanic and Atmospheric Administration (NOAA) Fisheries West Coast Regional Office resources; and the USFWS's Information for Planning and Consultation (IPaC) website (USFWS 2019a).

Reports reviewed for this assessment include:

- San Francisco Westside Recycled Water Project; Biological Assessment for Consultation with U.S. Fish and Wildlife Service; Environmental Science Associates (ESA); February 2016.
- Lake Merced Vegetation Mapping Update - Revised Draft; Nomad Ecology; May 2011.
- OSP Building 230 Ventilation Stack Construction Area, 2018 Rare Plant Survey Results; ESA; August 20, 2018.
- Results of Biological Resources Evaluation for Oceanside Water Pollution Control Plant Digester Gas Utilization Upgrade Project in San Francisco, California; Coast Ridge Ecology; December 13, 2016.
- Special-Status Plant Survey Report for Westside Pump Station Reliability Improvements Project; BioMaAS; October 25, 2016.

[2] The North Ocean Beach project area is not included in this assessment.

- Memorandum. Salvage and Reintroduction of San Francisco Spineflower; ESA; February 9, 2016.
- An unpublished map of special-status plants and CRPR 3 and 4 plant species in northern Fort Funston that was created by the National Park Service (NPS 1997-2018). This map includes the portion of Fort Funston that is located in the project Study Area.
- Bank Swallow Monitoring at Fort Funston, GGNRA, 2017, 2019 and 2020 NPS Reports.

Several other sources were reviewed for relevant biological resource information. Soil types present in the Study Area were obtained from the Natural Resources Conservation Service's (NRCS) online Web Soil Survey (NRCS 2019). Information on wetlands and other waters of the United States and state that are in and adjacent to the Study Area was reviewed in the National Wetland Inventory (NWI) database (USFWS 2019b) and the National Hydrography Dataset (NHD) (USGS 2018). The NWI database is a federal database that provides maps and information on the characteristics, extent, and status of the wetlands and waters. The NHD is another federal database maintained by the U.S. Geological Survey (USGS) that provides digital geospatial data on wetlands and surface waters such as creeks and rivers.

Special-Status Plants

For the purposes of this assessment, special-status plant species were defined as species with federal or state listing of rare, threatened or endangered and/or a California Rare Plant Rank (CRPR) of 1A, 1B, 2A, and 2B. Although not generally protected under CEQA, CRPR 3 and 4 species and locally significant species are included in this report, as the need to address impacts on these species is typically determined on a species-by-species basis based on factors such as location within the species' range, or local abundance. In addition, the *Locally Significant Plant Species of San Francisco County* list was reviewed for plant species that are locally uncommon (CNPS 2015). In this list, a native plant in San Francisco County is designated as "locally significant"[3] based on a variety of factors, including the species' federal, state, and CRPR status; current and historical geographic distribution; size of local populations; habitat rarity; life form; threats to populations in San Francisco County; local endemism; local type locality; and wildlife value.

Special-Status Wildlife

For the purpose of this assessment, special-status wildlife species include:

- Species listed as Endangered, Threatened, Rare, or as Candidates for listing under the federal or state Endangered Species Acts (FESA and CESA, respectively).
- Species listed under the federal Marine Mammal Protection Act (MMPA).
- CDFW-designated Species of Special Concern (SSC) and Fully Protected Species.

Table D (1), *Special-Status Species with Potential to Occur in the Study Area,* presents the species meeting the criteria above.

Additional animal species receive special protection under the federal Bald and Golden Eagle Protection Act and the federal Migratory Bird Treaty Act. Table D (2), *Other Sensitive Wildlife Species with Potential to Occur*

[3] Some of these locally significant plants may have a limited distribution in San Francisco County, while other species are common in the County but are considered locally significant for other reasons. Some locally significant plants are peripheral populations that occur at the edge of their distribution and possesses genetic traits that are unique to the local area and are considered important for the species' genetic adaptation, evolution, and persistence. A locally significant species could be considered common in the County but is ranked as locally significant because it occurs in a habitat that is uncommon elsewhere in the state.

in the Study Area, and Appendix B-2, *Sensitive Wildlife Species with Potential to Occur in the Study Area*, include a number of wildlife species that do meet the criteria above. These species were assessed as they are included in the November 2020 "Special Animals" list by CDFW.[4] Additional agency or other organizations' statuses identifying sensitive animal species considered in this assessment include:

- *American Fisheries Society* (AFS)[5]
- *International Union for Conservation of Nature* (IUCN) *Red List of Threatened Species.* The IUCN assesses, on a global scale, the conservation status of species, subspecies, varieties, and even selected subpopulations in order to highlight taxa threatened with extinction, and therefore promote their conservation. Detailed information is available from the IUCN Red List Online.
- *U.S. Fish and Wildlife Service (USFWS) Birds of Conservation Concern (BCC)*. The goal of the Birds of Conservation Concern 2008 report is to accurately identify the migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent highest conservation priorities and draw attention to species in need of conservation action.
- *Western Bat Working Group (WBWG)*[6]
- *Xerces Society for Invertebrate Conservation.* An international nonprofit, science-based conservation organization that works with scientists, land managers, educators, farmers, policy makers, and

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4 "Special Animals" is a broad term used to refer to all the animal taxa tracked by the CDFW California Natural Diversity Database (CNDDB), regardless of their legal or protection status. This list is also referred to as the list of "species at risk"." The Special Animals List includes species, subspecies, Distinct Population Segments (DPS), or Evolutionarily Significant Units (ESU) where at least one of the following conditions applies:

- Officially listed or proposed for listing under state and/or federal endangered species acts
- Taxa considered by the Department of Fish and Wildlife to be a Species of Special Concern (SSC)
- Taxa which meet the criteria for listing, even if not currently included on any list, as described in Section 15380 of the California Environmental Quality Act Guidelines
- Taxa that are biologically rare, very restricted in distribution, or declining throughout their range, but not currently threatened with extirpation
- Population(s) in California that may be peripheral to the major portion of a taxon's range but are threatened with extirpation in California
- Taxa closely associated with a habitat that is declining in California at a significant rate (e.g., wetlands, riparian, vernal pools, old growth forests, desert aquatic systems, native grasslands, valley shrubland habitats, etc.)
- Taxa designated as a special status, sensitive, or declining species by other state or federal agencies, or a non-governmental organization (NGO), and determined by the CNDDB to be rare, restricted, declining, or threatened across their range in California.

5 Designations for freshwater and diadromous species were taken from the paper:

- Jelks, H.L., S.J. Walsh, N.M. Burkhead, S. Contreras-Balderas, E. Díaz-Pardo, D.A. Hendrickson, J. Lyons, N.E. Mandrak, F. McCormick, J.S. Nelson, S.P. Platania, B.A. Porter, C.B. Renaud, J.J. Schmitter-Soto, E.B. Taylor, and M.L. Warren, Jr. 2008. Conservation status of imperiled North American freshwater and diadromous fishes. Fisheries 33(8):372-407. Available at: https://www.fs.fed.us/rm/pubs_other/rmrs_2008_jelks_h001.pdf

Designations for marine and estuarine species were taken from the paper:

- Musick, J.A. et al. 2000. "Marine, Estuarine, and Diadromous Fish Stocks at Risk of Extinction in North America (Exclusive of Pacific Salmonids). Fisheries 25(11):6-30. Available at: https://doi.org/10.1577/1548-8446(2000)025%3C0006:MEADFS%3E2.0.CO;2

6 The WBWG is composed of agencies, organizations, and individuals interested in bat research, management, and conservation from 13 western states and provinces. The goals of the group are to (1) facilitate communication among interested parties and reduce risks of species decline or extinction; (2) provide a mechanism by which current information on bat ecology, distribution, and research techniques can be readily accessed; and (3) develop a forum to discuss conservation strategies, provide technical assistance, and encourage education programs. Species are ranked as High, Medium, or Low Priority in each of 10 regions in western North America. Because California includes multiple regions where a species may have different WBWG Priority ranks, the CNNDB includes categories for Medium-High and Low-Medium Priority. The CNDDB tracks bat species that are at least Low-Medium Priority in California.

communities to protect the natural world through the conservation of invertebrates and their habitats.

In addition, the state has designated some wildlife species as “fully protected” which means that CDFW is charged with identifying and providing additional protection to those animals that are rare or face possible extinction. Fully Protected species may not be taken or possessed at any time and no licenses or permits may be issued for their take except for collection for scientific research.

Section 2080 of the Fish and Game Code prohibits "take" of any species that the commission determines to be an endangered or threatened species. Take is defined in Section 86 of the Fish and Game Code as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill." The California Fish and Game Code §3503 and §3503.5 also protect birds of prey along with their nests and eggs. Riparian habitat is also protected, and mitigation is required for projects that affect this habitat.

Field Surveys and Mapping

The entire landside portion of the Study Area (Figure 2) was surveyed on foot and the marine resources were assessed via desktop. Table B provides a list of biological resource surveys that were conducted in the Study Area to inform this Biological Resources Assessment (BRA).

Table B: Dates and Type of Surveys Conducted

Date	Type of Survey
May 31, 2019	Special-status plant survey
June 6, 2019	Special-status plant survey
July 9, 2019	BRA reconnaissance visit
June 11, 2019	San Francisco spineflower mapping
June 24, 2019	Bank swallow habitat mapping
July 16, 2019	Special-status plant survey; vegetation mapping
July 18, 2019	Special-status plant survey; vegetation mapping
July 24, 2019	BRA reconnaissance visit
September 6, 2019	Special-status plant survey; San Francisco gumplant mapping
September 20, 2019	Special-status plant survey; San Francisco gumplant mapping
April 10, 2020	Special-status plant survey
April 16, 2020	BRA reconnaissance visit; vegetation mapping
April 17, 2020	Special-status plant survey
May 20, 2020	BRA reconnaissance visit

A reconnaissance-level assessment of the Study Area for sensitive wildlife resources was conducted by BioMaAS, Inc. biologist Bill Stagnaro on July 9 and 24, 2019 and May 20, 2020. A focused bank swallow (*Riparia riparia*) survey was performed by BioMaAS, Inc. biologist Elizabeth Gruenstein on June 24, 2019. BioMaAS, Inc. botanist/biologist Michele Lee conducted vegetation mapping within the Study Area on July 16 and 18, 2019, and April 16, 2020. The reconnaissance surveys that were conducted in 2020 by Bill Stagnaro and Michele Lee were for the additional areas on zoo property on which the zoo is considering future parking improvements; protocol level special-status plant surveys were not conducted in these areas.

Vegetation communities and wildlife habitats in the Study Area were mapped in the field onto aerial photographs. Vegetation communities were classified into vegetation alliances as defined in *A Manual of California Vegetation, online* (CNPS 2019b) to the extent that was feasible. Sensitive natural communities were identified and described according to the CDFW list of California Sensitive Natural Communities (CDFW

2018a). CNDDB legacy sensitive natural communities are also addressed in accordance with current CDFW's guidance to include these sensitive communities in CEQA environmental reviews (CDFW 2019b).

Ms. Lee conducted a full season of protocol-level special-status plant surveys in 2019 and 2020 in the entire Study Area except for the zoo's potential future parking improvement area (Figures 3C, 3D, and 3F). She conducted three protocol-level special-status plant surveys of the Study Area in 2019: the first survey was conducted on May 31 and June 6; the second survey was conducted on July 16 and 18; and the third survey was conducted on September 6 and 20. She also conducted a spring protocol-level special-status plant survey of the entire Study Area on April 10 and 17, 2020. Surveys followed the CDFW (CDFW 2018b), CNPS (2001), and USFWS (2000) protocols for conducting special-status plant and sensitive natural community surveys. All vegetation communities in the Study Area were systematically surveyed to provide thorough coverage. Open, sandy areas were surveyed with small transects to ensure adequate coverage for special-status dune flora. Survey timing coincided with the blooming period of some of the target plant species with potential to occur in the Study Area. A list of plant species observed in the Study Area was recorded. Scientific nomenclature for plant species conforms to the *Jepson eFlora* (Jepson Flora Project 2019).

Reference populations of special-status plants San Francisco spineflower (CRPR 1B.2) and San Francisco wallflower (*Erysimum franciscanum*; CRPR 4.2), located 0.77 mile south of the Study Area in Fort Funston, were visited on the same days as the May 31 and July 16, 2019 surveys. This wallflower reference population was also visited on April 10, 2020 prior to the special-status plant survey conducted on that day. In addition, an existing population of San Francisco spineflower plants within the Study Area near the existing gravel and partially barren lot along Zoo Road ("zoo staging area") was assessed for their detectability during the May 31, July 16, and September 6, 2019 surveys and April 10, 2020 survey.

On September 20, 2019, BioMaAS, Inc. botanist/biologist, Michele Lee, attempted to but was unsuccessful in locating two records of San Francisco gumplant (*Grindelia hirsutula* var. *maritima*; CRPR 3.2) south of the Study Area at Fort Funston to serve as reference populations for surveys being conducted for this species. These two occurrences were recorded in northern Fort Funston on an unpublished NPS map of special-status plants and CRPR 3 and 4 plant species in northern Fort Funston roughly within 700 feet of the Study Area (NPS 1997-2018). There is a CNDDB record of San Francisco gumplant at Fort Funston from September 12, 1983 that overlaps with these two records and overlaps with the Study Area boundaries (CDFW 2019a). An attempt to locate these plants in 1985 was also unsuccessful (CDFW 2019a). The September 20 survey at Fort Funston also covered areas on the ground that correspond to where this CNDDB 1985 record is mapped.

Some portions of the Study Area, such as the zoo staging area, have been surveyed for special-status plants in support of the Westside Pump Station Reliability Improvements Project (BioMaAS 2016; BioMaAS 2017; and BioMaAS 2018a). Some additional San Francisco spineflower patches were found during these surveys in dune mat habitat along the western edge of the zoo staging area and were remapped during the 2019 surveys for this report. No other special-status plants were found during those 2016-2018 surveys, which only included portions of the Study Area addressed in this report.

Special-status plants that were mapped in the Study Area were recorded with Global Positioning System (GPS) units. Ms. Lee recorded the location of special-status San Francisco spineflower (*Chorizanthe cuspidata* var. *cuspidata*) in the Study Area on June 11, 2019 with a Trimble GPS unit.[7] Patches of San Francisco spineflower with a diameter of no more than approximately 10 feet were recorded with a data point and the number of plants at the point was estimated. San Francisco gumplant (*Grindelia hirsutula var. maritima*) patches located

[7] The Trimble Geo 7X handheld has an accuracy of 1-100 cm.

close to the Study Area near the zoo staging area were recorded with a Trimble R1 unit[8] with SBAS correction by Ms. Lee and Scott Smith with Environmental Science Associates on September 6, 2019. On September 20, 2019, plant locations were mapped using the Motion-X GPS application.

Results

Soils

The Natural Resource Conservation Service's Web Soil Survey map shows several soil types in the Study Area: Urban land-Sirdrak complex, 2 to 50 percent slopes (136), beaches (138), and Sirdrak sand, 5 to 50 percent slopes (129) (NRCS 2019). The Urban land-Sirdrak complex, 2 to 50 percent slopes (136) consists of a complex that is approximately 45 percent Urban land, 35 percent Sirdrak soil series and similar soils, and 20 percent other minor unnamed soil types. The Urban land mapping unit consists of developed areas that were formerly located on beach terraces and dunes. The Sirdrak soils, 2 to 50 percent slopes are located on beach terraces and dunes and have a typical profile consisting of sand from 0 to 60 inches below the ground surface. The Sirdrak sand, 5 to 50 percent slopes (129) occurs on dunes and the parent material is Eolian sands. It also consists of sand from 0 to 60 inches below the ground surface. These two Sirdrak soil types are not listed as a hydric soil and are not highly alkaline or saline, or serpentinite.

Vegetation Communities

Vegetation communities in the Study Area are described below. Figures 3a-i provide an aerial photograph of vegetation communities mapped within the Study Area. The Study Area was historically and primarily sand dunes and coastal scrub habitats that have been altered during the construction of roads and facilities, including the Westside Pump Station, Oceanside Treatment Plant, Ocean Beach NPS public restrooms at the Great Highway/Sloat Boulevard intersection, rock and sandbag revetments, Great Highway, San Francisco Zoo, and Zoo Wet Weather Pump Station.

The Study Area also includes areas on zoo property that are used by the zoo and SFPUC as staging areas. These areas are shown on Figure 3c and 3f as the zoo staging area. The northern portion of the zoo staging area is unpaved and used by the zoo as a staging and storage area and for valet parking (Figure 3c). The southern portion of the zoo staging area has a gravel base and is currently used as a construction staging area for the Westside Recycled Water Treatment Facility project (Figure 3f). As a result of development and recreation, all the vegetation and natural topography in the Study Area has been disturbed to some extent. Table C provides the acreage of each vegetation community mapped within the Study Area. Representative photographs are included in Appendix A. Appendix C-1 provides a list of plants that were observed in the Study Area and includes the plants' special status, local significance ranking, and California Invasive Plant Council (Cal-IPC) invasiveness ranking (Cal-IPC 2016).

[8] The Trimble R1 typically has an accuracy of ±1.5-2.5 feet.

Table C: Vegetation Communities in the Study Area	
Vegetation Community	**Acres**
Aggregate Base	1.79
Beach	0.75
Developed	16.80
Dune Mat/Ice Plant Mats	8.35
Dune Mat/Ice Plant Mats/Riprap	2.47
European Beach Grass Swards/Dune Mat/Ice Plant Mats	0.26
Intertidal Zone	6.44
Mulch/Ruderal	0.18
Ornamental Trees and Shrubs	5.52
Silver Dune Lupine Scrub/Ice Plant Mats	0.16
Salt Rush Swales	0.01
Arroyo Willow Thickets (potential wetland outside of project area)	0.09
Total	**42.82**

Developed

There are 16.8 acres of developed habitat in the Study Area (Figures 3a-i). Developed portions of the Study Area include roads, buildings, parking lots, paved surfaces, and landscaping. Roads in the Study Area include the northbound and southbound lanes of the Great Highway between Sloat Boulevard and Skyline Boulevard, a section of Skyline Boulevard where it intersects with the Great Highway, a section of Sloat Boulevard north of the San Francisco Zoo entrance, Herbst Road, Zoo Road, and a service road for the zoo that is an extension of Zoo Road (Appendix A; Photograph 1). Developed habitat in the Study Area provides no habitat or limited low quality habitat for special-status plants because it's predominantly hardscape and highly disturbed and maintained landscaped areas.

The NPS parking lot at Sloat Boulevard and a portion of the zoo's public parking lot are included in the Study Area, along with several buildings: Zoo Wet Weather Pump Station, Ocean Beach NPS public restrooms (at the intersection of Sloat Boulevard and the Great Highway), and zoo buildings adjacent to the zoo entrance on Sloat Boulevard. Along the Great Highway, the Study Area borders the Westside Pump Station buildings and the Oceanside Treatment Plant buildings. While portions of the Westside Pump Station, Oceanside Treatment Plant, and Zoo Pump Station may be used for construction staging, these facilities are not part of the Study Area because the areas are paved.

Dune Mat/Ice Plant Mats

Historically, the Study Area supported native coastal dunes and coastal scrub vegetation in more stabilized areas. The Study Area has a history of habitat disturbance due to construction and the spread of the invasive weeds such as ice plant/sea fig (*Carpobrotus* spp.). The classification and nomenclature for the 8.35-acre dune mat /ice plant mats community in the Study Area is based on two vegetation alliances in *A Manual of California Vegetation* (CNPS 2019): 1) *Mesembryanthemum spp. - Carpobrotus edulis* Herbaceous Semi-Natural Alliance (Ice Plant Mats), and 2) *Abronia latifolia - Ambrosia chamissonis* Herbaceous Alliance (Dune Mat). The dune mat/ice plant mats habitat in the Study Area consist of a complex mosaic of the CNPS ice plant mats alliance and CNPS dune mat alliance that were not feasible to map separately, so they were mapped as a combined dune mat/ice plant mats vegetation community. Dune mat/ice plant mats in the Study Area consists of dense to sparse patches of ice plant (*Carpobrotus edulis* and *C. chilensis*) (ice plant mats) interspersed with open, sandy areas that support native dune flora and non-native grasses and forbs (dune mat) (Figures 3a-i). Native plant diversity and abundance varies in dune mat/ice plant mats in the Study Area, but most of this habitat in the Study Area is disturbed and supports a mix of native and non-native grasses and forbs and a low cover of mostly native shrubs. Some areas that are mapped in the Study Area as dune mat/ice plant mats are dominated by patches of ice plant (*Carpobrotus edulis*) and sea fig (*Carpobrotus chilensis*) of various sizes (Appendix A; Photographs 1 and 2). The ice plant mat alliance is a very invasive habitat type that displaces native dune flora along the northern California coast. Ice plant was planted along the California coastal dunes to stabilize the sandy soils. It is an aggressive competitor and regrows easily from small stem fragments and reproduces from seeds (Cal-IPC 2016). Ice plant has a Cal-IPC rating of high (Appendix C-1; Cal-IPC 2006). Sea fig is also an aggressive weed on the California coast that can easily spread from small stem fragments and has a Cal-IPC rating of moderate (Cal-IPC 2006).

Native herbaceous dune flora that typically occurs in dune mat/ice plant mats in the Study Area include evening-primrose (*Camissoniopsis cheiranthifolia* ssp. *cheiranthifolia*), beach strawberry (*Fragaria chilensis*), beach burr (*Ambrosia c*), seaside daisy (*Erigeron glaucus*), and coast buckwheat (*Eriogonum latifolium*) (Appendix A; Photograph 2). Other native grasses and herbs that are less abundant in the Study Area include red fescue (*Festuca rubra*), spike bent grass (*Agrostis exarta*), common yarrow (*Achillea millefolium*), live forever (*Dudleya farinosa*), Heermann's bird's-foot trefoil (*Acmispon heermannii* var. *orbicularis*), strigose bird's-foot-trefoil (*Acmispon strigosus*), California poppy (*Eschscholzia californica*), sandmat (*Cardionema ramosissimum*), rattlesnake weed (*Daucus pusillus*), lizard-tail (*Eriophyllum staechadifolium*), Pacific seaside plantain (*Plantago maritima*), and thrift sea pink (*Armeria maritima* ssp. *californica*). Native shrubs that sporadically occur in dune mat/ice plant mats in the Study Area include silver dune lupine (*Lupinus chamissonis*), coastal sagewort (*Artemisia pycnocephala*), tree lupine (*Lupinus arboreus*), and coyote brush (*Baccharis pilularis* ssp. *pilularis*).

Dune mat/ice plant mats habitat in the southwestern part of the Study Area at Fort Funston, adjacent to the Great Highway, is generally less disturbed than other dune mat/ice plant mats habitats in the Study Area and supports a higher abundance and diversity of native dune flora (Appendix A; Photograph 3). This area is also adjacent to active Fort Funston restoration sites. Yellow sand verbena (*Abronia latifolia*) is uncommon in the Study Area but it was observed in the Study Area in this northern portion of Fort Funston. Special-status plants and CRPR 3 and 4 plant species on an unpublished National Park Service (NPS 1997-2018) map of northern Fort Funston, just south of the Study Area, include San Francisco spineflower, San Francisco gumplant, San Francisco wallflower, San Francisco (*Lessingia germanorum*), and blue coast gilia (*Gilia capitata* ssp. *chamissonis*), and San Francisco campion (*Silene verecunda* ssp. *verecunda*), indicating that suitable habitat for special-status dune flora is present in the vicinity of the Study Area. These records are from 1997 through 2018 so some of them could be extirpated. The closest special-status plant record on the NPS map to the Study Area is for San Francisco spineflower, which lies approximately 15 feet south of the Study Area boundary. This specific location of spineflower was not observed in the field during 2019-2020 special-status plant surveys. Furthermore, no special-status plants or CRPR 3 and 4 species were observed in this Fort Funston portion of the Study Area during the 2019 and 2020 surveys. However, during these surveys, approximately 90 feet from the Study Area, a population of San Francisco spineflower was observed in a protected ravine, within in a stand of sea lyme grass (*Elymus mollis* ssp. *mollis*), an uncommon native dune grass that is considered a sensitive natural community (CDFW 2018a). Sea lyme was not observed in the Study Area, but the edge of this stand of sea lyme grass at Fort Funston lies approximately 14 feet south of the nearest Study Area boundary.

BioMaAS

SOURCE: ESA 2020, Google Earth 2018

FIGURE 3A
Vegetation Communities and Habitats

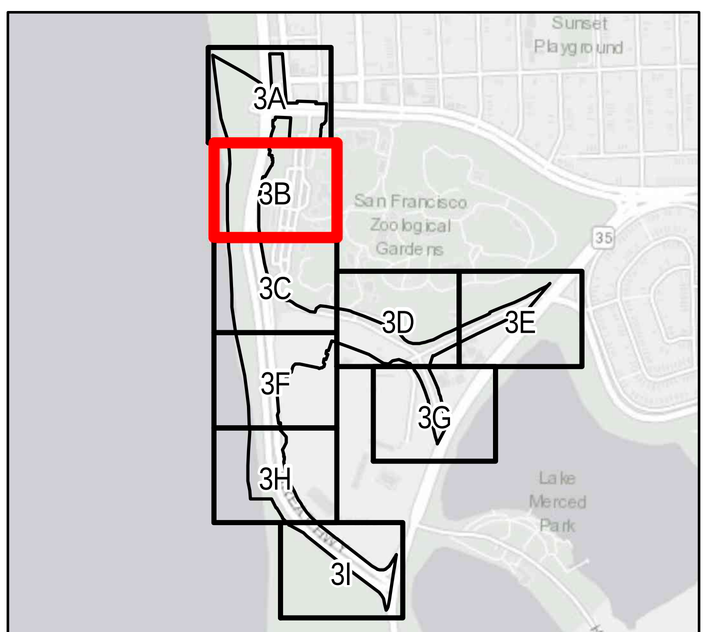
South Ocean Beach Long-term Improvement Project, San Francisco, CA

Study Area
Zoo Areas Evaluated with Reconnaissance Surveys 2020
Mean High Water (MHW)

Vegetation Communities and Habitats
- Aggregate Base
- Beach
- Developed
- Dune Mat/Ice Plant Mats
- Dune Mat/Ice Plant Mats/Riprap
- European Beach Grass Swards/Dune Mat/Ice Plant Mats
- Intertidal Zone/Foredunes
- Mulch/Ruderal
- Ornamental Trees and Shrubs
- Salt Rush Swales
- Silver Dune Lupine Scrub/Ice Plant Mats

Potential Jurisdictional Wetlands
- Arroyo Willow Thickets

** San Francisco spineflower occurs in the Study Area in and adjacent to the San Francisco spineflower mitigation area. Figure 6 provides a detailed map of its locations.*



0 40 80
Feet

BioMaAS

SOURCE: ESA 2020, Google Earth 2018

FIGURE 3B
Vegetation Communities and Habitats

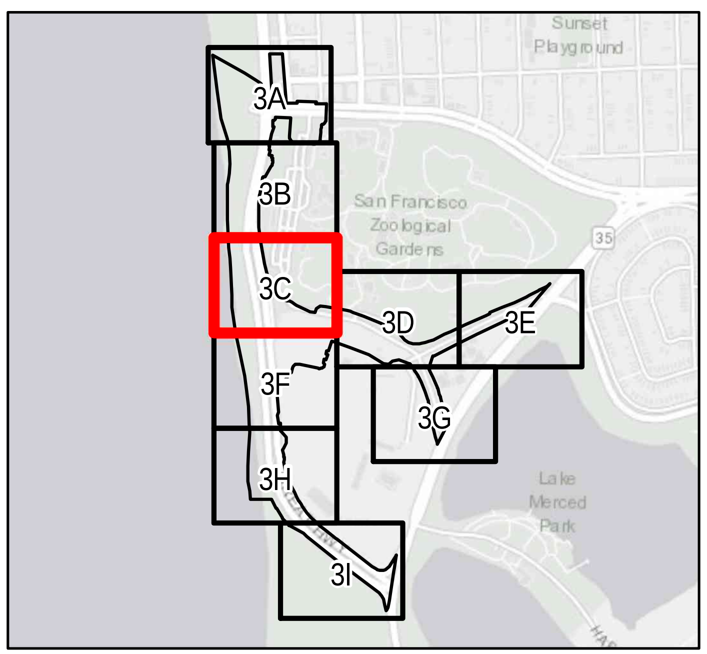
South Ocean Beach Long-term Improvement Project, San Francisco, CA

Study Area
Zoo Areas Evaluated with Reconnaissance Surveys 2020
Mean High Water (MHW)

Vegetation Communities and Habitats
- Aggregate Base
- Beach
- Developed
- Dune Mat/Ice Plant Mats
- Dune Mat/Ice Plant Mats/Riprap
- European Beach Grass Swards/Dune Mat/Ice Plant Mats
- Intertidal Zone/Foredunes
- Mulch/Ruderal
- Ornamental Trees and Shrubs
- Salt Rush Swales
- Silver Dune Lupine Scrub/Ice Plant Mats

Potential Jurisdictional Wetlands
- Arroyo Willow Thickets

** San Francisco spineflower occurs in the Study Area in and adjacent to the San Francisco spineflower mitigation area. Figure 6 provides a detailed map of its locations.*



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0 40 80 Feet

BioMaAS

SOURCE: ESA 2020, Google Earth 2018

FIGURE 3C
Vegetation Communities and Habitats

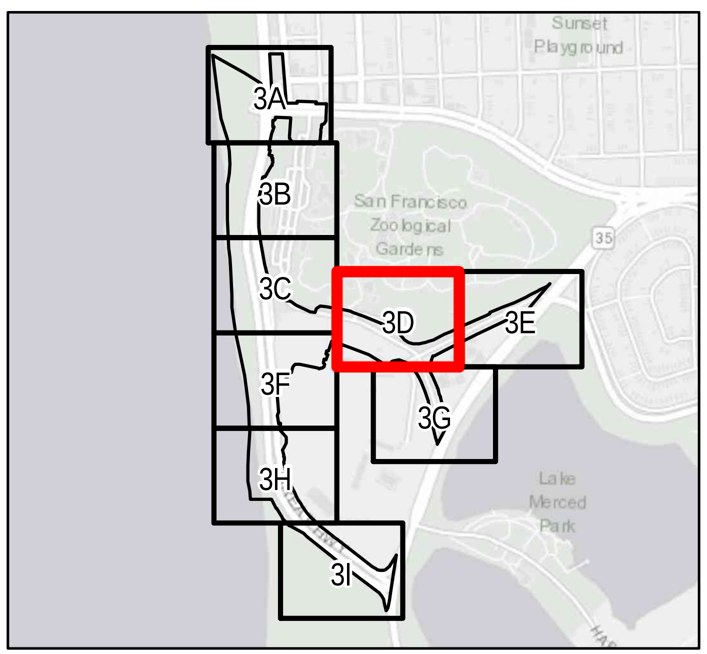
South Ocean Beach Long-term Improvement Project, San Francisco, CA

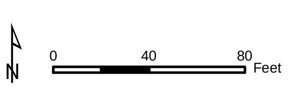
Study Area
Zoo Areas Evaluated with Reconnaissance Surveys 2020
Mean High Water (MHW)

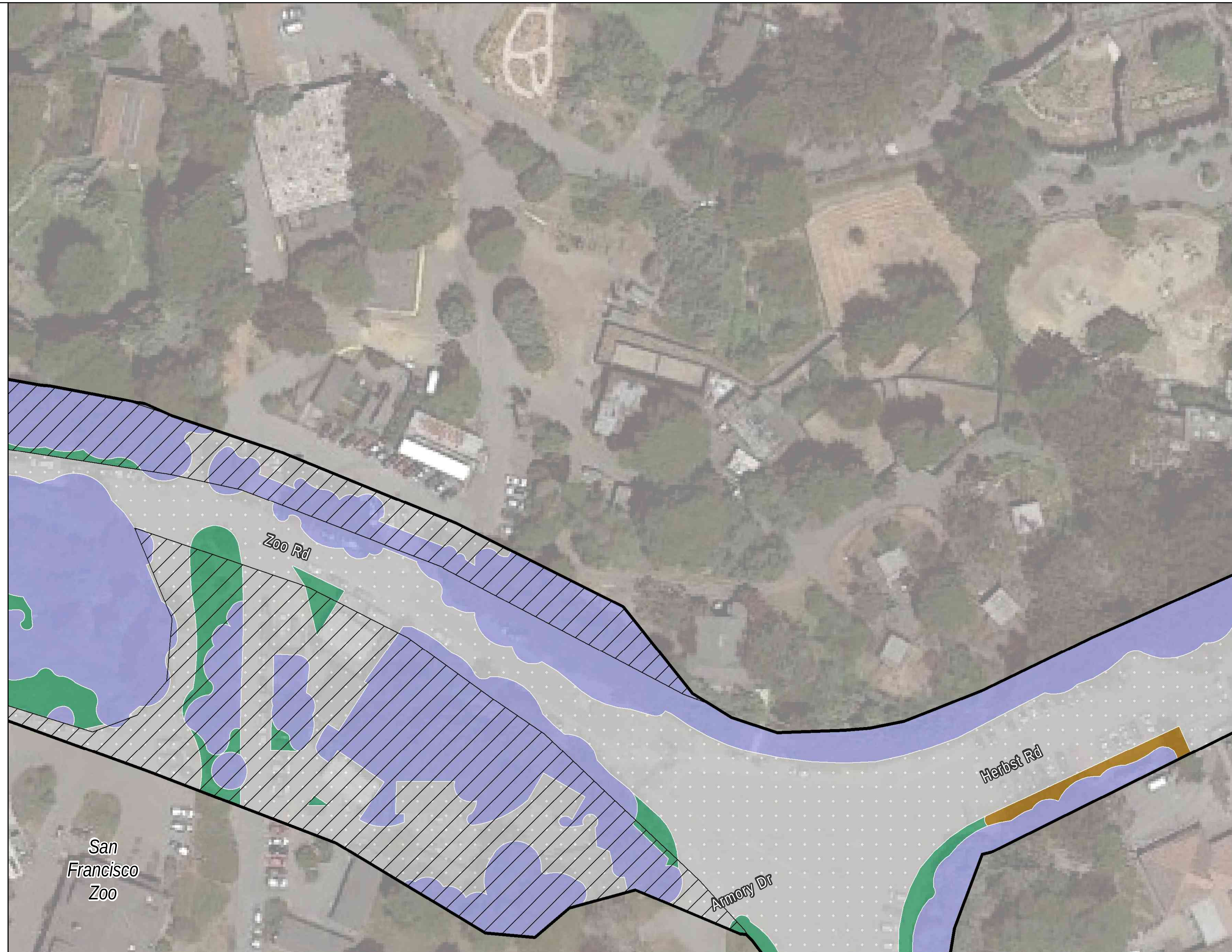
Vegetation Communities and Habitats
- Aggregate Base
- Beach
- Developed
- Dune Mat/Ice Plant Mats
- Dune Mat/Ice Plant Mats/Riprap
- European Beach Grass Swards/Dune Mat/Ice Plant Mats
- Intertidal Zone/Foredunes
- Mulch/Ruderal
- Ornamental Trees and Shrubs
- Salt Rush Swales
- Silver Dune Lupine Scrub/Ice Plant Mats

Potential Jurisdictional Wetlands
- Arroyo Willow Thickets

** San Francisco spineflower occurs in the Study Area in and adjacent to the San Francisco spineflower mitigation area. Figure 6 provides a detailed map of its locations.*







BioMaAS

SOURCE: ESA 2020, Google Earth 2018

FIGURE 3D
Vegetation Communities and Habitats

South Ocean Beach Long-term Improvement Project, San Francisco, CA

Study Area
Zoo Areas Evaluated with Reconnaissance Surveys 2020
Mean High Water (MHW)

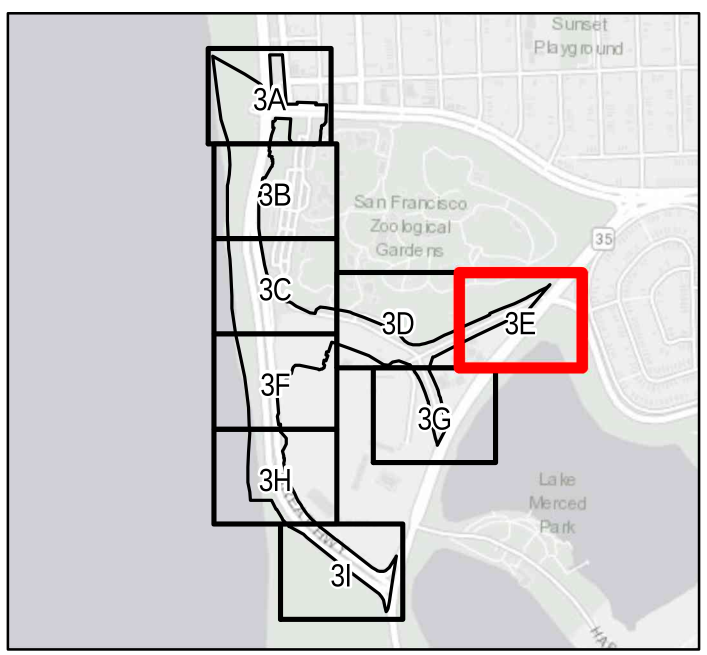
Vegetation Communities and Habitats

- Aggregate Base
- Beach
- Developed
- Dune Mat/Ice Plant Mats
- Dune Mat/Ice Plant Mats/Riprap
- European Beach Grass Swards/Dune Mat/Ice Plant Mats
- Intertidal Zone/Foredunes
- Mulch/Ruderal
- Ornamental Trees and Shrubs
- Salt Rush Swales
- Silver Dune Lupine Scrub/Ice Plant Mats

Potential Jurisdictional Wetlands

- Arroyo Willow Thickets

** San Francisco spineflower occurs in the Study Area in and adjacent to the San Francisco spineflower mitigation area. Figure 6 provides a detailed map of its locations.*



N
0 40 80 Feet

BioMaAS

SOURCE: ESA 2020, Google Earth 2018

FIGURE 3E
Vegetation Communities and Habitats

South Ocean Beach Long-term Improvement Project, San Francisco, CA

Study Area

Zoo Areas Evaluated with Reconnaissance Surveys 2020

Mean High Water (MHW)

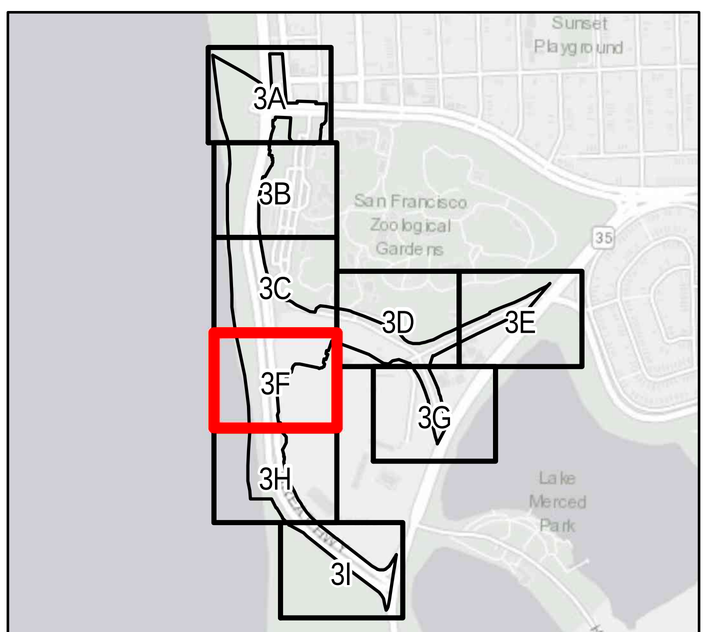
Vegetation Communities and Habitats

- Aggregate Base
- Beach
- Developed
- Dune Mat/Ice Plant Mats
- Dune Mat/Ice Plant Mats/Riprap
- European Beach Grass Swards/Dune Mat/Ice Plant Mats
- Intertidal Zone/Foredunes
- Mulch/Ruderal
- Ornamental Trees and Shrubs
- Salt Rush Swales
- Silver Dune Lupine Scrub/Ice Plant Mats

Potential Jurisdictional Wetlands

- Arroyo Willow Thickets

** San Francisco spineflower occurs in the Study Area in and adjacent to the San Francisco spineflower mitigation area. Figure 6 provides a detailed map of its locations.*



N

0 40 80 Feet

BioMaAS

SOURCE: ESA 2020, Google Earth 2018

FIGURE 3F

Vegetation Communities and Habitats

South Ocean Beach Long-term Improvement Project, San Francisco, CA

Study Area

Zoo Areas Evaluated with Reconnaissance Surveys 2020

Mean High Water (MHW)

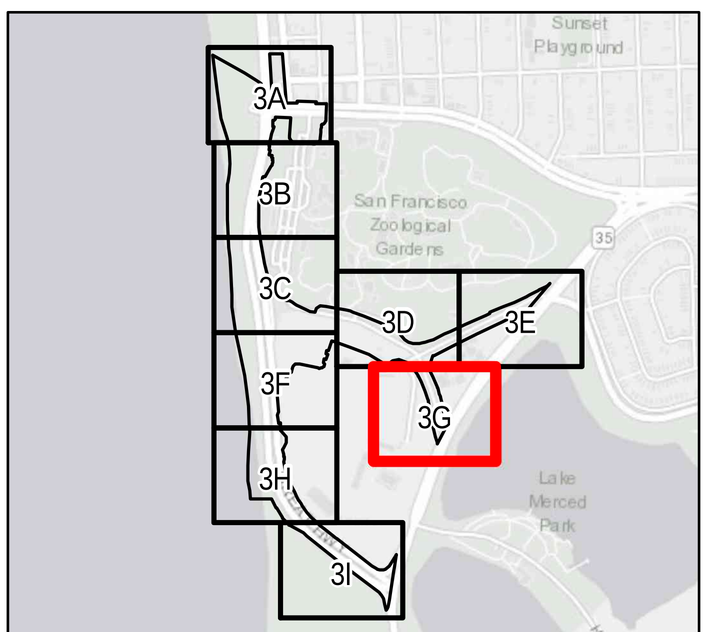
Vegetation Communities and Habitats

- Aggregate Base
- Beach
- Developed
- Dune Mat/Ice Plant Mats
- Dune Mat/Ice Plant Mats/Riprap
- European Beach Grass Swards/Dune Mat/Ice Plant Mats
- Intertidal Zone/Foredunes
- Mulch/Ruderal
- Ornamental Trees and Shrubs
- Salt Rush Swales
- Silver Dune Lupine Scrub/Ice Plant Mats

Potential Jurisdictional Wetlands

- Arroyo Willow Thickets

** San Francisco spineflower occurs in the Study Area in and adjacent to the San Francisco spineflower mitigation area. Figure 6 provides a detailed map of its locations.*



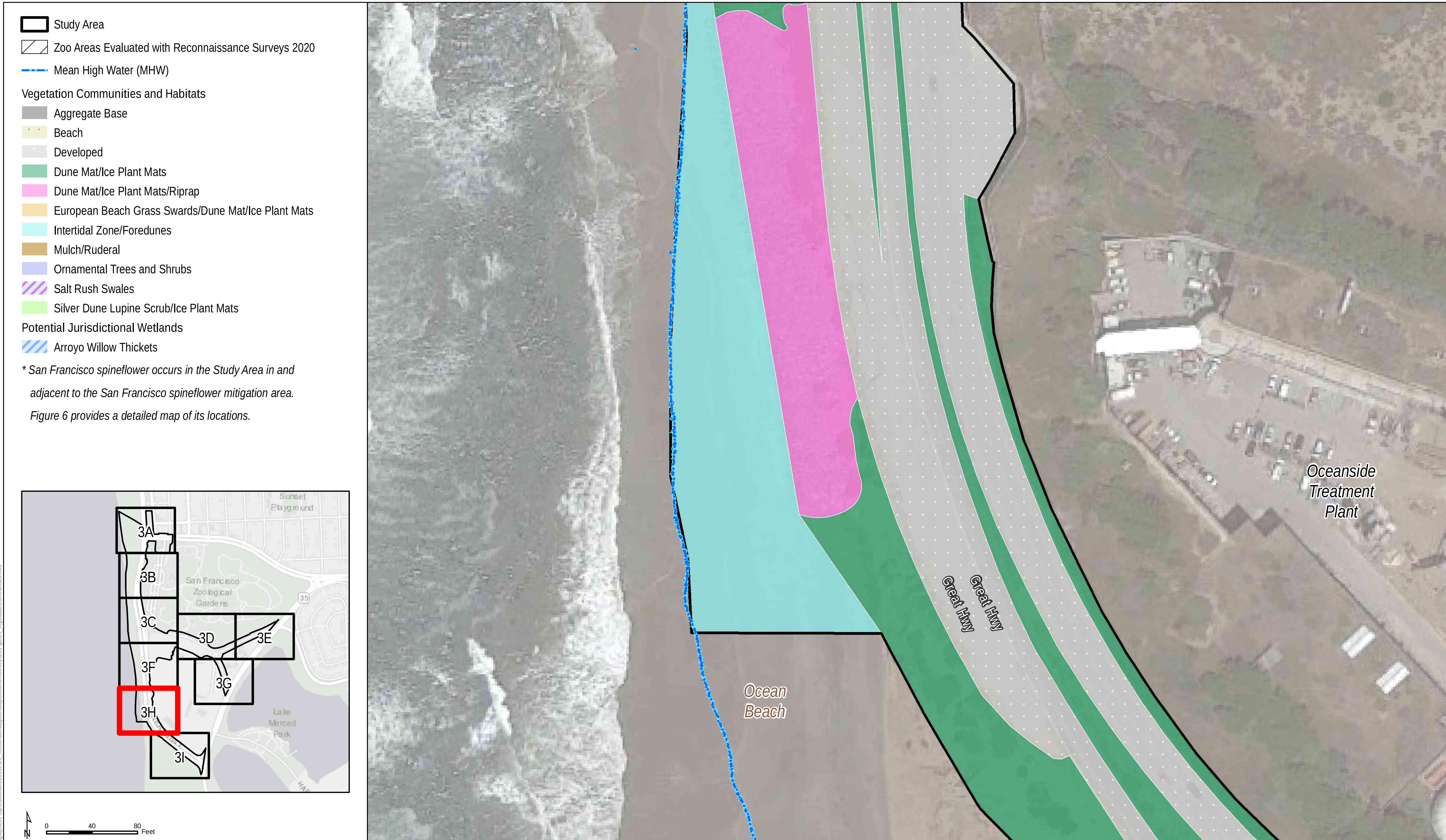
0 40 80 Feet

BioMaAS

SOURCE: ESA 2020, Google Earth 2018

FIGURE 3G
Vegetation Communities and Habitats

South Ocean Beach Long-term Improvement Project, San Francisco, CA



BioMaAS

SOURCE: ESA 2020, Google Earth 2018

FIGURE 3H
Vegetation Communities and Habitats

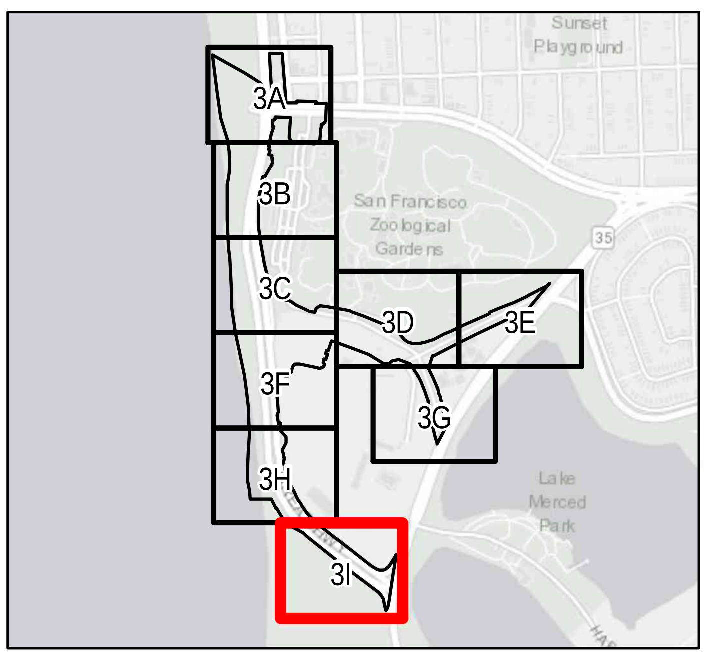
South Ocean Beach Long-term Improvement Project, San Francisco, CA

Study Area
Zoo Areas Evaluated with Reconnaissance Surveys 2020
Mean High Water (MHW)

Vegetation Communities and Habitats
Aggregate Base
Beach
Developed
Dune Mat/Ice Plant Mats
Dune Mat/Ice Plant Mats/Riprap
European Beach Grass Swards/Dune Mat/Ice Plant Mats
Intertidal Zone/Foredunes
Mulch/Ruderal
Ornamental Trees and Shrubs
Salt Rush Swales
Silver Dune Lupine Scrub/Ice Plant Mats

Potential Jurisdictional Wetlands
Arroyo Willow Thickets

** San Francisco spineflower occurs in the Study Area in and adjacent to the San Francisco spineflower mitigation area. Figure 6 provides a detailed map of its locations.*



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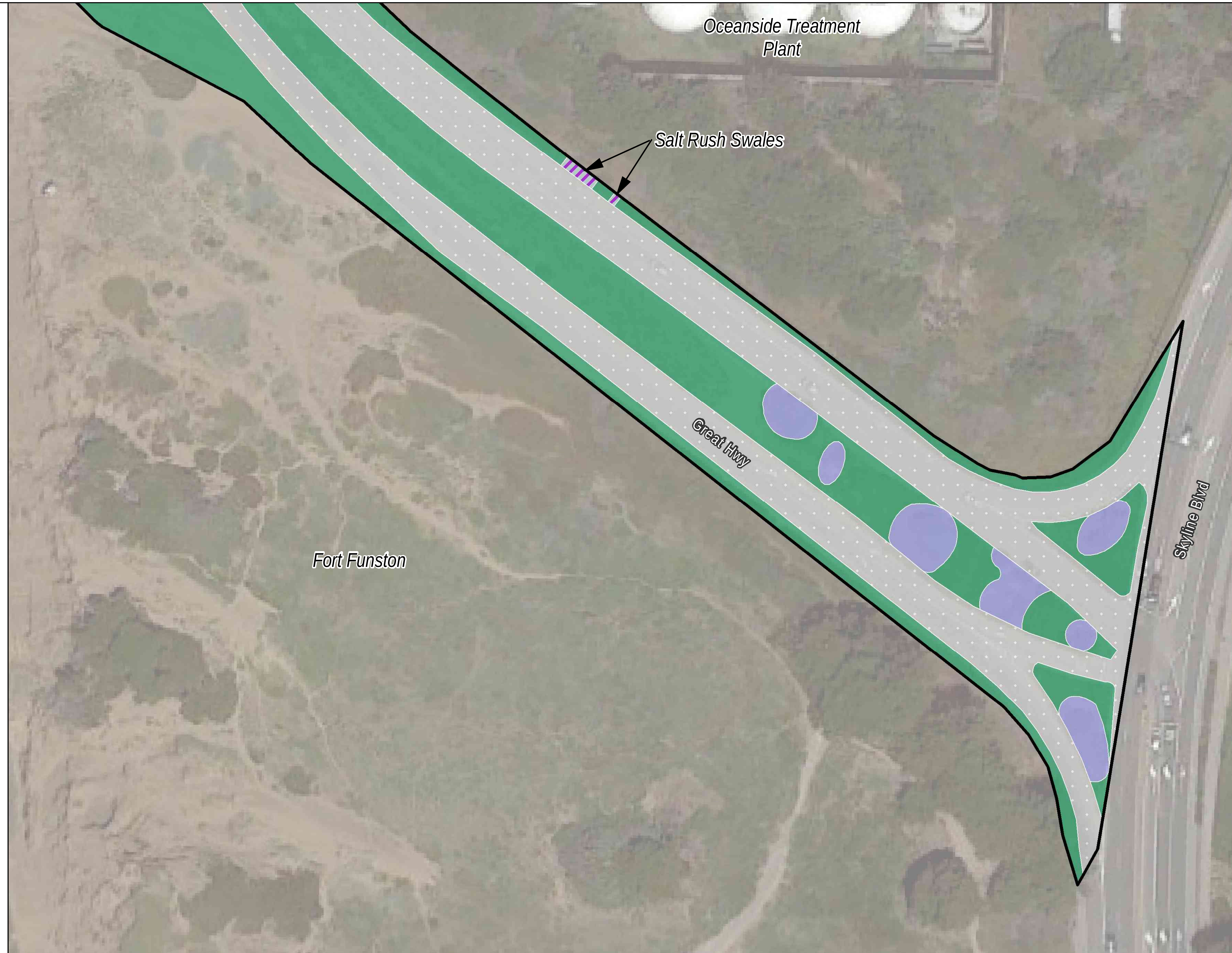
0 40 80 Feet



BioMaAS

SOURCE: ESA 2020, Google Earth 2018

FIGURE 3I
Vegetation Communities and Habitats

South Ocean Beach Long-term Improvement Project, San Francisco, CA

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Non-native forbs and grasses present in dune mat/ice plant mats in the Study Area are ruderal species that tolerate sandy soils and include some species that have a Cal-IPC invasive ranking. A few patches of European beach grass (*Ammophila arenaria*), which has a Cal-IPC rating of high, were observed in this habitat, but in most cases it was not abundant enough to map it as a separate vegetation alliance with the exception of an area at Ocean Beach in the northern portion of the Study Area (Figure 4a). Andean pampas grass (*Cortaderia jubata*), which also has a Cal-IPC rating of high, is uncommon in the Study Area and several individual plants were only observed in few locations in this habitat. Other ruderal forbs with a Limited or Moderate invasiveness ranking that were commonly observed in this dune mat/ice plant habitat include sea rocket (*Cakile maritima*), New Zealand spinach (*Tetragonia tetragonioides*), pig's-root (*Conicosia pugioniformis*), shortpod mustard (*Hirschfeldia incana*) burclover (*Medicago polymorpha*), and smooth cat's ears (*Hypochaeris glabra*). Other ruderal, non-native forbs in this habitat are cut-leaf plantain (*Plantago coronopus*), four-leaved allseed (*Polycarpon tetraphyllum* var. *tetraphyllum*), sourclover (*Melilotus indicus*), white sweet clover (*Melilotus albus*), crete weed (*Hedypnois cretica*), and scarlet pimpernel (*Lysimachia arvensis*). Most open, sandy patches in dune mat are associated with non-native grasses that also have a Cal-IPC invasive Moderate or Limited ranking, such as ripgut brome (*Bromus diandrus*), wild oat (*Avena barbata and A. fatua*), foxtail barley (*Hordeum murinum* ssp. *leporinum*), panic veldtgrass (*Ehrharta erecta*), soft chess (*Bromus hordeaceus*), and rattail sixweeks grass (*Festuca myuros*). Other less common and less invasiveness grasses observed in this habitat were hare's tail grass (*Lagurus ovatus*) and sickle grass (*Parapholis incurva*).

Several areas mapped as dune mat/ice plant mats on city property within the San Francisco Zoo along the Great Highway are native plant landscaping that is maintained by the zoo (Figure 4b). According to the San Francisco Zoo's Operations Director, Steve Beach (personal communication, 2016), this area was planted with native dune plants around 2000-2001. In addition, Mr. Beach stated that these areas were formerly irrigated, but that the irrigation system has not been in operation for the last several years, and that ice plant is eradicated once a year. These areas generally have lower non-native plant cover and higher abundance of thrift sea pink, coast buckwheat, seaside daisy, and coastal sagewort than other dune mat in the Study Area.

The dune mat alliance is considered a sensitive vegetation alliance by the CDFW (2018a). Dune mat in the Study Area supports common native dune flora, locally significant plants, and special-status plants. Although most of the dune mat habitat in the Study Area is disturbed and the quality of these remnant dunes in terms of native plant diversity and abundance are variable, much of this habitat in the Study Area provides suitable habitat for special-status dune plants. The dune mat alliance in the Study Area is interspersed with the ice plant mat alliance on a small scale. Various sized sandy openings occur within ice plant mats that can be categorized as dune mat alliance and that provide suitable habitat for special-status dune flora, such as San Francisco spineflower. Special-status San Francisco spineflower occurs in the central portion of the Study Area in the vicinity of zoo staging area (Figures 5b and 6). San Francisco spineflower and other special-status plants of the Study Area are discussed below under *Special-status Plant Species*. The quality of this habitat in the Study Area is relatively low in most areas because of current and historical disturbance and the predominance of non-native species in this type in the Study Area. Nonetheless, much of the dune mat in the Study Area provides suitable habitat for special-status dune flora. A full season of special-status plant surveys conducted in late May, June, July, and September of 2019 and April 2020 did not detect special-status plants, except for San Francisco spineflower. San Francisco gumplant, a CRPR 3.2 species, was also observed in the Study Area. The following native species that were observed in dune mat in the Study Area are considered locally significant: San Francisco spineflower, yellow sand verbena, Heermann's bird's-foot trefoil, spike bent grass, beach burr, silver dune lupine, and Pacific seaside plantain (CNPS 2015). None of these species are abundant in the Study Area where dune mat habitat is a mix of native and non-native species.

Ornamental Trees and Shrubs

There are 5.52 acres of Ornamental Trees and Shrubs habitat in the Study Area (Figures 3a-i). This habitat has an overstory layer that is primarily ornamental trees and tall shrubs and an understory of smaller shrubs, non-native grasses, and mostly ruderal species that tolerate sandy soils (Appendix A; Photograph 4). Monterey cypress (*Hesperocyparis macrocarpa*), a native tree that is not locally native, is the most common species in this habitat. Other ornamental trees and shrubs include ngaio tree (*Myoporum laetum*), blue gum (*Eucalyptus globulus*), blackwood acacia (*Acacia melanoxylon*), pride of Madeira (*Echium candicans*), pink melaleuca (*Melaleuca nesophila*), and plume acacia (*Albizia lophantha*). Other trees that are less common in this habitat include New Zealand Christmas tree (*Metrosideros excelsa*), Monterey pine (*Pinus radiata*), Catalina ironwood (*Lyonothamnus floribundus* ssp. *asplenifolius*), and peppermint tree (*Agonis flexuosa*). The understory of this habitat consists of litter and sparse vegetation in dense canopy areas and in more open canopy areas and on edges, the vegetation is similar to ice plant mats/dune mat (disturbed) vegetation but in some areas supports more non-native grasses. In addition, panic veldtgrass and fine leaved fumitory (*Fumaria parviflora*) were common in this habitat type in some areas. The understory also sometimes supports Cape ivy (*Delairea odorata*) and English ivy (*Hedera helix*), two species that have a Cal-IPC (2006) invasive ranking of high. This habitat type supports few native plants species and predominantly consists of non-native plant species, and in most areas it provides low quality habitat for special-status plants.

Dune Mat/Ice Plant Mats/Riprap

There are 2.47 acres of dune mat/ice plant mats/riprap that occur along the slopes at Ocean Beach (Figures 3b, 3c, 3f and 3h). This habitat supports similar plants species as the dune mat/ice plant mats that was described above but these areas are on slopes where riprap was placed for erosion control (Appendix A; Photograph 5). Dune flora and ice plant/sea fig grow in the opening between the riprap and in sandy areas without riprap.

Aggregate Base

There are 1.79 acres of aggregate base in the Study Area at zoo staging area (Figures 3c and 3f). The surface consists of aggregate base and are primarily barren except for a couple of less disturbed areas that support some of the ruderal non-native species present in dune mat/ice plant mats habitat in the Study Area (Appendix A; Photograph 6).

Beach

This community within the Study Area consists of 0.75 acre at South Ocean Beach (Figures 3a and 3b). It is located on a terrace above the intertidal zone that is adjacent to public parking. This habitat consists of barren sand that is regularly disturbed by public access (Appendix A; Photographs 7 and 12).

European Beach Grass Swards/Dune Mat/Ice Plant Mats

There is only one small patch of European beach grass swards/dune mat/ice plant mats (0.26 acre) in the Study Area at Ocean Beach (Figure 3a). It is located on a slope adjacent to a public access path that leads to the intertidal area of the beach. Floristic composition is similar to the dune mat/ice plant mats as described above, but there is a higher cover of European beach grass in this habitat (Appendix A; Photograph 9). Associated species include beach burr, ice plant/sea fig (*Carpobrotus* spp.), beach strawberry, beach evening-primrose, and European sea rocket. This habitat also supports less annual grasses and has more barren sand than many other dune mat/ice plant mat areas.

Study Area

5-Mile Study Area Radius

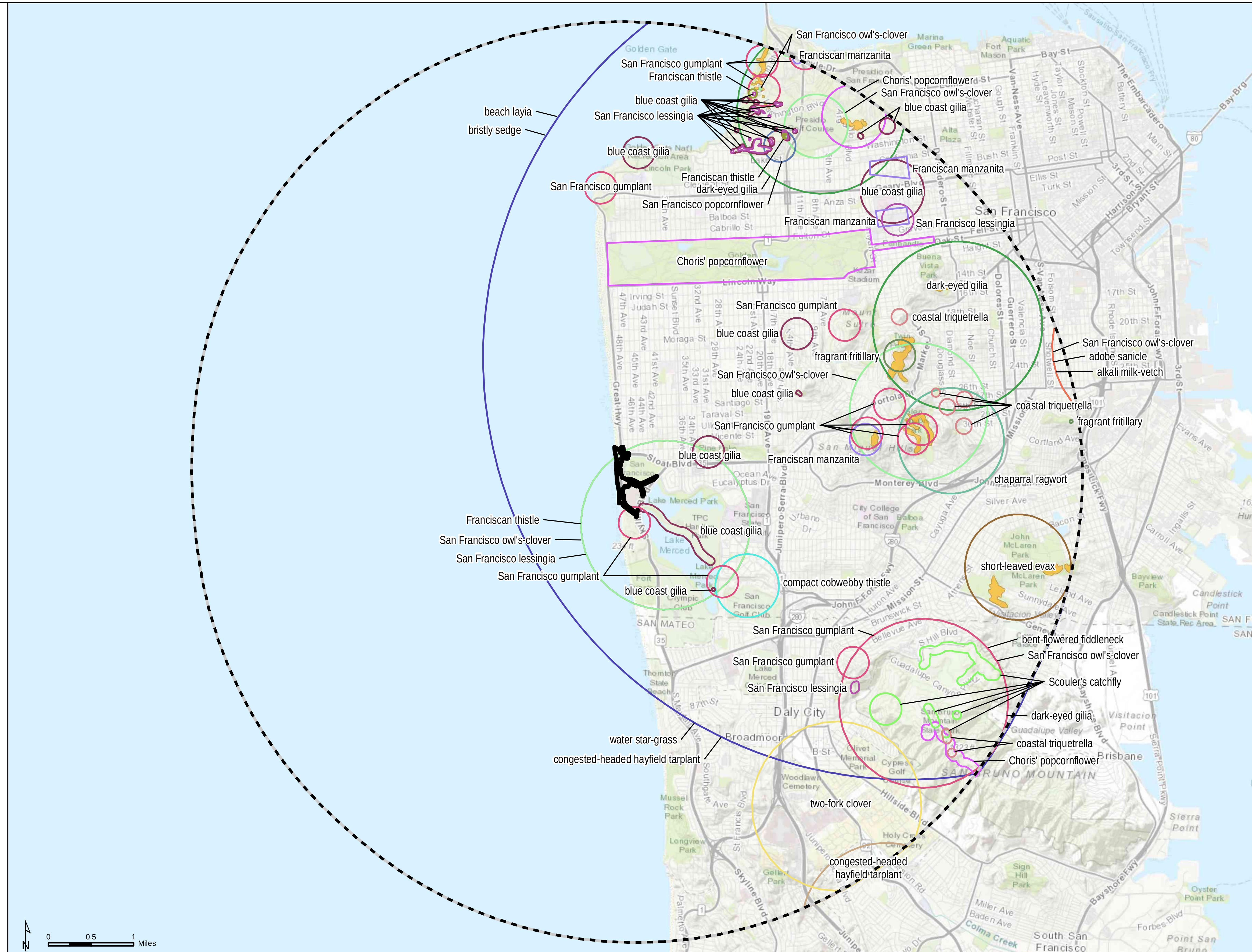
CNDDB Occurrences Within a 5-Mile Radius of the Study Area

Plant

- Adobe sanicle (*Sanicula maritima*)
- Alkali milk-vetch (*Astragalus tener* var. *tener*)
- Beach layia (*Layia carnosa*)
- Bent-flowered fiddleneck (*Amsinckia lunaris*)
- Blue coast gilia (*Gilia capitata* ssp. *chamissonis*)
- Bristly sedge (*Carex comosa*)
- Chaparral ragwort (*Senecio aphanactis*)
- Choris' popcornflower (*Plagiobothrys chorisianus* var. *chorisianus*)
- Coastal triquetrella (*Triquetrella californica*)
- Compact cobwebby thistle (*Cirsium occidentale* var. *compactum*)
- Congested-headed hayfield tarplant (*Hemizonia congesta* ssp. *congesta*)
- Dark-eyed gilia (*Gilia millefoliata*)
- Fragrant fritillary (*Fritillaria liliacea*)
- Franciscan manzanita (*Arctostaphylos franciscana*)
- Franciscan thistle (*Cirsium andrewsii*)
- San Francisco gumplant (*Grindelia hirsutula* var. *maritima*)
- San Francisco lessingia (*Lessingia germanorum*)
- San Francisco owl's-clover (*Triphysaria floribunda*)
- San Francisco popcornflower (*Plagiobothrys diffusus*)
- Scouler's catchfly (*Silene scouleri* ssp. *scouleri*)
- Short-leaved evax (*Hesperevax sparsiflora* var. *brevifolia*)
- Two-fork clover (*Trifolium amoenum*)
- Water star-grass (*Heteranthera dubia*)

USFWS Critical Habitat

- Franciscan manzanita (*Arctostaphylos franciscana*)



BioMaAS

Source: CDFW (5/2019), ESRI 2020

FIGURE 4A

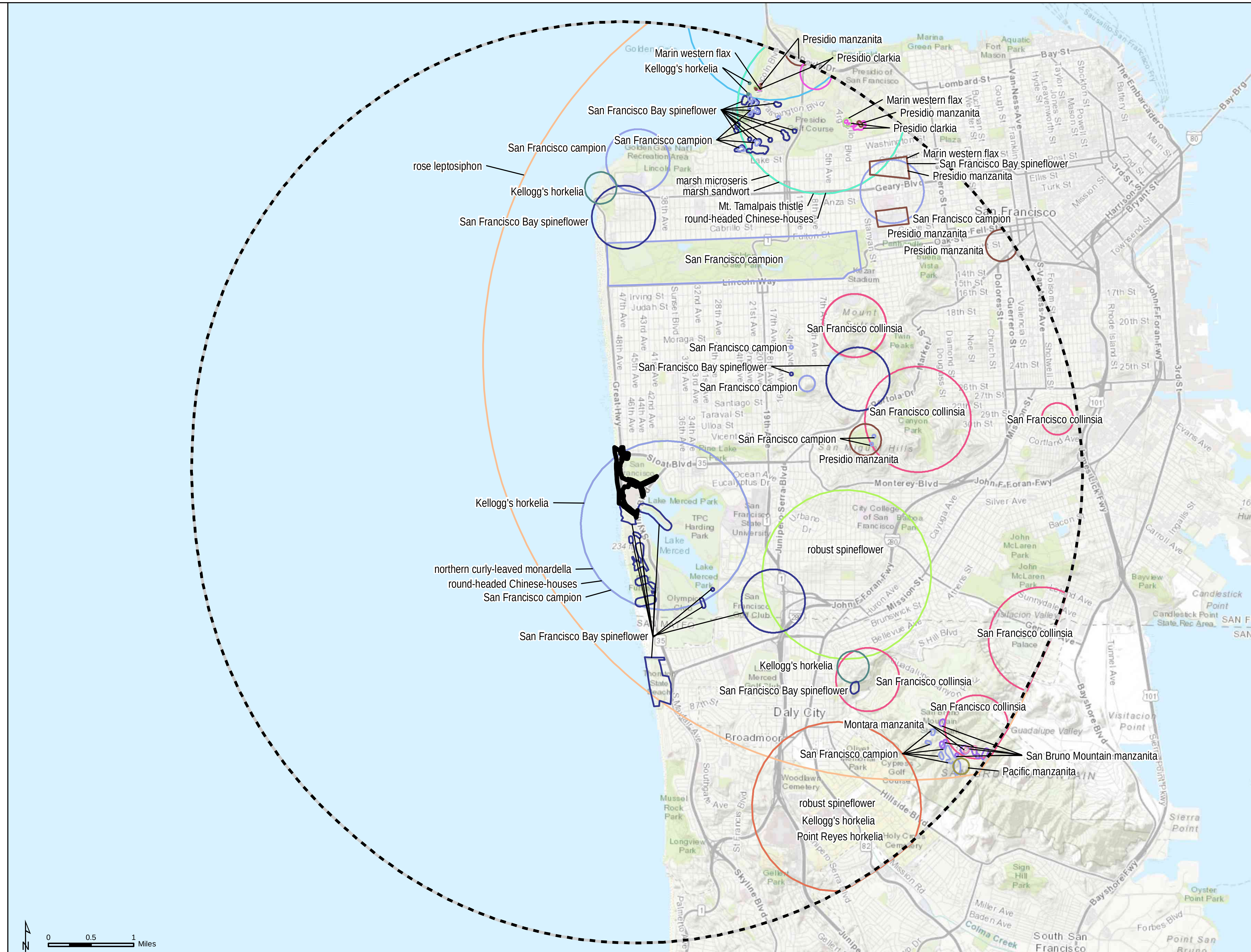
CNDDB Plant Occurrences and Critical Habitat Within a 5-Mile Radius of the Study Area

South Ocean Beach Long-term Improvement Project, San Francisco, CA

Study Area
5-Mile Study Area Radius
CNDDB Occurrences Within a 5-Mile Radius of the Study Area

Plant

- Kellogg's horkelia (*Horkelia cuneata* var. *sericea*)
- Marin western flax (*Hesperolinon congestum*)
- Marsh microseris (*Microseris paludosa*)
- Marsh sandwort (*Arenaria paludicola*)
- Montara manzanita (*Arctostaphylos montaraensis*)
- Mt. Tamalpais thistle (*Cirsium hydrophilum* var. *vaseyi*)
- Northern curly-leaved monardella (*Monardella sinuata* ssp. *nigrescens*)
- Pacific manzanita (*Arctostaphylos pacifica*)
- Point Reyes horkelia (*Horkelia marinensis*)
- Presidio clarkia (*Clarkia franciscana*)
- Presidio manzanita (*Arctostaphylos montana* ssp. *ravenii*)
- Robust spineflower (*Chorizanthe robusta* var. *robusta*)
- Rose leptosiphon (*Leptosiphon rosaceus*)
- Round-headed Chinese-houses (*Collinsia corymbosa*)
- San Bruno Mountain manzanita (*Arctostaphylos imbricata*)
- San Francisco Bay spineflower (*Chorizanthe cuspidata* var. *cuspidata*)
- San Francisco campion (*Silene verecunda* ssp. *verecunda*)
- San Francisco collinsia (*Collinsia multicolor*)



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Source: CDFW (5/2019), ESRI 2020

FIGURE 4B
CNDDB Plant Occurrences Within a 5-Mile Radius of the Study Area

South Ocean Beach Long-term Improvement Project, San Francisco, CA

Mulch/Ruderal

Mulch/ruderal habitat occurs adjacent to the Pomeroy Center along Herbst Road and is 0.18 acre (Figure 3d and 3e). The unpaved areas adjacent to the road are mulched and function as a sidewalk. Vegetation that is growing up through the mulch is sparse to somewhat dense and is primarily non-native annual grasses with some ruderal vegetation. Non-native grasses and forbs observed here include foxtail barley, slender wild oat, panic veldtgrass, cut-leaf plantain, and sheep's sorrel (*Rumex acetosella*). These areas appear to be periodically mowed.

Silver Dune Lupine Scrub/Ice Plant Mats

Silver dune lupine scrub/ice plant mats is only mapped in one location in the Study Area adjacent to the zoo staging area (Figure 3f). The classification and nomenclature for the 0.16-acre silver dune lupine /ice plant mats community in the Study Area is based on two vegetation alliances in *A Manual of California Vegetation* (CNPS 2019): 1) *Lupinus chamissonis - Ericameria ericoides* Shrubland Alliance (Silver Dune Lupine Scrub) and 2) *Mesembryanthemum* spp. - *Carpobrotus edulis* Herbaceous Semi-Natural Alliance (Ice Plant Mats). Silver dune lupine scrub/ice plant mats habitat in the Study Area consists of a mosaic of dense to sparse patches of ice plant (*Carpobrotus edulis* and *C. chilensis*) (ice plant mats) interspersed with open, sandy areas that support native shrubs and native dune flora, as well as non-native grasses and forbs (Figure 3d). The species composition of this habitat is similar to dune mat/ice plant mats in the Study Area – as described above - but silver dune lupine scrub has a higher cover of shrubs than dune mat, including silver dune lupine, coastal sagewort, tree lupine, and coyote brush (Appendix A; Photograph 10). This area also supports San Francisco spineflower (Appendix A; Photograph 11). The distribution of San Francisco spineflower in the Study Area is discussed in more detail in *Special-Status Plant Species*, below. The growth of Monterey cypress and plume acacia are stunted and these trees form a discontinuous small tree layer. Silver dune lupine scrub also tends to have a higher cover of red fescue than other habitats, as well as a higher cover of native forbs such as beach evening-primrose, Heermann's bird's-foot trefoil**,** strigose bird's-foot-trefoil, and rattlesnake weed. Although ice plant and sea fig are significant components of this habitat and there are a few Andean pampas grass patches, this habitat is one of the higher quality habitats in the Study Area and may be considered a sensitive vegetation community, as discussed in detail in *Sensitive Vegetation Communities* section, below.

Arroyo Willow Thickets

An arroyo willow thicket vegetation community is located just east of the zoo staging area (Figure 3c). This vegetation community corresponds to arroyo willow thickets (*Salix lasiolepis* Shrubland Alliance) described in the *Manual of California Vegetation Online* (CNPS 2019b). There is only one patch of arroyo willow thickets in the Study Area, consisting of 0.09 acres adjacent to upland ornamental Monterey cypress, plume acacia, ngaio tree, and pride of Madeira, that form a nearly contiguous stand of trees and shrubs. The relative cover of arroyo willow (*Salix lasiolepis*) is greater than 50 percent in the tree canopy, so this habitat meets the CNPS (2019b) membership rule for the arroyo willow thickets alliance. Arroyo willow is a facultative wet (FACW) species in the USACE Arid West wetland region (Lichvar et al. 2016; USACE 2019) and its presence may be indicative of a potential aquatic (wetland) feature. The field surveys did not include a formal wetland delineation that investigated soils and hydrology of this area; however, topography and hydrology which may indicate the presence of potential aquatic features were noted. The potential jurisdictional status of this arroyo willow thicket and a nearby topographic depression are discussed in more detail in the *Jurisdictional Wetlands and Other Waters* section, below.

Intertidal Zone

The intertidal zone consists of 6.44 acres at Ocean Beach (Figure 3a). It includes the intertidal zone of the Pacific Ocean landward to the mean high tide line. It is the barren, sandy area that is accessed by the public (Appendix A; Photograph 12). It is disturbed on a regular basis by tides and public access, so it lacks vegetation.

Salt Rush Swales

Two small patches of salt rush (*Juncus lescurii*) occur along the Great Highway between shoulder of the road and a fence that coincides with the Study Area boundary (Figure 3i). This habitat corresponds to salt rush swales (*Juncus lescurii* Herbaceous Alliance) described in the *Manual of California Vegetation Online* (CNPS 2019b). This alliance has a state rarity rank of S2?.[9] However, these areas do not meet the membership criteria for this alliance. The membership rule requires greater than 50 percent relative cover of salt rush. The relative cover of salt rush is approximately 30-35 percent. In addition, these areas are only 30.0 feet by 9.25 feet and 6.0 feet by 9.05 feet, which is only a total of 0.01 acre. These patches are approximately 15 feet apart and located at the toe of a slope extending outside of the Study Area. On September 20, 2019, the plants appeared disturbed by vehicles and possibly road maintenance mowing.

Salt rush is a facultative wet (FACW) species in the USACE Arid West wetland region (Lichvar et al. 2016; USACE 2019). During the field survey, the soil within this vegetation community was not moist and there was no evidence of wetland hydrology. Both patches of salt rush occurred among several desiccated arroyo willows (also FACW species, as described above) and were adjacent to arroyo willows located just outside of the Study Area, on the other side of the fence. Salt rush also sporadically occurs with these willows outside of but adjacent to the Study Area. This area is included in the aquatic resources delineation performed of the project area to determine if the feature meets criteria for federal or state wetlands jurisdictional to the U.S. Army Corps of Engineers, Regional Water Quality Control Board, or California Coastal Commission (ESA, 2021). The delineation concludes this feature does not qualify as a wetland regulated by any of these agencies.

Jurisdictional Wetlands and Other Waters

The Pacific Ocean is considered an other water that is regulated by the USACE, Regional Water Quality Control Board (RWQCB), and California Coastal Commission (CCC). The USACE regulates the Pacific Ocean as a navigable water under Section 10 of the Clean Water Act and under Section 404 of the Clean Water Act up to the high tide line. The NWI database classifies the Pacific Ocean within the Study Area as estuarine and marine deepwater habitat, further described as a marine system, subtidal subsystem, unconsolidated bottom class, and subtidal water regime (USFWS, 2019b). The adjacent intertidal zone and wet sandy beach of the Study Area is classified as estuarine and marine wetland habitat, further described as a marine system, intertidal subsystem, unconsolidated shore class with a regularly flooded water regime (USFWS, 2019b).

Aside from the Pacific Ocean, the NWI (USFWS, 2019b) and NHD (USGS, 2018) databases did not document any wetlands or other waters within the Study Area. An aquatic resources delineation of the project area was conducted on December 9, 2020 which identified the Pacific Ocean as the only federal or state-regulated aquatic feature within the project area (ESA, 2021). The delineation was conducted of the project area, a subset of the Study Area, and did not include the arroyo willow thicket because this location is not within the

9 "?" indicates that S2 is a tentative ranking.

revised project area. The jurisdictional status of potential aquatic features within the Study Area, but not in the project area assessed in the aquatic resources delineation, are described below.

Based on vegetation mapping observations, and superficial observations of topography and hydrology, the arroyo willow and California blackberry thickets located in the ornamental tree and shrub area (Figure 3c), could meet the criteria of wetlands that are regulated by the USACE, RWQCB, or CCC.

The arroyo willow thicket occurs in a low-lying area that also primarily supports upland shrubs and trees and apparently does not become inundated during the rainy season. This area is generally located in the area mapped as arroyo willow thicket and the immediately adjacent ornamental trees and shrubs areas as shown in Figure 3c and 3e. According to Mr. Beach, the zoo's operations director, this area is not a channel and is not connected to culverts for stormwater conveyance or to other drainage features (personal communication, Beach 2019). Dense vegetation and trash and debris piles limited access and visibility, but no culverts or outlets were observed in the depression and it was dry during the May, June, July, and September 2019 surveys. According to Mr. Beach, although water drains into this low-lying area, the soil is too sandy for water to pond here in the winter. Mr. Beach believes this depression is possibly a naturally low-lying area and has no knowledge of soil excavations that could have created the depression. The topography of this area has also been altered by trash and debris piles. This depression is partially barren and primarily supports upland vegetation in the overstory and the understory, including Monterey cypress, plume acacia, ngaio tree, and pride of Madeira (Appendix A; Photograph 8). Invasive cape ivy occurs in the understory along with non-native grasses and forbs species that occur in ornamental trees and shrub habitat described above. The open edges of this habitat are ruderal and support invasive poison hemlock (*Conium maculatum*), shortpod mustard (*Hirschfeldia incana*), and New Zealand spinach. Few hydrophytic plant species were observed in or adjacent to the depression except for occasional thickets of California blackberry (*Rubus ursinus*) and this patch of arroyo willow. Native California blackberry (*Rubus ursinus*), a facultative species (FAC) in the Arid West U.S. Army Corps of Engineers (USACE) region, occurs sporadically in the understory of the ornamental trees and shrubs (Lichvar et al. 2016; USACE 2019). The Geotechnical Interpretive Report (GIR) for this project reports that the groundwater elevation based on SFPUC's 2017 Annual Groundwater Monitoring Report for Westside Basin was at approximately 10 feet in the vicinity of the project development footprint (project site). This report also states that groundwater elevations recorded in the vicinity of the project site in previous borings and monitoring wells range from 5.5 to 13.5 feet (AGS 2019). A groundwater table that is present at these reported depths could possibly provide a water source for these willows.

Based on vegetation mapping and initial observations of topography and hydrology, this arroyo willow thicket could meet the criteria of federal or state- jurisdictional wetlands. The sandy depression near the arroyo willow thicket is unlikely to be considered a jurisdictional other water because it does not appear to remain inundated during the rainy season and appears to be isolated from other water sources that may be jurisdictional waters of the United States and state. However, a formal delineation was not conducted of this area and observations on the hydrology of this depression were limited to the non-rainy season.

A similar low-lying depression occurs just north of Zoo Road in an area surveyed in 2020 (general location shown on Figures 3c and 3d). This area containing the depression is mapped as ornamental trees and shrubs and has an overstory dominated by Monterey cypress. The understory is dominated by upland non-native grasses and forbs. No standing water was observed within the depression during the April 16, 2020 reconnaissance survey. The depression does not appear to be hydrologically connected to culverts for stormwater conveyance or to other drainage features. The topography flattens out at the western end of this depression. This area is unlikely to be considered a wetland or water feature meeting federal or state criteria because it lacks hydrophytic vegetation, the sandy soil composition does not retain water and a source of hydrology connecting the apparent isolated depression was not found.

Special-Status Plant Species and CRPR 3 and 4 Plant Species

Background Research

CNDDB, CNPS and USFWS database searches produced a list of 45 potentially occurring special-status plant species, two CRPR 3 plant species, and four CRPR 4 plant species in the vicinity of the Study Area. CNDDB records of special-status plant species and USFWS Critical Habitats documented within the five miles of the Study Area are shown in Figures 4a and 4b. Appendix B-1 provides a table of special-status plants and CRPR 3 and 4 plants with CNDDB, CNPS, or USFWS database records within five miles of the Study Area and evaluates their potential to occur within vegetation communities in the Study Area. Based on the vegetation surveys, 18 of the 45 these special-status plant species, one CRPR 3 species, and one CRPR 4 species were eliminated due to the absence of suitable habitat such as marshes, vernal pools, and oak woodlands or substrates such as alkaline soils and serpentine areas. Of the remaining species, 27 special-status plants, one CRPR species, and three CRPR 4 species were determined to have low potential due to marginal habitat present or absence of plants observed during special-status plant surveys in 2019 and 2020 which coincided with the blooming period of these species. One special-status plant with a CRPR of 1B.2, San Francisco spineflower, occurs in the Study Area. One gumplant (*Grindelia* sp.) patch that was tentatively identified as San Francisco gumplant (*Grindelia hirsutula var. maritima*; CRPR 3.2), is also present in the Study Area.

An unpublished NPS map of special-status plants and CRPR 3 and 4 plant species documented in the northern part of Fort Funston shows occurrences of plants south of the Study Area boundary (NPS 1997-2018). Dune mat/ice plant mats habitat in the southwestern part of the Study Area at Fort Funston, adjacent to the Great Highway, is generally less disturbed than other dune mat/ice plant mats habitats in the Study Area and supports a higher abundance and diversity of native dune flora (Appendix A; Photograph 3). This area is more likely to support special-status dune flora than other portions of the Study Area where this community is present. Special-status plants and CRPR 3 and 4 plant species on this NPS map include San Francisco spineflower, San Francisco gumplant, San Francisco wallflower, San Francisco (*Lessingia germanorum*), blue coast gilia (*Gilia capitata* ssp. *chamissonis*), and San Francisco campion (*Silene verecunda* ssp. *verecunda*). These records are from 1997 through 2018 and some of them could be extirpated. One special-status plant or CRPR 3 and 4 plant occurrence was recorded by the NPS approximately 15 feet south of the Study Area boundary (San Francisco spineflower). However, this specific location of spineflower was not observed in the field during 2019-2020 special-status plant surveys of the Study Area. No special-status plants or CRPR 3 and 4 species were observed in this Fort Funston portion of the Study Area during the 2019 and 2020 surveys. It is noted that during these surveys San Francisco spineflower was observed at Fort Funston approximately 90 feet south of the Study Area in a protected ravine among a stand of sea lyme grass (*Elymus mollis* ssp. *mollis*), an uncommon native dune grass that is considered a sensitive natural community (CDFW 2018a).

Special-Status Plant Survey Results

On May 31, 2019 and April 10, 2020, spineflower and wallflower individuals at the reference populations were still blooming. Some spineflower flowers were desiccated, but this species is still very detectable after it blooms because the tiny flowers are in heads that remain on the plant and the plant turns red as it becomes desiccated. This color makes it detectable against the light sandy soil. There were, however, small individuals that were so desiccated they were not very detectable. During the May 31 survey, some of wallflower plants were observed blooming but some were only rosettes without flowers. By July 16, 2019 most wallflower plants were no longer flowering and had desiccated fruit; many spineflower plants no longer had leaves, but the red stems and heads of the plants was still evident, except for some smaller, desiccated plants.

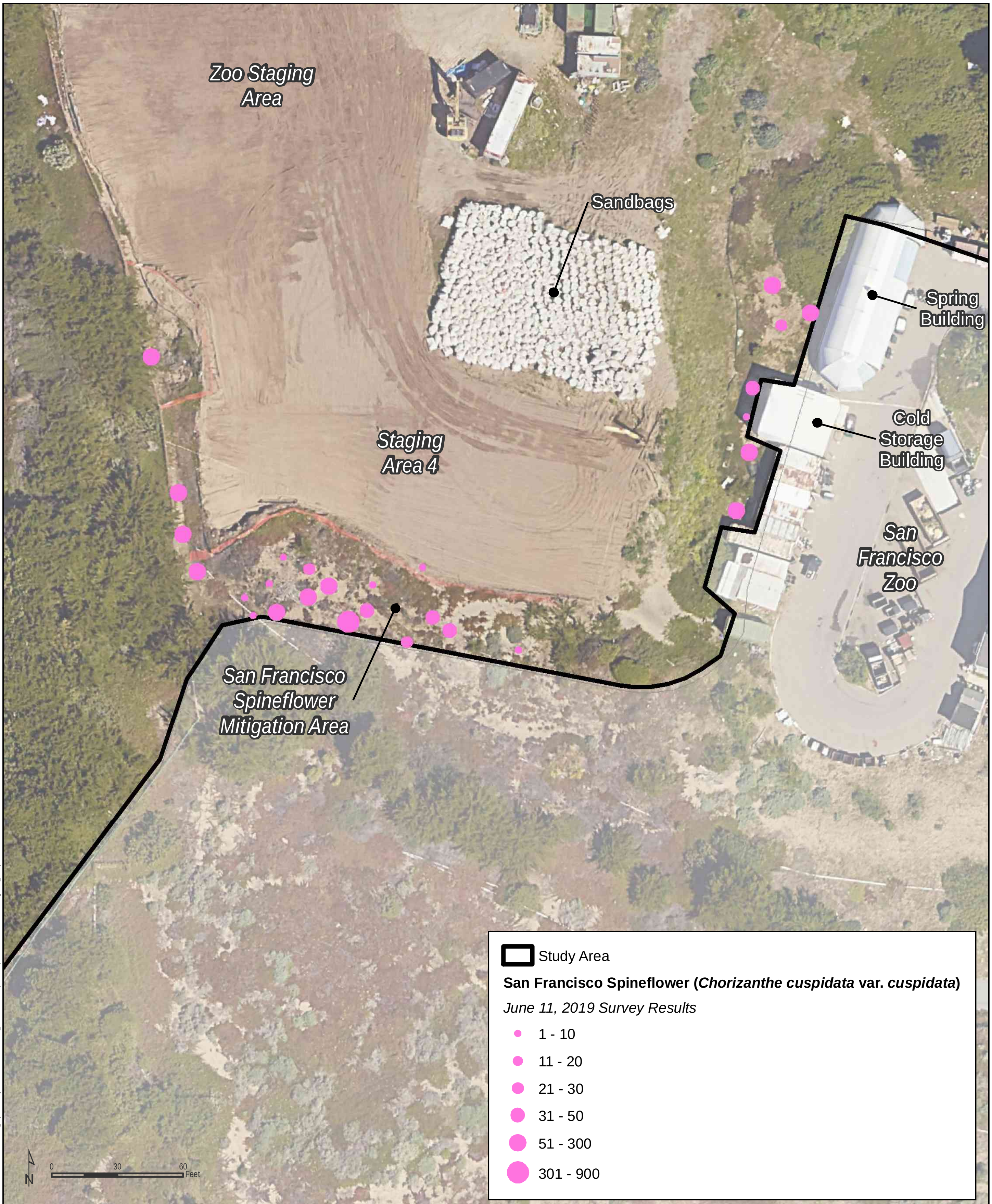
San Francisco Spineflower

Patches of San Francisco spineflower that were identified in the field in the vicinity of the zoo staging area are shown in Figure 5. The figure depicts points with an abundance category that represents each patch. There were a total of 2,113 plants observed in the Study Area. Many of these patches of spineflower located on city property within the San Francisco Zoo were previously identified during surveys for the SFPUC's Pacific Rod and Gun Club (PRGC) Upland Soil Remediation Project. A soil stockpile, formerly located in the vicinity of the existing sandbags and zoo staging area, was identified for use as clean backfill material at the PRGC site. During pre-construction surveys of the stockpile in 2015, three populations of San Francisco spineflower were identified: 1) on top of the soil stockpile (280 plants), 2) east of the stockpile, and 3) south of the stockpile (ESA 2016a). The population east of the (former) stockpile and west of the zoo's spring building and cold storage building was not disturbed during construction and was mapped on June 11, 2019. The population atop the soil stockpile could not be avoided if the soil stockpile was to be used as backfill material at the PRGC. In accordance with the CDFW-approved *San Francisco Spineflower Relocation Plan* (ESA 2016a), the city in 2015 collected seeds from the stockpile plants prior to disturbance and redistributed them in 2016 within the established south population, immediately south of the current zoo staging area and identified on Figure 5 as the *San Francisco Spineflower Mitigation Area*. The goal of the reintroduction was to establish at least 280 plants in a two-year monitoring period to compensate at a 1:1 ratio for the impacted stockpile plants (ESA 2016b). At the end of the Year 2 monitoring period, 736 spineflower individuals were established (ESA 2016b; ESA 2017) which fulfilled the compensatory mitigation requirements for the PRGC project, and no further monitoring was required in subsequent years.

San Francisco Gumplant

One patch of San Francisco gumplant shrubs was identified in dune mat/ice plant mats habitat in the southern portion of the Study Area. On September 20, 2019, this patch of San Francisco gumplant was observed in a narrow strip of dune mat/ice plant mats between the guard rail that separates the northbound and southbound lanes of the Great Highway (Figure 6). This patch is approximately 23.1 square feet. It was not feasible to count the number of individual plants in this patch because the bases were tangled with ice plant, but more than four plants were present. Given the location of this patch, it is unlikely that these San Francisco gumplant shrubs were planted. San Francisco gumplant is a CRPR 3.2 species that is not considered a special-status species.

San Francisco gumplant (*Grindelia hirsutula* var. *maritima*) is morphologically very similar to Pacific gumplant (*Grindelia stricta* var. *platyphylla*) according to treatments of these taxa in the Jepson eFlora (The Jepson Flora Project 2019). The database record for San Francisco gumplant in the CNPS online *Inventory of Rare and Endangered Plants* notes the following regarding this taxon: Can be difficult to identify; many herbarium specimens need to be checked for correct identification. May be a hybrid between *G. hirsutula var. hirsutula* and *G. stricta* var. *platyphylla* or *G. stricta* var. *angustifolia*; needs further study (not in *The Jepson Manual II* (TJM 2)). See *Pittonia* 2:289 (1892) for original description and *Novon* 2(3):215-217 (1992) for revised nomenclature. (CNPS 2019a). The specimens of San Francisco gumplant in and adjacent to the Study Area were reviewed with a microscope and tentatively identified as San Francisco gumplant. This identification was based primarily on the original descriptions of *Grindelia stricta* its varieties and *Grindelia hirsutula* in the *Novon* journal article (Lane 1992). In this article, *Grindelia stricta* has robust pappus that are > 0.3 mm wide at the base and



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BioMaAS

SOURCE: San Francisco County 2018, Google Earth 2018

FIGURE 5

San Francisco Spineflower (Chorizanthe cuspidata var. cuspidata) in the Study Area

South Ocean Beach Long-term Improvement Project, San Francisco, CA

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BioMaAS

Source: San Francisco County 2018, ESA 2020, (Imagery) Maxar 8/2017

FIGURE 6

San Francisco gumplant (*Grindelia hirsutula* var. *maritima*)

South Ocean Beach Long-term Improvement Project, San Francisco, CA

V-shaped in cross section and Grindelia hirsutula has slender pappus < 0.3 mm wide. The identification of the specimens in and adjacent to the Study Area is further complicated by the fact that these specimens could be nursery cultivars. Nursery cultivars can have morphological characteristics that are not typical of more genetically unaltered plants that are in natural habitats. The specimens from the Study Area would require genetic testing to confirm they are the special-status San Francisco gumplant and not the common Pacific gumplant.

Special-Status and Sensitive Wildlife Species

A total of 113 special-status or other sensitive wildlife species were included on the California Natural Diversity Database (CDFW 2019a; 2019c) and USFWS Species database search results for the seven USGS quadrangles surrounding the Study Area (San Francisco South, Point Bonita, San Francisco North, Oakland West, Hunters Point, Montara Mountain, and San Mateo). Appendix B-2 provides a table of special-status and other sensitive animals with CNDDB or USFWS database records within five miles of the Study Area and evaluates their potential to occur within the Study Area. Of these species, special-status wildlife species that were determined to have potential to occur within or immediately adjacent to the Study Area are shown in Table D (1). Sensitive wildlife species (those listed as special status on the CDFW Special Animals List but not afforded protection under the federal or state endangered species acts or designated as a species of special concern by the California Department of Fish and Wildlife) that were determined to have potential to occur within or immediately adjacent to the Study Area are shown in Table D (2). These special status and other sensitive wildlife species are discussed below. A summary of the formal status, habitat affinities, and potential for occurrence within or immediately adjacent to the Study Area for each of the wildlife species assessed is presented in Appendix B-2. Special-status and other sensitive wildlife species known to occur within a 5-mile radius of the Study Area are shown in Figure 7. Appendix C-2 contains a full list of all wildlife species observed in and adjacent to the Study Area during the reconnaissance level survey.

Table D (1): Special-Status Wildlife Species with Potential to Occur in the Study Area

Common Name	Scientific Name	Federal Status	State Status	Other Status
Western bumble bee	*Bombus occidentalis*	--	CESA: CE	XERCES: Imperiled
Pacific lamprey	*Entosphenus tridentatus*	--	CDFW: SSC	AFS: VU
Green sturgeon	*Acipenser medirostris*	FESA: FT	CDFW: SSC	AFS:VU, IUCN: NT
Steelhead	*Oncorhynchus mykiss*	FESA: FT	--	AFS: TH
Coho salmon	*Oncorhynchus kisutch*	FESA: FE	CESA: SE	AFS: TH
Chinook salmon	*Oncorhynchus tshawytscha*	Central Valley spring-run, FESA: FT Sacramento River winter-run, FESA: FE	Central Valley fall /late fall-run, CDFW: SCC Central Valley spring-run, CESA: ST Sacramento River winter-run, CESA: SE	--

Table D (1): Special-Status Wildlife Species with Potential to Occur in the Study Area				
Common Name	Scientific Name	Federal Status	State Status	Other Status
Longfin smelt	*Spirinchus thaleichthys*	--	CESA: ST	
Pacific pond turtle	*Actinemys marmorata*	--	CDFW: SSC	IUCN: VU
Western snowy plover	*Charadrius alexandrinus*	FESA: FT	CDFW: SSC	USFWS: BCC
Western burrowing owl	*Athene cunicularia hypugea*	--	CDFW: SSC	USFWS: BCC
Olive-sided flycatcher	*Contopus cooperi*	--	CDFW: SSC	--
Bank swallow	*Riparia*	--	CESA: ST CDFW: SSC	--
Saltmarsh common yellowthroat	Geothlypis trichas sinuosa)	--	CDFW: SSC	USFWS: BCC
Western red bat	*Lasiurus blossevillii*	--	CDFW: SSC	WBWG: H
California sea-lion	*Zalophus californianus*	MMPA	--	--
Pacific harbor seal	*Phoca vitulina richardii)*	MMPA	--	--

Notes.
Federal Status - Federal Endangered Species Act (FESA); Marine Mammal Protection Act (MMPA);
FT – Listed as Threatened under FESA; FE – Listed as Endangered under FESA.

State Status – California Endangered Species Act (CESA)
CE – Candidate for listing as Endangered under CESA; SE- Listed as Endangered under the CESA; ST – Listed as Threatened under the CESA; California Department of Fish and Wildlife (CDFW), Species of Special Concern (SSC).

Other Status – American Fisheries Society (AFS), Vulnerable (VU), Threatened (TH); U.S. Fish and Wildlife Service (USFWS), Bird of Conservation Concern (BCC); Western Bat Working Group, High Priority Species (H).

Table D (2): Other Sensitive Wildlife Species with Potential to Occur in the Study Area			
Common Name	Scientific Name	Federal/State Status	Other Status
Double-crested cormorant	*Phalacrocorax aritus*	--	CDFW: Watch List (WL)
Cooper's hawk	Accipiter cooperii	--	CDFW: WL
Silver-haired bat	*Lasionycteris noctivagans*	--	WBWG: M
Hoary bat	*Lasiurus cinereus*	--	WBWG: M
Little brown bat	*Myotis lucifugus*	--	WBWG: M
Fringed myotis	*Myotis thysanodes*	--	WBWG: H

Other Status: CDFW Watch List Species (WL); Western Bat Working Group (WBWG) Medium (M) and High (H) Priority Species

Western Bumble Bee

Status

The Western bumble bee (*Bombus occidentalis*) has a global and state rank of G2, G3, S1 and is a Xerces Society Imperiled species. Western bumble bee is a candidate for listing by CDFW under the California Endangered Species Act (CESA).

General Ecology and Distribution

The historical range of the Western bumble bee in California as stretching from the Channel Islands to the northern extent of the state, primarily in the coastal and Sierra Nevada ranges and mostly excluding the Central Valley and drier, warmer areas. It notes that Cameron et al. (2011), comparing 2007-2009 records versus 1900-1999, estimated a 28 percent range decline in North America, and in recent years (2002-2012), the North American range of this species has declined by about half. This species appears to be increasingly restricted to the Sierra-Cascades and coastal areas.[10] The western bumblebee favors *Melilotus, Cirsium, Trifolium, Centaurea, Chrysothamnus* and *Eriogonum*. Most bumble bees nest in the ground in cavities such as abandoned rodent burrows, holes in building foundations, or stacks of firewood (USDA 2012).

Study Area Occurrence

Suitable foraging and burrowing habitat is available in the Study Area for the western bumble bee. *Baccharis, Lupinus, Lotus, Grindelia, Melilotus, Trifolium,* and *Eriogonum* plant species were observed in the Study Area during the rare plant surveys (Appendix C-1). Botta's pocket gopher (*Thomomys bottae*) burrows and natural expansion cracks and other openings in the ground may provide habitat for this species. Based on the scarcity of western bumble bee identifications in the regional area, age of local sightings (1968; CDFW, 2019a), and absence of sightings in San Francisco in the last 50 years, species potential within the Study Area is unknown, but considered unlikely.

Reptiles

Pacific Pond Turtle

Status

The Pacific (western) pond turtle (*Actinemys marmorata*) is designated as a state Species of Special Concern by CDFW.

General Ecology and Distribution

This species is normally associated with permanent ponds, lakes, streams, irrigation ditches or permanent pools along intermittent streams (CDFG 2000). Storer (1930) suggested that two distinct habitats may be used for oviposition: 1) along large slow-moving streams, in which eggs are deposited in nests constructed in sandy banks and 2) along foothill streams, where females may climb hillsides, sometimes moving considerable distances to find a suitable nest site.

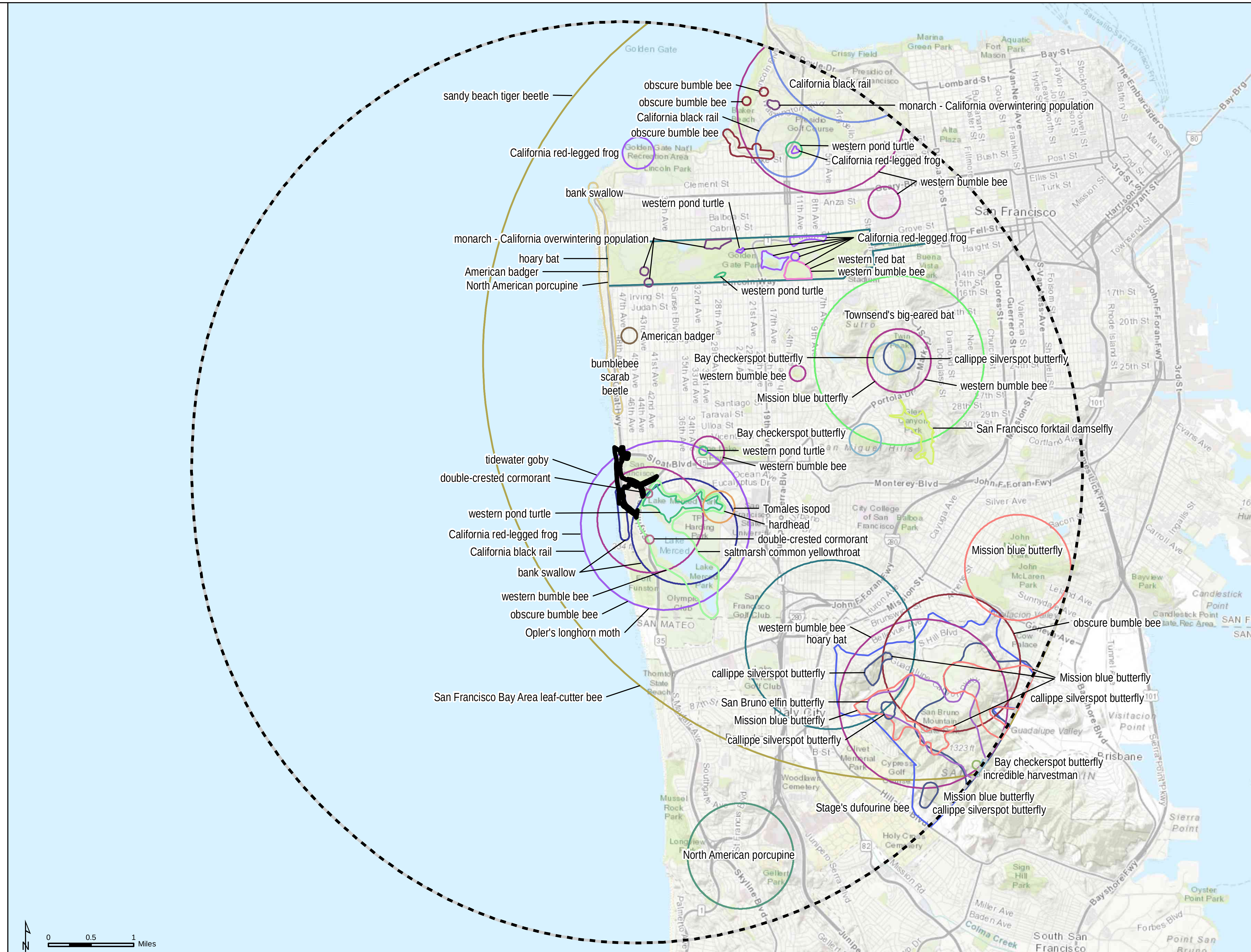
[10] Petition to the State of California Fish and Game Commission to list the Crotch bumble bee (*Bombus crotchii*), Franklin's bumble bee (*Bombus franklini*), Suckley cuckoo bumble bee (*Bombus suckleyi*), and western bumble bee (*Bombus occidentalis occidentalis*) as Endangered under the California Endangered Species Act. Submitted by The Xerces Society for Invertebrate Conservation, Defenders of Wildlife, Center for Food Safety, October 2018.

Study Area
5-Mile Study Area Radius
CNDDB Occurrences Within a 5-Mile Radius of the Study Area

Wildlife

- American badger (*Taxidea taxus*)
- Bank swallow (*Riparia riparia*)
- Bay checkerspot butterfly (*Euphydryas editha bayensis*)
- Bumblebee scarab beetle (*Lichnanthe ursina*)
- California black rail (*Laterallus jamaicensis coturniculus*)
- California red-legged frog (*Rana draytonii*)
- Callippe silverspot butterfly (*Speyeria callippe callippe*)
- Double-crested cormorant (*Phalacrocorax auritus*)
- Hardhead (*Mylopharodon conocephalus*)
- Hoary bat (*Lasiurus cinereus*)
- Incredible harvestman (*Banksula incredula*)
- Mission blue butterfly (*Plebejus icarioides missionensis*)
- Monarch - California overwintering population (*Danaus plexippus pop. 1*)
- North American porcupine (*Erethizon dorsatum*)
- Obscure bumble bee (*Bombus caliginosus*)
- Opler's longhorn moth (*Adela oplerella*)
- Saltmarsh common yellowthroat (*Geothlypis trichas sinuosa*)
- San Bruno elfin butterfly (*Callophrys mossii bayensis*)
- San Francisco Bay Area leaf-cutter bee (*Trachusa gummifera*)
- San Francisco forktail damselfly (*Ischnura gemina*)
- Sandy beach tiger beetle (*Cicindela hirticollis gravida*)
- Stage's dufourine bee (*Dufourea stagei*)
- Tidewater goby (*Eucyclogobius newberryi*)
- Tomales isopod (*Caecidotea tomalensis*)
- Townsend's big-eared bat (*Corynorhinus townsendii*)
- Western bumble bee (*Bombus occidentalis*)
- Western pond turtle (*Emys marmorata*)
- Western red bat (*Lasiurus blossevillii*)

** San Francisco gartersnake (Thamnophis sirtalis tetrataenia) and American peregrine falcon (Falco peregrinus anatum) location details are supressed by the CNDDB. These species are known to occurr within the 5-mile search radius.*



BioMaAS

SOURCE: CDFW (5/2019), USFWS (12/2018), ESRI 2020

FIGURE 7

CNDDB Wildlife Occurrences Within a 5-Mile Radius of the Study Area

South Ocean Beach Long-term Improvement Project, San Francisco, CA

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Study Area Occurrence

The Pacific pond turtle has been observed in East Lake Merced by biologists who conducted surveys for the San Francisco Recreation and Park Department's *Significant Natural Resource Areas Management Plan* (EIP 2000). Lake Merced is approximately 130 feet east of the Study Area. The Study Area adjacent to Lake Merced at the Great Highway/Skyline Boulevard intersection and Herbst Road/Skyline Boulevard intersection may contain suitable upland oviposition sites for this species. Skyline Boulevard may act as a dispersal barrier for this species; however, the turtle's presence cannot be ruled out as turtles could potentially cross Skyline Boulevard into the Study Area.

Avian Species

Seven special-status avian species have the potential to occur within or adjacent to the Study Area: double-crested cormorant, western snowy plover, western burrowing owl, olive-sided flycatcher, bank swallow, saltmarsh common yellowthroat and Cooper's hawk. The Study Area may also provide suitable breeding habitat for many common avian species. The following is a brief description of special-status bird species which may occur within or immediately adjacent to the Study Area.

Double-crested Cormorant

Status

Nesting colonies of the double-crested cormorant are on the CDFW Watch List.[11]

General Ecology and Distribution

This species requires undisturbed nest-sites beside water, on islands or on a mainland. It feeds mainly on fish (Cogswell 1977) but also on crustaceans and amphibians and breeds mostly April to July or August. It uses wide rock ledges on cliffs; rugged slopes; and live or dead trees, especially tall ones; perching sites must be barren of vegetation (Bartholomew 1943).

Study Area Occurrence

Double-crested cormorants have nested in eucalyptus groves on the western side of South Lake Merced and on the northwest edge of North Lake Merced since at least 1997 (EIP 2000). In the 2000 breeding season, the nesting colony in South Lake Merced consisted of approximately 40 nests (EIP 2000). At the time of the site visit, the nearest nest sites were located across the street from the Pomeroy Recreation & Rehabilitation Center, approximately 40 feet east of the Lake Merced bike path (Figure 8; Appendix A, Photo 13). The large trees along the shore of Lake Merced at the Skyline Boulevard/Great Highway intersection may provide breeding habitat for this species.

Western Snowy Plover

Status

Western snowy plover is listed as threatened by the USFWS under the federal Endangered Species Act (FESA). The western snowy plover is also designated as a state Species of Special Concern" by CDFW.

[11] Watch List: The Department of Fish and Wildlife maintains a list consisting of taxa that were previously designated as "Species of Special Concern" but no longer merit that status, or which do not yet meet SSC criteria, but for which there is concern and a need for additional information to clarify status.

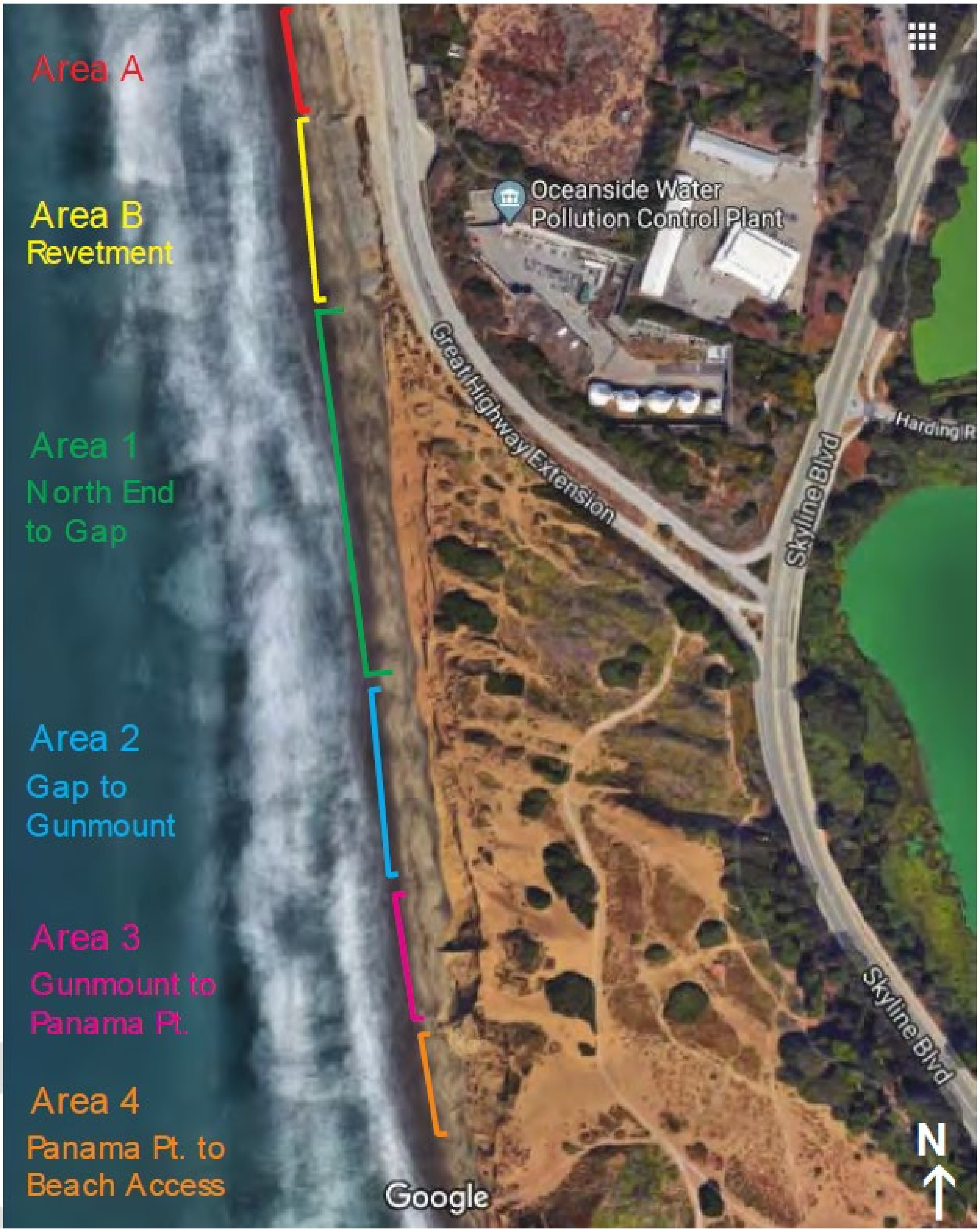

Figure 8. Map of Bank Swallow Survey Site at Fort Funston.
Map indicates designated monitoring areas (NPS, 2017).

General Ecology and Distribution

The coastal population breeds along the Pacific coast from southern Washington to southern Baja California, Mexico, with the majority of birds breeding along the California coast. Nesting season runs from mid-March through mid-September. At beaches, it forages above and below the mean high-water line, gathering food from sand surface, kelp, marine mammal carcasses, or low foredune vegetation (Page et al. 1995). On Pacific coast beaches, plovers are thought to feed on mole crabs (*Emerita analoga*), crabs (*Pachygrapsus crassipes*), polychaetes, amphipods, sand hoppers (*Orchestoidea*), tanadacians (*Leptochelia dubia*), flies, beetles, clams, and ostracods (Page et al. 1995).

Study Area Occurrence

This species is known to winter along Ocean Beach, but is not known to breed there. The plovers are present for an extended period of the year, from early July through the end of May. However, numbers peak between January and March. Plovers are not uniformly distributed along Ocean Beach; rather, they tend to be concentrated in three sectors: between Lincoln and Judah Streets, between Noriega and Pacheco Streets, and between Pacheco and Rivera Streets (Fong et. al., 2000). Of these areas, the only location within the project area is the North Ocean Beach borrow site.

Western Burrowing Owl

Status

The western burrowing owl is designated as a state Species of Special Concern by CDFW and a Bird of Conservation Concern by the USFWS.

General Ecology and Distribution

The Western burrowing owl (*Athene cunicularia hypugaea*) is a grassland specialist distributed throughout w. North America, primarily in open areas with short vegetation and bare ground in desert, grassland, and shrub-steppe environments (Klute et al. 2003). Although the general wintering range of burrowing owls is known, very little is known about habitats used during the winter (Holroyd et al. 2001).

Study Area Occurrence

Western burrowing owl are not expected to breed in the Study Area; however, they have been recorded overwintering at Ocean Beach. One individual has been present in the riprap west of the Great Highway, across from the Oceanside Water Pollution Control Plant within the Study Area (Appendix A, Photo 16). The other individual has been recorded beneath the staircase and walkway of the Great Highway at Noriega Street (1.1 mile north of the Study Area). BioMaAS Inc. biologists confirmed owl presence at these two locations while monitoring for the 2018 sand backpass effort (BioMaAS 2018b). From 2014 to 2016, Audubon Society volunteers observed the burrowing owl in the rip rap fly out, several times, in late afternoon and head directly south-southeast over toward the Lake Merced Area.[12] This owl may be foraging in the open areas around Lake Merced and the adjacent golf course.

Olive-sided Flycatcher

Status

The olive-sided flycatcher is designated as a state Species of Special Concern by CDFW and a Bird of Conservation Concern by the USFWS.

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[12] Personal communication with Audubon Citizen Scientist Jane Hart, 2017. Ms. Hart monitored these owls from 2014-2016.

General Ecology and Distribution

Breeding habitat for the olive-sided flycatcher is primarily late-successional conifer forests with open canopies (e.g., 0%–39% canopy cover; Verner 1980). This flycatcher undergoes one of the longest and most protracted migrations of all Nearctic migrants, wintering primarily in Panama and the Andes Mountains of South America (Altman 2012). It has a very discernable "quick, three beers!" call that make its presence easily known.

Study Area Occurrence

This species has been documented at Lake Merced outside but adjacent to the Study Area (Murphy, 2000). Trees within the Study Area may provide suitable breeding habitat for this species.

Bank Swallow

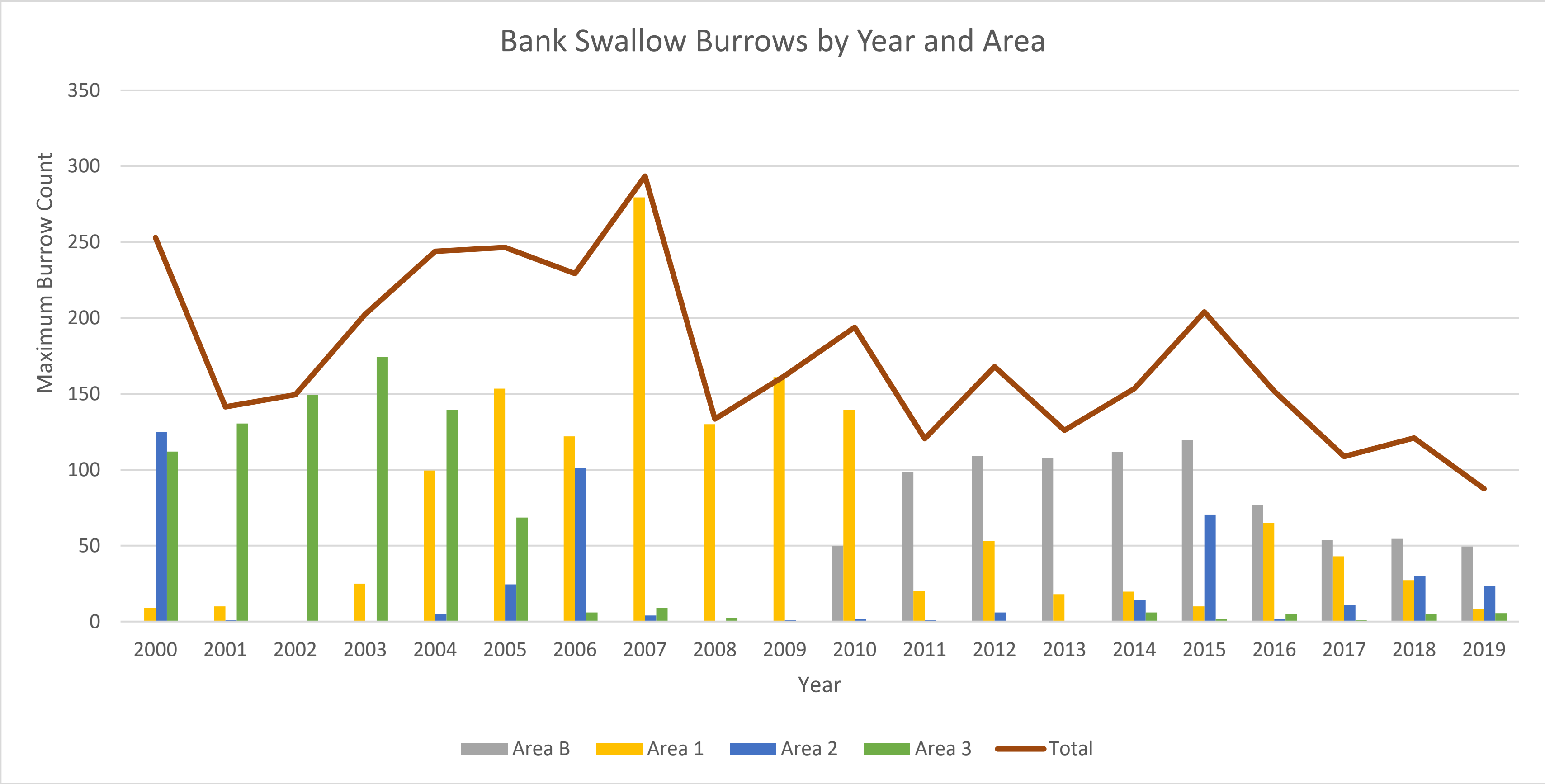
Status

The bank swallow is listed as a state threatened species under the CESA by CDFW.

General Ecology and Distribution

This species arrives in California from South America in early March and numbers peak by early May (CDFG 1999). Birds vacate their breeding grounds as soon as juveniles begin dispersing from the colonies around late June and early July (Garrison, 1998). The birds tend to arrive at Fort Funston in late March or early April and depart for their wintering grounds in early August (NPS, 2007). Nesting colonies are located in vertical banks or bluffs in friable soils, and these colonies can support dozens to thousands of nesting birds (Garrison, 1998). Bank Swallows typically nest in colonies up to 1,500 nesting pairs, but they also nest solitarily (Hoogland and Sherman 1976, Cramp 1988, Turner and Rose 1989).

Table E: Bank Swallow Maximum Burrow Counts by Year and Area, Bank Swallow Monitoring at Fort Funston 2000 – 2019



Source: NPS, 2019.

Study Area Occurrence

Bank swallow nest in the sand cliff face along Ocean Beach in front of the treatment plant (within the Study Area), shown as Area B, and south into Fort Funston outside the Study Area (Figure 8). Its nest locations can be seen as small holes (two to four inches in diameter) in the sand cliff face (Appendix A, Photo 15). Historic observations indicate that bank swallows have used the cliffs at Fort Funston for breeding since at least 1905 (Laymon et al. 1987). The Fort Funston breeding colony is one of only a few remaining bank swallow colonies in coastal California (Laymon et al. 1987). The National Park Service has monitored the bank swallows at Fort Funston since 1993, and using consistent burrow count methodology since 2000. The location and number of bank swallow burrows identified during nesting season within the six monitoring areas has varied over time (Table E). Since 2000, bank swallow burrow counts have ranged from a maximum of 294 burrows in 2007 to none in 2020 (NPS, 2020). A June 21, 2019 field visit by BioMaAS staff detected 36 suitable burrows, 20 collapsed burrows and two active bank swallow nest sites in the Ocean Beach cliff face above the revetment area (Area B on Figure 8).

Recently, NPS observed bank swallows nesting in coastal bluffs beyond the historical boundaries of the Fort Funston colony. In 2019, 41 burrows were observed in an area along the bluffs south of Fort Funston in the bluffs above Phillip Burton Memorial Beach adjacent to the Olympic Golf Club and south of Area 4 shown on Figure 8 (NPS, 2019). Nesting was documented at this location again in 2020 (NPS, 2020).

Saltmarsh Common Yellowthroat

Status

The saltmarsh common yellowthroat is designated as a state Species of Special Concern by CDFW and a Bird of Conservation Concern by the USFWS.

General Ecology and Distribution

The current range includes four main areas: coastal riparian and wetland areas of western Marin County, the tidal marsh system of San Pablo Bay, the tidal marsh system of southern San Francisco Bay, and coastal riparian and wetland areas in San Mateo County. Additionally, there are some disjunct (isolated) populations: Stafford Lake, Marin County (Shuford 1993); Lake Merced, San Francisco County (unpubl. Atlas data); and wet areas on San Bruno Mountain, San Mateo County (unpubl. Atlas data). For the San Francisco Bay area as a whole, about 60% of yellowthroats occupy brackish marsh, 20% riparian woodland/swamp, 10% freshwater marsh, 5% salt marsh, and 5% upland (Hobson et al. 1986, Shuford 1993, Terrill 2000). They nest on tussocks, bulrushes or sedges in marshes and the nest is a bulky open cup made of weeds, grass stems and other plant materials, lined with finer materials (Kaufmann 1996).

Study Area Occurrence

There is not suitable breeding habitat in the Study Area, however, this species has confirmed breeding occurrences at Lake Merced. The marsh vegetation along the edge of Lake Merced at the Skyline Boulevard/Great Highway intersection may provide suitable nesting habitat for this species and individuals may occur in the Study Area during breeding season while foraging.

Cooper’s Hawk

Status

The Cooper’s hawk is a CDFW Watch List Species.[13]

General Ecology and Distribution

This medium sized hawk nests in large trees in wooded areas but is increasingly found nesting in urban areas (Peeters and Peeters 2005). Nests are typically 25-50 feet high, often about two-thirds of the way up the tree in a crotch or on a horizontal branch (Cornell Lab of Ornithology, 2019). The Cooper’s hawk breeds in extensive forests and smaller woodlots of deciduous, coniferous, and mixed pine-hardwoods, as well as in pine plantations, in both suburban and urban habitats. It captures a variety of prey, mainly medium-sized birds and mammals such as doves, jays, robins, chipmunks, and other rodents (Curtis, et al 2006).

Study Area Occurrence

The stands of mature/tall trees in the Study Area may provide suitable breeding (and foraging) habitat for this species.

Bat Species

One special-status bat (western red bat) and four other sensitive bat species (silver-haired bat, hoary bat, little brown bat and fringed myotis) have the potential to occur within or adjacent to the Study Area. Each of these species have potential to occur in the Study Area due to the presence of suitable habitat and recent acoustic detections of each species at adjacent Fort Funston (Fellers, 2005). The status, general ecology, distribution and occurrences in the Study Area vicinity for each of these species are discussed below.

Western Red Bat

Status

The western red bat is designated as a state Species of Special Concern by CDFW and a Western Bat Working Group (WBWG) High Priority species.

General Ecology and Distribution

The western red bat is typically solitary, roosting primarily in the foliage of trees or shrubs. Day roosts are commonly in edge habitats adjacent to streams or open fields, in orchards, and sometimes in urban areas. This bat may also occasionally use caves. Arousal from hibernation on warm days to feed has been reported, as has periodic foraging during the winter in the San Francisco Bay area (WBWG 2019).

Study Area Occurrence

This species was detected by National Park Service researchers between July 2004 and July 2005 at Fort Funston. The researchers detected bat vocalizations using Anabat bat detectors. The trees and shrubs in the Study Area may provide suitable roost sites.

Silver-haired Bat

Status

The silver-haired bat is a WBWG Medium Priority species.

[13] Watch List: The Department of Fish and Wildlife maintains a list consisting of taxa that were previously designated as "Species of Special Concern" but no longer merit that status, or which do not yet meet SSC criteria, but for which there is concern and a need for additional information to clarify status.

General Ecology and Distribution

Maternity roosts appear to be almost exclusively in trees — inside natural hollows and bird excavated cavities or under loose bark of large diameter snags. Roosting sites are generally at least 15 meters above the ground. This species has been found hibernating in hollow trees, under sloughing bark, in rock crevices, and occasionally under wood piles, in leaf litter, under foundations, and in buildings, mines and caves (WBWG, 2019).

Study Area Occurrence

This species was detected by National Park Service researchers between July 2004 and July 2005 at Fort Funston. The researchers detected bat vocalizations using Anabat bat detectors. The trees in the Study Area may provide suitable roost sites.

Hoary Bat

Status

The hoary bat is a WBWG Medium Priority species.

General Ecology and Distribution

This bat species is the most widespread North American bat and may be found at any location in California, although distribution is patchy in the southeastern deserts (Zeiner et al. 1988-1990). The hoary bat generally roosts in dense foliage of medium to large trees with preferred sites hidden from above, with few branches below, and that have ground cover of low reflectivity (Zeiner et al. 1988-1990).

Study Area Occurrence

This species was detected by National Park Service researchers between July 2004 and July 2005 at Fort Funston. The researchers detected bat vocalizations using Anabat bat detectors. The medium to large trees in and adjacent to the Study Area may provide suitable roost habitat for this species.

Little Brown Bat

Status

The little brown bat is a WBWG Medium Priority species.

General Ecology and Distribution

The little brown bat, or little brown myotis, is among the most widespread and common bats in mesic, typically forested, areas of temperate North America. Summer maternity colony sites (consisting largely of reproductive females and dependent young) include tree cavities, caves and human-occupied structures. Hibernation sites (typically caves and abandoned mines) and seasonality have been studied in eastern and mid-continent populations, but are poorly known in the west (WBWG 2019).

Study Area Occurrence

This species was detected by National Park Service researchers between July 2004 and July 2005 at Fort Funston. The researchers detected bat vocalizations using Anabat bat detectors. The trees and structures in and adjacent to the Study Area may provide suitable maternity roost habitat for this species.

Fringed Myotis

Status

The fringed myotis is a WBWG High Priority species.

General Ecology and Distribution

The fringed myotis ranges through much of western North America from southern British Columbia, Canada, south to Chiapas, Mexico and from Santa Cruz Island in California, east to the Black Hills of South Dakota. This species roosts in crevices in buildings, underground mines, rocks, cliff faces, and bridges. Roosting in decadent trees and snags, particularly large ones, is common throughout its range in western U. S. and Canada (WBWG 2019).

Study Area Occurrence

This species was detected by National Park Service researchers between July 2004 and July 2005 at Fort Funston. The researchers detected bat vocalizations using Anabat bat detectors. The large trees and structures in and adjacent to the Study Area may provide suitable roost habitat for this species.

Marine Resources

This section provides background information on marine resources of the Study Area, specifically species with potential to occur within 0.5-mile offshore of South Ocean Beach.

Essential Fish Habitat

Essential fish habitat (EFH) includes coral reefs, kelp forests, bays, wetlands, rivers, and even areas of the deep ocean that are necessary for fish reproduction, growth, feeding, and shelter. Congress established the EFH mandate in 1996 to improve the nation’s main fisheries law—the Magnuson-Stevens Fishery Conservation and Management Act—highlighting the importance of healthy habitat for commercial and recreational fisheries. NOAA Fisheries collaborates with partners—especially regional fishery management councils—and uses the best available science to identify, describe, and map essential fish habitat for all federally managed fish. The habitat off of Ocean Beach is listed as EFH for salmon as well as for: Groundfish, Coastal Pelagic Species, Finfish, Market Squid, and Krill Species.

Habitat Areas of Particular Concern

Along the West Coast, NOAA Fisheries relies on Fishery Management Councils to identify habitats that fall within Habitat Areas of Particular Concern (HAPC) – discreet subsets of EFH that provide important ecological functions and/or are especially vulnerable to degradation. There are no HAPCs mapped within 0.5 mile of Ocean Beach.

Groundfish Fishery Management Plan

The EFH model characterizes habitat in terms of three variables: depth, latitude, and substrate (both physical and biogenic substrate, where possible). For the purposes of the model these three characteristics provide a reasonable representation of the essential features of habitat that influence the occurrence of fish. Depending on these characteristics and the observed distributions of fish in relation to them, each location (a parcel or polygon of habitat in the GIS) is allocated a suitability value between 0 and 100%. This is called the Habitat Suitability Probability, or HSP, and it is calculated for as many species and life stages in the Fishery Management Plan (FMP) as possible based on available data. These scores and the differences between scores for different locations are then used to develop a proxy for the areas that can be regarded as “essential”. The higher the HSP, the more likely the habitat area should be identified as EFH.

The HSP for groundfish is displayed in six categories by the Pacific Fishery Management Council: <0.01, 0.01-0.19, 0.20-0.39, 0.40-0.59, 0.60-0.79 and >= 0.80. For the purposes of this assessment, groundfish mapped with an HSP of 0.40 or higher in the Study Area (up to 0.5 mile off shore) were given a moderate or higher potential to occur in the Study Area. Of the 168 groundfish species detailed in the EFH model, 26 have an HSP of 0.40 or higher.

Pelagic Fishery Management Plan

Stocks managed under this FMP include: Pacific sardine (*Sardinops sagax*), Pacific (chub) mackerel (*Scomber japonicas*), Northern anchovy *(Engraulis mordax*; Central and Northern subpopulations), market squid (*Doryteuthis opalescens*) Jack mackerel (*Trachurus symmetricus)* and Krill or Euphausiids. Ecosystem Component Species include Pacific herring (*Clupea pallasii pallasii*), jacksmelt (*Atherinopsis californiensis*), round herring (*Etrumeus teres*), thread herring (*Opisthonema libertate, O. medirastre*), mesopelagic fishes (Families: *Myctophidae, Bathylagidae, Paralepididae, and Gonostomatidae*), Pacific sand lance (*Ammodytes hexapterus*), Pacific saury (*Cololabis saira*), silversides (*Atherinopsidae*), smelts (*Osmeridae*) and pelagic squids. Each of these species has potential to occur in the Study Area (in the Pacific Ocean within 0.5 mile of Ocean Beach).

Nearshore Fishery Management Plan

The CDFW (2002) prepared the Nearshore Fishery Management Plan (NFMP) in 2002. The NFMP establishes a hierarchical framework within which adjustments to the management of the nearshore fishery can be made in a responsible and timely manner in order to meet the 1999 Marine Life Management Act mandate for adaptive management. Of the 19 species addressed in the NFMP, six have a life stage with some potential to occur in the Study Area (and are also addressed in the EFH model for groundfish): Black-and-yellow rockfish (*Sebastes chrysomelas*), Blue rockfish (*Sebastes mystinus*), Gopher rockfish (*Sebastes carinatus*), Grass rockfish (*Sebastes rastrelliger*), Kelp rockfish (*Sebastes atrovirens*) and kelp greenling (*Hexagrammos decagrammus*).

Special-Status Fish Species

Special-status fish species known to occur off shore of Ocean Beach include: Pacific lamprey, green sturgeon, steelhead, Coho salmon, Chinook salmon and longfin smelt. Study Area occurrences are not included for these species as each has a life stage with potential to occur in the Study Area (within 0.5 mile of Ocean Beach).

Pacific Lamprey

Status

This species is listed as a CDFW Species of Special Concern.

General Ecology and Distribution

As adults in the marine environment, Pacific lampreys are parasitic and feed on a variety of fish including Pacific salmon, flatfish, rockfish, and Pollock. After spending 1 to 3 years in the marine environment, Pacific lampreys cease feeding and migrate to freshwater between February and June. Pacific lampreys spawn in similar freshwater stream habitats as salmon; in gravel bottomed streams.

Green Sturgeon

Status

The southern Distinct Population Segment (DPS) of this species is listed as federally threatened and also a CDFW Species of Special Concern.

General Ecology and Distribution

This anadromous fish is found in nearshore waters, ranging from Mexico to the Bering Sea. Adult green sturgeons have potential to occur in the Pacific Ocean off Ocean Beach and migrate into freshwater beginning in late February with spawning occurring in March through July.

Steelhead

Status

The Central California Coast steelhead distinct population segment, or DPS, is listed by the NMFS as threatened and includes all naturally spawned populations of steelhead (and their progeny) in streams from the Russian River to Aptos Creek, Santa Cruz County, California (inclusive). It also includes the drainages of San Francisco and San Pablo Bays.

California Central Valley Steelhead are listed as threatened under the ESA. This DPS includes naturally spawned anadromous steelhead originating below natural and manmade impassable barriers from the Sacramento and San Joaquin Rivers and their tributaries; excludes such fish originating from San Francisco and San Pablo Bays and their tributaries. This DPS does include steelhead from two artificial propagation programs: Coleman National Fish Hatchery Program and Feather River Fish Hatchery Program.

General Ecology and Distribution

Steelhead are born in fresh water streams where they spend their first one to three years of life. They then emigrate to the ocean where they spend between one to four years. They return to their native fresh water stream to spawn, typically during the rainy season in California. Unlike salmon, steelhead may not die after spawning and are able to spawn more than once.

Coho Salmon

Status

The Central California Coast Coho ESU is listed as endangered by CDFW and NMFS.

General Ecology and Distribution

This ESU includes naturally spawned Coho salmon originating from rivers south of Punta Gorda, California to and including Aptos Creek, as well as such Coho salmon originating from tributaries to San Francisco Bay. Also, Coho salmon are from three artificial propagation programs: Don Clausen Fish Hatchery Captive Broodstock Program, Scott Creek/King Fisher Flats Conservation Program and the Scott Creek Captive Broodstock Program.

Coho Salmon in northern California coastal streams are typically associated with low gradient reaches of tributary streams, which provide suitable spawning areas and good juvenile rearing habitat. Upon entry into the ocean, immature Coho Salmon remain in inshore waters, congregating in schools as they move north along the continental shelf. Brown and Moyle found historical records of occurrence of Coho Salmon in 582 California streams, ranging from the Smith River to the Big Sur River on the central coast, but by 1991 had been lost from about half these streams (Moyle 2002).

Chinook Salmon

Status

The Central Valley fall /late fall-run ESU is a CDFW Species of Special Concern, the Central Valley spring-run ESU is state and federal threatened and the Sacramento River winter-run ESU is state and federal endangered.

General Ecology and Distribution

Four distinct runs of Chinook salmon spawn in the Sacramento-San Joaquin River system, named for the season when the majority of the run enters freshwater as adults. Fall-run Chinook Salmon migrate upstream as adults from July through December and spawn from early October through late December. Late-fall-run Chinook Salmon migrate into the rivers from mid-October through December and spawn from January through mid-April. Spring-run Chinook Salmon enter the Sacramento River from late March through

September. Adult Sacramento River winter-run Chinook Salmon pass under the Golden Gate Bridge from November through May, and pass into the Sacramento River from December through early August and spawn in the upper mainstem Sacramento River from mid-April through August.

Longfin Smelt

Status

This species is listed as a state threatened and federal candidate species.

General Ecology and Distribution

In California, Longfin Smelt is historically found in the San Francisco Estuary and the Sacramento/San Joaquin Delta (Bay-Delta), Humboldt Bay, and the estuaries of the Eel River and Klamath River— and uses a variety of habitats from nearshore waters, to estuaries and lower portions of freshwater streams (Garwood 2017).

Marine Mammals

The Marine Mammal Protection Act (MMPA) was enacted on October 21, 1972 and protects all marine mammals. In addition to protection under the MMPA, some of the marine mammal species are listed under the Federal ESA. The following 11 marine mammals dominate the coastal and pelagic water off of Ocean Beach: gray whale (*Eschrichtius robustus*), humpback whale (*Megaptera novaeangliae*), blue whale (*Balaenoptera musculus)*, Pacific white-sided dolphin (*Lagenorhynchus obliquidens*), harbor porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*), California sea lion, Northern fur seal (*Callorhinus ursinus*), Steller sea lion (*Eumetopias jubatus*), Northern elephant seal (*Mirounga angustirostris*) and Pacific harbor seal.

Of the above species, California sea lion and Pacific harbor seal are the most likely to be encountered immediately (within 0.5 mile) off shore of Ocean Beach. These two species are unlikely to haul out on Ocean Beach due to the high level of human disturbance. California sea lions are found in association with Pacific harbor seals at Seal Rocks and Lands End but are sporadic in their use of the sites (GGNRA 2006).

California Sea Lion

Status

This species is afforded protection by the 1972 MMPA.

General Ecology and Distribution

The California sea lion is the most abundant pinniped in California waters; over 50,000 are found on California islands and along entire mainland coast (Bonnell et al. 1978, Le Boeuf et al. 1983). They breed from May to August in concentrated rookeries on Channel Islands and in Mexico. Females rarely give birth north of San Miguel Island (Santa Barbara County) (Zeiner et al. 1988-1990). Año Nuevo Island and the Farallon Islands provide major haul-out grounds for males throughout the year (Orr and Poulter 1965, Le Boeuf and Bonnell 1980).

Pacific Harbor Seal

Status

This species is afforded protection by the 1972 MMPA.

General Ecology and Distribution

This species is a fairly common, non-migratory pinniped found on California islands and along entire mainland coast. It frequently hauls out in small to moderate-sized groups on emergent offshore and tidal rocks, mudflats, sandbars, and sandy beaches (Orr 1972).

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Appendix A
Representative Photographs

Photo 1: Developed areas in the Study Area include the Great Highway and old sections of the Great Highway that are closed adjacent to Ocean Beach. Dune mat/ice plant mat vegetation is shown on the left. Photo taken on July 18, 2019 looking north.

Photo 2: Dune mat/ice plant mats in the southern Study Area between northbound and southbound sections of the Great Highway, showing ice plant/sea fig, beach evening-primrose, beach strawberry, bare sandy patches, and desiccated ruderal plants. Photo taken on July 18, 2019 looking west.

Photo 3: Dune mat/ice plant mats at Fort Funston, in the southern Study Area, showing yellow sand verbena, beach burr, and European sea rocket. This area is generally less disturbed than most dune mat in the Study Area. Photo taken on July 18, 2019 looking east toward the Great Highway (left, background).

Photo 4: Ornamental trees and shrubs at the Zoo Wet Weather Pump Station. Monterey cypress is the most common tree in this habitat. The understory here is dominated by non-native annual grasses and ruderal plants. Photo taken on May 31, 2019 looking south.

Photo 5: Dune mat/ice plant mats/riprap at Ocean Beach, showing ice plant/sea fig, cut-leaf plantain, and European sea rocket. Photo taken on July 18, 2019 looking south along Ocean Beach.

Photo 6: Staging area 4 is all aggregate base. It is an active staging area with no vegetation establishment, except for ruderal plants on the edge. Photo taken on July 16, 2019, looking southeast from the access road to this area.

Photo 7: Beach habitat at Ocean Beach (left). The public accesses the lower intertidal area from the parking lot (right) and then down the slope from this flat beach terrace. Photo taken on July 18, 2019 looking north.

Photo 8: Arroyo willow thickets (background, left) and ornamental trees and shrubs near the zoo staging area, including plume acacia, pride of Madeira, and Monterey cypress (background, right).

Photo 9: European beach grass swards/dune mat/ice plant mats/riprap at Ocean Beach, showing European beach grass, beach burr, ice plant/sea fig, cut-leaf plantain, and European sea rocket. Photo taken on July 18, 2019 looking south from adjacent sandy access path.

Photo 10: Silver dune lupine/dune mat/ice plant mats, showing San Francisco spineflower (marked off by wood), silver dune lupine, yellow bush lupine, ice plant/sea fig, and Monterey cypress. Photo taken on July 18, 2019 looking west.

Photo 11: San Francisco spineflower adjacent to the zoo staging area. Some plants still had green leaves and some flowers. Flower heads are still very visible after the small flowers are desiccated. Photo taken on May 31, 2019.

Photo 12: Intertidal zone and beach habitat at Ocean Beach. The intertidal zone and beach (left) are sandy barren areas that lack vegetation because of regular disturbance. Dune mat/ice plant mats are established on some of the adjacent foredune slopes (right, background). Photo taken on July 18, 2019 looking northwest from sandy access path.

Photo 13: One double-crested cormorant nest shown here from the rookery at Lake Merced, located across the street from the Pomeroy Recreation & Rehabilitation Center.

Photo 14: Ocean Beach provides intertidal foraging habitat for many bird species, such as this whimbrel.

Photo 15: A portion of the bank swallow colony across the street from the wastewater treatment facility (2019).

Photo 16: A western burrowing owl was observed over wintering in the rip rap across the street from the wastewater treatment facility from 2014-2016 (Photo taken in 2014).

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Appendix B
Full List of Special-status and Sensitive Species Potentially Present in the Study Area

APPENDIX B-1: FULL LIST OF SPECIAL-STATUS PLANTS AND CRPR 3 AND 4 SPECIES POTENTIALLY PRESENT IN THE STUDY AREA						
Scientific Name	Common Name	CRPR 1 and 2	CRPR 3 and 4 (other)	Federal/ State Status	Life form, habitat, bloom time	Potential for occurrence
Arabis blepharophylla	coast rock cress	--	4.3	--	Perennial herb. Rocky areas in broadleafed upland forest, coastal bluff scrub, coastal prairie, and coastal scrub. 3-1100 meters (m). February-May.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Amsinckia lunaris	bent-flowered fiddleneck	1B.2	--	--	Perennial herb. Coastal bluff scrub, cismontane woodland, and valley and foothill grassland. 3-500 m. March-June.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Arctostaphylos franciscana	Franciscan manzanita	1B.1	--	FE/--	Perennial evergreen shrub. Coastal scrub (serpentinite). 60-300 m. February-April.	**Unlikely.** No suitable habitat present, no serpentine areas.
Arctostaphylos imbricata	San Bruno Mountain manzanita	1B.1	--	--/SE	Perennial evergreen shrub. Rocky areas in chaparral and coastal scrub. 275-370 m. February-May.	**Unlikely.** Suitable habitat potentially present, but this species is an evergreen shrub that would have been identifiable during surveys.
Arctostaphylos montana ssp. *ravenii*	Presidio manzanita	1B.1	--	FE/SE	Perennial evergreen shrub. Serpentinite outcrops in chaparral, coastal prairie, and coastal scrub. 45-215 m. February-March.	**Unlikely.** Suitable serpentine habitat is not present. This species is an evergreen shrub that would have been identifiable during surveys.
Arctostaphylos montaraensis	Montara manzanita	1B.2	--	--	Perennial evergreen shrub. Coastal scrub and chaparral (maritime). 80-500 m. January-March.	**Unlikely.** Suitable habitat potentially present, but this species is an evergreen shrub that would have been identifiable during surveys.
Arctostaphylos pacifica	Pacific manzanita	1B.1	--	--/SE	Perennial evergreen shrub. Chaparral and coastal scrub. 320 m. February-April.	**Unlikely.** Suitable habitat potentially present, but this species is an evergreen shrub that would have been identifiable during surveys. There is only one CNDDB record of this species in San Mateo County.
Arenaria paludicola	marsh sandwort	1B.1	--	FE/SE	Perennial stoloniferous herb. Freshwater and brackish marshes. 3-170 m. May-August.	**Unlikely.** No suitable habitat present. Arroyo Willow Thicket/Ornamental Trees and Shrubs habitat in the Study Area is not a marsh; this area supports willows because they tap into a shallow ground water table.

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Scientific Name	Common Name	CRPR 1 and 2	CRPR 3 and 4 (other)	Federal/ State Status	Life form, habitat, bloom time	Potential for occurrence
Astragalus nuttallii var. *nuttallii*	ocean bluff milk-vetch	--	4.2	--	Perennial herb. Coastal dunes and coastal bluff scrub. 3-120 m. January- November.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Astragalus tener var. *tener*	alkali milk-vetch	1B.2	--	--	Annual herb. Alkali playa, alkali flats, mesic valley and foothill grassland, and vernal pools. 1-60 m. March-June.	**Unlikely.** No suitable habitat present.
Carex comosa	bristly sedge	2B.1	--	--	Perennial rhizomatous herb. Moist areas in coastal prairie, valley and foothill grassland, and freshwater marshes on margins of lakes. 0-105 m. (March) April-September.	**Unlikely.** No suitable habitat present. Arroyo willow thickets habitat in the Study Area is not a marsh. Not observed during surveys which occurred within the blooming period range of this taxa.
Centromadia parryi ssp. *parryi*	pappose tarplant	1B.1	--	--	Annual herb. Somewhat mesic areas, often alkaline soils. Chaparral, coastal prairie, meadows and seeps, coastal salt marshes, valley and foothill grassland. 0-420 m. May-November.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Chorizanthe cuspidata var. *cuspidata*	San Francisco spineflower	1B.2	--	--	Annual herb. Coastal bluff scrub, coastal dunes, coastal prairie, and coastal scrub. Sandy soil on terraces and slopes. Closely related to *C. pungens.* 5-215 m. April-July (August).	**Present.** Occurs in the Study Area at the mitigation area, near the zoo staging area, and the edges of zoo staging area (Figure 6). Also occurs in the vicinity of the southern portion of the Study Area at Fort Funston (NPS 1997-2018; CDFW 2019a).
Chorizanthe robusta var. *robusta*	robust spineflower	1B.1	--	FE/-	Annual herb. Cismontane woodland, coastal dunes, and coastal scrub. Sandy terraces and bluffs or in loose sand. 3-120 m. April-September.	**Low potential.** Suitable habitat potentially present. Two CNDDB occurrences are historic and possibly extirpated. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Cirsium andrewsii	Franciscan thistle	1B.2	--	--	Perennial herb. Coastal bluff scrub, broadleaved upland forest, and coastal scrub. Mesic areas and sometimes serpentine seeps. 0-150 m. March-July.	**Unlikely.** No suitable habitat present.

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Scientific Name	Common Name	CRPR 1 and 2	CRPR 3 and 4 (other)	Federal/ State Status	Life form, habitat, bloom time	Potential for occurrence
Cirsium hydrophilum var. *vaseyi*	Mt. Tamalpais thistle	1B.2	--	--	Perennial herb. Serpentinite seeps in broadleafed upland forest, chaparral, and meadows. 240-620 m. May-August.	**Unlikely.** No suitable habitat present.
Cirsium occidentale var. *compactum*	compact cobwebby thistle	1B.2	--	--	Perennial herb. Chaparral, coastal dunes, coastal prairie, and coastal scrub. 5-150 m. April-June.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Clarkia franciscana	Presidio clarkia	1B.1	--	FE/SE	Annual herb. Coastal scrub and valley and foothill grassland. Serpentinite outcrops. May intergrade with *C. bartsiifolia* var. *bartsiifolia*. 25-335 m. May-July.	**Unlikely.** No suitable habitat present. Serpentinite outcrops or soils are not present in the Study Area.
Collinsia corymbosa	round-headed Chinese-houses	1B.2	--	--	Annual herb. Coastal dunes. 0-20 m. April-June.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Collinsia multicolor	San Francisco collinsia	1B.2	--	--/--	Annual herb. Closed-cone coniferous forest and coastal scrub. On decomposed shale (mudstone) mixed with humus. Sometimes serpentinite. 30-250 m. February-May.	**Unlikely.** No suitable habitat present. Decomposed shale and serpentinite soils are not present in the Study Area.
Equisetum palustre	marsh horsetail	--	3	--	Perennial rhizomatous herb. Marshes. 45-1000 m. Blooming period unknown.	**Unlikely.** No suitable habitat present.
Erysimum franciscanum	San Francisco wallflower	--	4.2	--	Perennial herb. Often serpentinite or granitic soils in chaparral, coastal dunes, coastal scrub, and valley and foothill grassland. Sometimes roadsides. 0-550 m. March-June.	**Low potential.** Suitable habitat potentially present. Occurs in the vicinity of the southern portion of the Study Area at Fort Funston (NPS 1997-2018). Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Fritillaria liliacea	fragrant fritillary	1B.2	--	--	Perennial herb; Coastal scrub, valley and foothill grassland, coastal prairie. Often on serpentine; various soils reported though usually clay, in grassland. 3-410m. February – April.	**Low potential.** Marginally suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.

APPENDIX B-1: FULL LIST OF SPECIAL-STATUS PLANTS AND CRPR 3 AND 4 SPECIES POTENTIALLY PRESENT IN THE STUDY AREA						
Scientific Name	Common Name	CRPR 1 and 2	CRPR 3 and 4 (other)	Federal/ State Status	Life form, habitat, bloom time	Potential for occurrence
Gilia capitata ssp. *chamissonis*	blue coast gilia	1B.1	--	--	Annual herb. Coastal dunes and coastal scrub. 2-200 m. April-July.	Low potential. Suitable habitat potentially present. Occurs in the vicinity of the southern portion of the Study Area at Fort Funston (NPS 1997-2018). Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Gilia millefoliata	dark-eyed gilia	1B.2	--	--/--	Annual herb. Coastal dunes. 2-30 m. April-July.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Grindelia hirsutula var. *maritima*	San Francisco gumplant	--	3.2	--/--	Perennial herb. Sandy or serpentinite areas in coastal bluff scrub, coastal scrub, and valley and foothill grassland. 15-400 m. June-September.	**Present.** Occurs in the Study Area in one patch of plants in the southern portion of the Study Area along the Great Highway (Figure 7). Also occurs immediately adjacent to the Study Area near the zoo staging area; the closest patch is 2 feet from the Study Area (Figure 7). The plants near the zoo staging area might have been planted and could be nursery cultivars. The patch of plants along the Great Highway occur in a narrow dune mat/ice plant mats strip and thus are less likely to be planted. Occurs in the vicinity of the southern portion of the Study Area at Fort Funston (NPS 1997-2018).
Helianthella castanea	Diablo helianthella	1B.2	--	--	Perennial herb. Broadleaved upland forest, chaparral, cismontane woodland, coastal scrub, riparian woodland, and valley and foothill grassland. Usually in chaparral/oak woodland interface in rocky, azonal soils. Often in partial shade. 60-1300 m. May-June.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Hemizonia congesta ssp. *congesta*	congested-headed hayfield tarplant	1B.2	--	--	Annual herb. Valley and foothill grassland. Sometimes roadsides. 20-560 m. April-November.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.

APPENDIX B-1: FULL LIST OF SPECIAL-STATUS PLANTS AND CRPR 3 AND 4 SPECIES POTENTIALLY PRESENT IN THE STUDY AREA						
Scientific Name	Common Name	CRPR 1 and 2	CRPR 3 and 4 (other)	Federal/ State Status	Life form, habitat, bloom time	Potential for occurrence
Hesperevax sparsiflora var. *brevifolia*	short-leaved evax	1B.2	--	--	Annual herb. Coastal bluff scrub (sandy), coastal dunes, and coastal prairie. 0-215 m. March-June.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Hesperolinon congestum	Marin western flax	1B.1	--	FT/ST	Annual herb. Chaparral and valley and foothill grassland. Serpentinite soils. 5-370 m. April-July.	**Unlikely.** No suitable habitat present. Serpentinite are not present in the Study Area.
Heteranthera dubia	Heteranthera dubia	2B.2	--	--	Perennial herb. Marshes with still or slow-moving water and a pH of 7 or higher (alkaline), usually in slightly eutrophic waters. 30-1495 m. July-October.	**Unlikely.** No suitable habitat present.
Horkelia cuneata var. *sericea*	Kellogg's horkelia	1B.1	--	--	Perennial herb. Closed-cone coniferous forest, coastal scrub, coastal dunes, and chaparral (maritime). Sandy or gravelly openings. 10-200 m. April- September.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Horkelia marinensis	Point Reyes horkelia	1B.2	--	--	Perennial herb. Coastal dunes, coastal prairie, and coastal scrub. Sandy flats and dunes near the coast. 5-755 m. May-September.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Iris longipetala	coast iris		4.2	--	Perennial rhizomatous herb. Mesic areas in coastal prairie, lower montane coniferous forest, and meadows and seep. 0-600 m. March-May.	**Unlikely.** No suitable habitat present.
Layia carnosa	beach layia	1B.1	--	FE/SE	Annual herb. Coastal dunes and coastal scrub (sandy). 0-60 m. March-July.	**Low potential.** Suitable habitat potentially present. There is only one broadly mapped CNDDB record within 5 miles of the Study Area and it is believed to be extirpated. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Leptosiphon rosaceus	rose leptosiphon	1B.1	--	--	Annual herb. Coastal bluff scrub. 0-100 m. April-July.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.

APPENDIX B-1: FULL LIST OF SPECIAL-STATUS PLANTS AND CRPR 3 AND 4 SPECIES POTENTIALLY PRESENT IN THE STUDY AREA						
Scientific Name	Common Name	CRPR 1 and 2	CRPR 3 and 4 (other)	Federal/ State Status	Life form, habitat, bloom time	Potential for occurrence
Lessingia germanorum	San Francisco lessingia	1B.1	--	FE/SE	Annual herb. Coastal scrub (remnant dunes). 25-110 m. June-November.	**Low potential.** Suitable habitat potentially present. Occurs in the vicinity of the southern portion of the Study Area at Fort Funston (NPS 1997-2018). Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Malacothamnus arcuatus	arcuate bush-mallow	1B.2	--	--	Shrub. Chaparral. Gravelly alluvium. 15-355 m. April-September.	**Unlikely.** No suitable habitat present.
Microseris paludosa	marsh microseris	1B.2	--	--	Perennial herb. Closed-cone coniferous forest, cismontane woodland, coastal scrub, and valley and foothill grassland. 5-355 m. April-July.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Monardella sinuata ssp. *nigrescens*	northern curly-leaved monardella	1B.2	--	--	Annual herb. Chaparral (Santa Cruz Co.), coastal dunes, coastal scrub, and lower montane coniferous forest (Santa Cruz Co., ponderosa pine sandhills). Sandy soils. 0-300 m. April-September.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Pentachaeta bellidiflora	white-rayed pentachaeta	1B.1	--	FE/SE	Annual herb. Cismontane woodland and valley and foothill grassland (often serpentinite). 35-620 m. March-May.	**Low potential.** Suitable habitat potentially present, but no serpentinite is present in the Study Area. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Plagiobothrys chorisianus var. *chorisianus*	Choris' popcornflower	1B.2	--	--	Annual herb. Mesic sites in chaparral, coastal scrub, and coastal prairie. 3-160 m. March-June.	**Unlikely.** No suitable habitat present.
Plagiobothrys diffusus	San Francisco popcornflower	1B.1	--	--/SE	Annual herb. Coastal prairie and valley and foothill grassland 60-360 m. March-June.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Sanicula maritima	adobe sanicle	1B.1	--	--/SR	Perennial herb. Clay, serpentinite soils. Chaparral, coastal prairie, meadows and seeps, and valley and foothill grassland. 30-240 m. February-May.	**Unlikely.** No suitable habitat present. No serpentine soils present in the Study Area.

APPENDIX B-1: FULL LIST OF SPECIAL-STATUS PLANTS AND CRPR 3 AND 4 SPECIES POTENTIALLY PRESENT IN THE STUDY AREA						
Scientific Name	Common Name	CRPR 1 and 2	CRPR 3 and 4 (other)	Federal/ State Status	Life form, habitat, bloom time	Potential for occurrence
Senecio aphanactis	chaparral ragwort	2B.2	--	--	Annual herb. Chaparral, cismontane woodland, and coastal scrub. Sometimes associated with alkaline soils. 15-800 m. January-April (May).	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Silene scouleri ssp. *scouleri*	Scouler's catchfly	2B.2	--	--	Perennial herb. 0-600 m. Coastal bluff scrub, coastal prairie, and valley and foothill grassland. 0-600 m. (March-May) June-August (September).	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Silene verecunda ssp. *verecunda*	San Francisco campion	1B.2	--	--	Perennial herb. Coastal scrub, valley and foothill grassland, coastal bluff scrub, chaparral, and coastal prairie. Sandy soils. 30-645 m. February-August.	**Low potential.** Suitable habitat potentially present. Historic occurrence at Lake Merced is possibly extirpated. Occurs in the vicinity of the southern portion of the Study Area at Fort Funston (NPS 1997-2018). Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Suaeda californica	California seablite	1B.1	--	FE/-	Shrub. Margins of coastal salt marshes. 0-15 m. July-October.	**Unlikely.** No suitable habitat present.
Trifolium amoenum	two-fork clover	1B.1		FE/--	Annual herb. Coastal bluff scrub and alley and foothill grassland (sometimes serpentinite). 5-415 m. April-June.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Triphysaria floribunda	San Francisco owl's-clover	1B.2		--/--	Annual herb. Coastal prairie, coastal scrub, and valley and foothill grassland. On serpentine and nonserpentine substrates. 10-160 m. April-June.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.
Triquetrella californica	coastal triquetrella	1B.2		--/--	Moss. Coastal bluff scrub, coastal scrub valley, and foothill grasslands. Grows within 30 m from the coast in coastal scrub, grasslands and in open gravels on roadsides, hillsides, rocky slopes, and fields. On gravel or thin soil over outcrops. 10-100 m.	**Low potential.** Suitable habitat potentially present. Not observed during 2019 and 2020 protocol-level special-status plant surveys.

Explanation of Status Codes for Special-Status Plants

Federal:

FE	Listed as endangered under the Federal Endangered Species Act
TE	Listed as threatened under the Federal Endangered Species Act

State:

SE	Listed as endangered under the California Endangered Species Act
SR	Listed as rare under the California Endangered Species Act
ST	Listed as threatened under the California Endangered Species Act

California Rare Plant Rank (CRPR):

1A	Plants Presumed Extirpated in California and Either Rare or Extinct Elsewhere
1B	Plants Rare, Threatened, or Endangered in California and Elsewhere
2A	Plants Presumed Extirpated in California, But Common Elsewhere
2B	Plants Rare, Threatened, or Endangered in California, But More Common Elsewhere
3	Review List: Plants about which more information is needed
4	Watch List: Plants of limited distribution

Threat Ranks:

0.1	Seriously threatened in California (over 80% of occurrences threatened / high degree and immediacy of threat)
0.2	Moderately threatened in California (20-80% occurrences threatened / moderate degree and immediacy of threat)
0.3	Not very threatened in California (less than 20% of occurrences threatened / low degree and immediacy of threat or no current threats known)

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	Federal/ State Status	Other Status	Habitat Association	Potential for Occurrence in the Study Area
Invertebrates				
Haliotis cracherodii Black abalone	FE	--	This mollusk can be found in rocky intertidal and subtidal habitats, ranging from Point Arena in northern California to Mexico.	**Low.** There is very minimal rocky intertidal habitat off of Ocean Beach and Fort Funston.
Banksula incredula Incredible harvestman	--	G1,S1	This G1S1 harvestman has a 1992 occurrence on San Bruno Mountain collected from a Franciscan sandstone talus slope.	**Low.** No known nearby occurrences.
Linderiella occidentalis California linderiella	--	G2G3 S2S3	This CDFW G2G3 S2S3 species inhabits low alkalinity seasonal pools in unplowed grasslands.	**None.** Suitable pool habitat is not present.
Syncaris pacifica California freshwater shrimp	FE, SE	--	This species is found in shallow pools in low gradient streams with substantial riparian cover.	**None.** Typical low gradient stream habitat was not observed in the Study Area.
Caecidotea tomalensis Tomales isopod	--	G2 S2,S3	This species has been detected in Lake Merced, NE side of north lake", 1 specimen collected by Bogatin in 1971, 3 specimens collected by L. Serpa on 26 Jan. 1984, but none were found subsequently by Environment and Ecology, Inc. (1993), White (2005), or by G. O. Graening on 19 Jan. 2010 (Graening 2010).	**Low.** Suitable aquatic habitat is not present in the Study Area, however, this species was collected in 1984 from North Lake Merced (CNDDB 2019).
Ischnura gemina San Franciscoo forktail damselfly	--	G2, S2, IUCN:VU	This insect is a resident in the San Francisco Bay area; they are active on sunny, warm days near clean bodies of water and wetlands with emergent vegetation in the San Francisco Bay Area.	**Low.** Only known from one small wetland by Fort Point.
Lichnanthe ursina Bumblebee scarab beetle	--	G2,S2	This CDFW G2 S2 beetle is patchily distributed along the coast and are restricted to dunes. There were many occurrences along Ocean Beach from 1881 to 1949 (CNDDB 2019).	**Low.** Current status of this species along Ocean Beach is unknown as there are no recent occurrences. Not observed during surveys in the Presidio in the 1994.
Coelus globosus Globose dune beetle	--	G1G2 S1S2	The globose dune beetle is listed in the City of Half Moon Bay Land Use Plan Chapter 3 and Municipal Code Section 18.38.085 as a "rare and endangered species". This species lives in foredune vegetation.	**Low.** No known nearby occurrences. Not observed during surveys in the Presidio in the 1994.

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	Federal/ State Status	Other Status	Habitat Association	Potential for Occurrence in the Study Area
Invertebrates (continued)				
Hydroporus leechi Leech's skyline diving beetle	--	G1 S1	This CDFW G1 S1 insect has been found in freshwater ponds, shallow waters of streams, marshes, and lakes. It is believed to have been extirpated from its type locality along Skyline Boulevard in Pacifica, San Mateo County.	**Low.** Believed extirpated from the one known occurrence location.
Hydrochara rickseckeri Ricksecker's water scavenger beetle	--	G2? S2?	This CDFW G2? S2? water scavenger beetle is a large but rarely collected aquatic beetle known from central California.	**None.** Study Area is outside of known range.
Cicindela hirticollis gravida Sandy beach tiger beetle	--	G5T2 S2	This CDFW G5T2 S2 beetle is found in moist sand and dunes near the ocean, such as in swales behind dunes or upper beaches beyond normal high tide. Historical records indicate there are 23 museum specimens collected between 1906 and 1922 (CNDDB 2019).	**Low.** Current status of this species along Ocean Beach is unknown as there are no recent occurrences.
Adela oplerella Opler's longhorn moth	--	G2S2	This G2S2 moth has occurrence data from Lake Merced in 1908 and 1909.	**Low.** There are no nearby recent occurrences for this species.
Euphydryas editha bayensis Bay checkerspot butterfly	FT	--	Restricted to native grasslands on outcrops of serpentine soil in the vicinity of San Francisco Bay. *Plantago erecta* is the primary host plant, *Orthocarpus densiflorus* and *O. purpurescens* are the secondary host plants.	**Low.** Typical grassland habitat was not observed in the Study Area.
Speyeria callippe Callippe silverspot	FE	--	The Callippe silverspot butterfly is a subspecies of the more common callippe fritallary butterfly (*Speyeria callippe*). The silverspot's hostplant is Johnny jump-up (*Viola pedunculata*).	**Low.** Typical habitat was not observed in the Study Area.
Speyeria zerene myrtlaeae Myrtle's silverspot butterfly	FE	--	Myrtle's silverspot is found in coastal dune or prairie habitat. Populations were formerly found in dunes and bluffs from San Mateo County north to the mouth of the Russian River in Sonoma County. The populations south of the Golden Gate apparently have been extirpated by urban development.	**Low.** This species is not known to occur in the San Francisco dune habitat.

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	**Federal/ State Status**	**Other Status**	**Habitat Association**	**Potential for Occurrence in the Study Area**
Invertebrates (continued)				
Plebejus icarioides missionensis Mission blue butterfly	FE	--	Inhabits grasslands of the San Francisco Peninsula. The mission blue butterfly uses three larval host plants: *Lupinus albifrons*, *L. formosus*, and *L. variicolor*.	**Low.** Typical grassland habitat was not observed in the Study Area. Larval host plants not observed.
Callophrys mossii bayensis San Bruno elfin butterfly	FE	--	Occurs in coastal, mountainous areas with grassy ground cover, mainly in the vicinity of San Bruno Mountain. Elfin colonies are located on steep, north-facing slopes within the fog belt. The San Bruno elfin butterfly's larval host plant is *Sedum spathulifolium*.	**Low.** Typical grassland habitat was not observed in the Study Area. Larval host plant not observed.
Danaus plexippus Monarch butterfly	--	G4T2T3 S2S3	Winter roosts sites located in wind-protected tree groves (eucalyptus, Monterey pine, cypress) with water and nectar sources nearby.	**Low.** There are no known roost sites in or near the Study Area.
Bombus occidentalis Western bumble bee	State candidate	G2,G3,S1 XERCES:IM	Historically broadly distributed in western North America. *Bombus occidentalis* occurs along the Pacific coast and western interior of North America, from Arizona, New Mexico and California, north through the Pacific Northwest and into Alaska. Eastward, the distribution stretches to the northwestern Great Plains and southern Saskatchewan.	**Unknown.** Based on the scarcity of western bumble bee in the regional area, age of nearby sightings (1968), and absence of recent sightings in the study area, species potential is unknown, but considered unlikely.
Fish				
Entosphenus tridentatus Pacific lamprey	SSC	--	After spending one to three years in the marine environment, Pacific lampreys cease feeding and migrate to freshwater between February and June. They spawn in habitat similar to that of salmon: gravel bottomed streams at the upstream end of riffle habitat.	**Moderate.** This species is known to occur in the off shore marine environment.
Acipenser medirostris North American Green sturgeon, southern DPS	FE	--	Brackish water habitats along the California Coast from San Diego north to the mouth of the Smith River in Del Norte County.	**Moderate.** This species is known to occur in the off shore marine environment.
Oncorhynchus mykiss Steelhead -Central California Coast and California Central Valley Steelhead DPS	FT	--	Steelhead are born in fresh water streams where they spend their first one to three years of life. They then emigrate to the ocean where they spend between one to four years.	**Moderate.** This species is known to occur in the off shore marine environment.

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	Federal/ State Status	Other Status	Habitat Association	Potential for Occurrence in the Study Area
Fish (continued)				
Oncorhynchus kisutch Coho salmon- Central California Coast ESU	FE, SE	--	This evolutionarily significant unit, or ESU, includes naturally spawned Coho salmon originating from rivers south of Punta Gorda, California to and including Aptos Creek, as well as such Coho salmon originating from tributaries to San Francisco Bay.	**Moderate.** This species is known to occur in the off shore marine environment.
Oncorhynchus tshawytscha Chinook salmon- Central Valley fall /late fall-run ESU (CDFW Species of Special Concern), the Central Valley spring-run ESU (ST, FT) and the Sacramento River winter-run (SE, FE)	see left	see left	Chinook are anadromous fish native to the North Pacific Ocean and the river systems of western North America, ranging from California to Alaska, as well as Asian rivers ranging from northern Japan to the Palyavaam River in the Arctic north-east Siberia.	**Moderate.** This species is known to occur in the off shore marine environment.
Spirinchus thaleichthys Longfin smelt	FC, ST, SSC	--	This is an anadromous smelt found in California's bay, estuary, and nearshore coastal environments from San Francisco Bay north to near the Oregon border.	**Moderate.** This species is known to occur in the off shore marine environment.
Thaleichthys pacificus Eulachon	FT	--	Eulachon are commonly known as smelt, candlefish, or hooligan. Eulachon are a small, anadromous fish (moving between freshwater and saltwater) and are found from northern California to southwest Alaska.	**Low.** This species typically occurs further north of the Study Area.
Mylopharodon conocephalus Hardhead	SSC	--	This species is listed in Lake Merced/Harding Park as historically collected by CDFW biologists during sporadic sampling over the period between 1939 and 1989.	**Low.** Suitable habitat is not present in the Study Area, however, this species may still persist in Lake Merced.
Eucyclogobius newberryi Tidewater goby	FE, SSC	--	Requires beds of loose, silt-free, well-oxygenated coarse gravel for spawning. After hatching, juveniles spend at least one summer in the freshwater rearing areas, so the stream must have either perennial flow or cool ephemeral pools with subsurface flow, shade, food, and shelter during the dry season.	**None.** Suitable habitat is not present in the Study Area. This species was last observed in Lake Merced in 1895 (CNDDB 2019)

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	Federal/ State Status	Other Status	Habitat Association	Potential for Occurrence in the Study Area
Amphibians				
Ambystoma californiense California tiger salamander	FT, ST	--	This species needs underground refuges, especially ground squirrel burrows and vernal pools or other seasonal water sources for breeding.	**None.** There are no known nearby occurrences.
Dicamptodon ensatus California giant salamander	SSC	--	They occur up to 2,160 m (6,500 ft.) primarily in humid coastal forests, especially in Douglas fir, redwood, red fir, and montane and valley-foothill riparian habitats (Stebbins 1972). They live in or near streams in damp forests, and California giant salamanders tend to be common where they occur (Stebbins 1985).	**Low.** Typical aquatic habitat is not present in the Study Area.
Taricha rivularis Red-bellied newt	SSC	--	This species is a stream or river dweller that typically lives in broadleaved upland forest, North coast coniferous forest, Redwood, Riparian forest and Riparian woodland.	**None.** The Study Area is outside of the known range of this species.
Rana boylii Foothill yellow-legged frog	SSC	--	Partly-shaded, shallow streams and riffles with a rocky substrate in a variety of habitats. Need at least some cobble-sized substrate for egg laying.	**None.** Typical aquatic habitat not present and there are no nearby known occurrences for this species.
Spea hammondi Western spadefoot toad	SSC	--	This species occurs primarily in grasslands, but occasional populations also occur in valley-foothill hardwood woodlands.	**Low.** There are no known occurrences for this species near the Study Area.
Rana draytonii California red-legged frog	FT, SSC	--	Occurs in a variety of ponds, sloughs, low-gradient streams, and low-salinity lagoons. Adults may forage in, and migrate through, terrestrial grasslands, riparian woodlands, and forests, but require weedy, slow moving or standing water that persists through most of the dry season for successful reproduction. Introduced bullfrogs and predatory fish are implicated in the decline of red-legged frogs throughout their range	**Low.** Typical aquatic habitat is not present in the Study Area. This species has historic occurrences in Lake Merced, however, it has not been observed since 2000 (SF Rec and Park Dept. 2006). If present in Lake Merced, the Study Area may serve as dispersal habitat.

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	Federal/ State Status	Other Status	Habitat Association	Potential for Occurrence in the Study Area
Reptiles				
Actinemys marmorata Pacific (Western) pond turtle	SSC	--	Ponds, marshes rivers, streams, and irrigation ditches that have emergent or riparian vegetation and sunny basking sites. Upland nesting habitat consists of friable soil exposed to full sun.	**Moderate.** Typical aquatic habitat is not present in the Study Area, however, this species is known to occur in Lake Merced.
Chelonia mydas Green turtle	FT	--	In the eastern North Pacific, green turtles have been sighted from Baja California to southern Alaska, but most commonly occur from San Diego south.	**Low.** Typically occurs to the south in warmer waters.
Dermochelys coriacea Leatherback sea turtle	FE	--	Eastern Pacific leatherbacks nest along the Pacific coast of the Americas in Mexico and Costa Rica.	**Low.** Typically occurs to the south in warmer waters.
Lepidochelys olivacea Olive ridley sea turtle	FT	--	In the Eastern Pacific, they occur from Southern California to Northern Chile.	**Low.** Typically occurs to the south in warmer waters.
Anniella pulchra pulchra Northern California (Silvery) legless lizard	SSC	--	This fossorial lizard usually forages at the base of shrubs or other vegetation either on the surface or just below it in leaf litter or sandy soil.	**Low.** This species is not known to occur near the Study Area.
Phrynosoma blainvilli Coast horned lizard	SSC	--	This lizard occurs in valley-foothill hardwood, conifer and riparian habitats, as well as in pine-cypress, juniper and annual grassland habitats in the Sierra Nevada foothills from Butte Co. to Kern Co. and throughout the central and southern California coast.	**Low.** This species is not known to occur near the Study Area.
Thamnophis sirtalis tetrataenia San Francisco garter snake	FE, SE, FP	--	Vicinity of freshwater marshes, ponds, and slow moving streams. Prefers dense cover and water depths of at least one foot. Upland areas near water are important.	**Low.** This species is not known to occur near the Study Area.
Birds				
Bucephala islandica Barrow's goldeneye	SSC	--	A very uncommon winter resident (October to March) along the central California coast, mainly in San Francisco Bay and vicinity, and in Marin and Sonoma Counties.	**Low.** May forage in aquatic habitat, not known to breed in California.
Gavia immer Common loon	SSC	--	From September to May, fairly common in estuarine and subtidal marine habitats along entire coast, and uncommon on large, deep lakes in valleys and foothills throughout state.	**Low.** May forage in the adjacent aquatic habitat, but the main breeding grounds are in the northern U.S. and Canada.

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	Federal/ State Status	Other Status	Habitat Association	Potential for Occurrence in the Study Area
Birds (continued)				
Phoebastria (=Diomedea) albatrus Short-tailed albatross	FE, SSC	--	Most breeding activity occurs at two island colonies: the largest, on Torishima, is home to about 85% of the world's population; and the remainder nest on Minami Kojima, in the Senkaku Island Group, northwest of Taiwan.	**Low.** May rarely forage off shore of Study Area.
Pelecanus erythrorhynchos American white pelican	SSC	--	This pelican currently breeds primarily in the interior of North America from the Canadian and U.S. prairies patchily south and west through the Intermountain West, reaching its southwestern limit in southern Oregon, northeastern California, and western Nevada (Evans and Knopf 1993).	**Low.** This species forages in aquatic habitat adjacent to the Study Area, but is not known to breed in the vicinity of the Study Area.
Pelecanus occidentalis californicus California brown pelican	FP	--	This pelican nests from the Channel Islands of southern California southward along the Baja California coast and in the Gulf of California to coastal southern Mexico.	**Low.** This species forages in aquatic habitat adjacent to the Study Area, but is not known to breed in the vicinity of the Study Area.
Phalacrocorax auritus Double-crested cormorant	--	CDFW:WL	Yearlong resident of coast; nests adjacent to water. Rookeries are protected under section 3503 of the California Fish and Game Code.	**Moderate.** This species forages and nests at Lake Merced, but is not known to breed in the Study Area.
Pandion haliaetus Osprey	--	CDFW:WL	Breeds in northern California from Cascade Ranges south to Lake Tahoe, and along the coast south to Marin County.	**Low.** This species has been observed foraging, but not nesting, at Lake Merced.
Accipiter cooperii Cooper's hawk	--	CDFW:WL	This medium sized hawk nests in large trees in wooded areas but is increasing found nesting in urban areas (Peeters and Peeters 2005).	**Moderate.** Suitable nesting habitat is present in the Study Area.
Accipiter striatus Sharp-shinned hawk	--	CDFW:WL	Breeds in ponderosa pine, black oak, riparian deciduous, mixed conifer, and Jeffrey pine habitats. Prefers, but not restricted to, riparian habitats. North facing slopes, with plucking perches are critical requirements.	**Low.** No known breeding records in the vicinity of the Study Area.
Aquila chrysaetos Golden eagle	FP	BCC	Rolling foothills, mountain areas, sage-juniper flats and deserts. Cliff-walled canyons provide nesting habitat in most parts of range; also large trees in open areas.	**Low.** This species has no nearby nesting occurrences.

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	Federal/ State Status	Other Status	Habitat Association	Potential for Occurrence in the Study Area
Birds (continued)				
Buteo regalis Ferruginous hawk	--	BCC	Uncommon winter resident and migrant at lower elevations and open grasslands in the Modoc Plateau, Central Valley, and Coast Ranges. No breeding records from California.	**Low.** This species does not breed in the area.
Buteo swansoni Swainson's hawk	ST	--	The Swainson's Hawk breeds in the western United States and Canada and winters in South America as far south as Argentina.	**Low.** This species is not known to breed in the area.
Circus cyaneus Northern harrier	SSC	--	This CDFW watch list species is found in coastal salt and freshwater marsh. Nests are built of a large mound of sticks in wet areas.	**Low.** Suitable nesting habitat is not present in the Study Area.
Elanus leucurus White-tailed kite	FP	--	Rolling foothills and valley margins with scattered oaks and river bottomlands or marshes nest to deciduous woodland. Open grasslands, meadows or marshes for foraging close to isolated, dense-topped trees for nesting and perching.	**Low.** This species has no nearby nesting occurrences.
Haliaeetus leucocephalus Bald eagle	FD, SE,FP	BCC	This species requires large bodies of water, or free-flowing rivers with abundant fish and adjacent snags or other perches.	**Low.** Typical nesting habitat is available in the large trees around Lake Merced, however, this species has no known nests in the vicinity of the Study Area.
Falco columbarius Merlin	--	CDFW WL	This CDFW Watch List falcon winters in California from September through May. Wintering grounds are protected under section 3503 of the California Fish and Game Code.	**Low.** This species may forage in the Study Area but does not breed in the area.
Falco mexicanus Prairie falcon	--	BCC	This species is an uncommon permanent resident that ranges from southeastern deserts northwest throughout the Central Valley and along the inner Coast Ranges and Sierra Nevada. Distributed from annual grasslands to alpine meadows, but associated primarily with perennial grasslands, savannahs, rangeland, some agricultural fields, and desert scrub areas.	**Low.** May forage in the area but suitable nesting habitat is not present in the Study Area.
Falco peregrinus anatum Peregrine falcon	FP	BCC	Breeding sites located on cliffs. Forages far afield, even to marshlands and ocean shores.	**Low.** May forage in the area but suitable nesting habitat is not present in the Study Area.

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	**Federal/ State Status**	**Other Status**	**Habitat Association**	**Potential for Occurrence in the Study Area**
Birds (continued)				
Laterallus jamaicensis coturniculus California black rail	ST, FP	BCC	Yearlong resident of saline, brackish, and fresh emergent wetlands in the Sacramento-San Joaquin River delta, the San Francisco Bay area, Bolinas Lagoon and Tomales Bay in Marin County, Morro Bay in San Luis Obispo County, White Slough in San Joaquin County, the Salton Sea area, and the Lower Colorado River Valley.	**Low.** Emergent wetland habitat is not present in the Study Area. This species occurred at Lake Merced in 1937 (CNDDB 2019) but has not been recorded recently.
Rallus obsoletus obsoletus California Ridgeway's rail	FE, SE, FP		This species is restricted almost entirely to the tidal marshes of San Francisco estuary.	**None.** Tidal marsh habitat is not present in the Study Area.
Charadrius alexandrinus Western snowy plover	FT, SSC	BCC	This species is found on flat, open coastal beaches, in dunes, and near stream mouths along the west coast.	**Present.** This species is known to winter, but not breed, along Ocean Beach.
Numenius americanus Long-billed curlew	--	BCC, CDFW:WL	An uncommon to fairly common breeder from April to September in wet meadow habitat in northeastern California in Siskiyou, Modoc, and Lassen Counties. Uncommon to locally very common as a winter visitor from early July to early April along most of the California coast, and in the Central and Imperial valleys, where the largest flocks occur.	**Low.** This species forages at Ocean Beach but is more typically observed on the Bay side and does not nest in the vicinity.
Hydroprogne caspia Caspian tern	--	BCC	Common to very common along the California coast and at scattered locations inland, from April through early August. Nesting colonies are located at south San Francisco Bay, San Diego Bay, and several lakes in Modoc and Lassen cos. (Cogswell 1977, Garrett and Dunn 1981).	**Low.** This species may forage in the ocean or Lake Merced but does not nest near the Study Area.
Sternula antillarum browni California least tern	FE, SE	--	Nests along the coast from San Francisco Bay south to northern Baja California. Colonial breeder on bare or sparsely vegetated, flat substrates: sand beaches, alkali flats, landfills or paved areas.	**Low.** This species may forage in the vicinity of the Study Area but is not known to breed near the Study Area.
Rynchops niger Black skimmer	SSC	--	Nests on gravel bars, low islets, and sandy beaches, in unvegetated sites. Nesting colonies usually less than 200 pairs.	**Low.** This species may forage in the vicinity of the Study Area but is not known to breed near the Study Area.

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	Federal/ State Status	Other Status	Habitat Association	Potential for Occurrence in the Study Area
Birds (continued)				
Brachyramphus marmoratus Marbled murrelet	FT, SE	--	Requires dense, mature forests of redwood and Douglas-fir for breeding (Cogswell 1977). In California, probably prefers to nest in tall trees; nest made of moss and lichen.	**None.** Typical nest trees not present in Study Area.
Coccyzus americanus Yellow-billed cuckoo	FT, SE	--	An uncommon to rare summer resident of valley foothill and desert riparian habitats in scattered locations in California.	**Low.** No nearby known occurrences for this species.
Asio flammeus Short-eared owl	SSC	--	This species nests in swamp lands, lowland meadows and irrigated alfalfa fields. Tule patches or tall grass are needed for nesting and/or daytime seclusion.	**Low.** There are no known nearby occurrences for this species.
Asio otus Long-eared owl	SSC	--	Nests in conifer, oak, riparian, pinyon-juniper, and desert woodlands that are either open or are adjacent to grasslands, meadows, or shrublands. Key habitat components are some dense cover for nesting and roosting, suitable nest platforms, and open foraging areas. Uses old crow, magpie, hawk, heron, and squirrel nest in a variety of trees with dense canopy.	**Low.** There are no known nearby occurrences for this species.
Athene cunicularia hypugea Western burrowing owl	SSC	BCC	Open, dry annual or perennial grasslands, deserts, and scrublands characterized by low-growing vegetation. Subterranean nester, dependent upon burrowing mammals, most notably, the California ground squirrel.	**Present.** This species has been observed wintering along Ocean Beach.
Strix occidentalis caurina Northern spotted owl	FT	--	This species typically lives in evergreen forest and woodland.	**Low.** This species typically nests in forests that are not located in the Study Area.
Chaetura vauxi Vaux's swift	SSC	--	These swifts nest in cavities in a variety of trees and less frequently in artificial structures, particularly chimneys.	**Low.** Typical coniferous nesting habitat is not present in the Study Area.
Cypseloides niger Black swift	SSC	--	This species typically nests on cliffs behind or adjacent to waterfalls.	**None**. Typical nesting habitat is not present in the Study Area.
Contopus cooperi Olive-sided flycatcher	SSC	--	Breeding habitat for the olive-sided flycatcher is primarily late-successional conifer forests with open canopies (e.g., 0%–39% canopy cover; Verner 1980).	**Moderate.** This species has been documented at Lake Merced. Suitable breeding habitat is available in the Study Area.

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	Federal/ State Status	Other Status	Habitat Association	Potential for Occurrence in the Study Area
Birds (continued)				
Lanius ludovicianus Loggerhead shrike	SSC	BCC	In California, loggerhead shrikes breed mainly in shrublands or open woodlands with a fair amount of grass cover and areas of bare ground.	**Low.** There are no known nearby occurrences for this species.
Eremophila alpestris actia California horned lark	--	CDFW:WL	A common to abundant resident in a variety of open habitats, usually where trees and large shrubs are absent.	**Low.** Typical habitat not present in Study Area.
Progne subis Purple martin	SSC	--	Martins use a wide variety of nest substrates (e.g., tree cavities, bridges, utility poles, lava tubes, and, formerly, buildings), but nonetheless are very selective of habitat conditions nearby.	**Low.** The Study Area is outside of the current known range for this species.
Riparia riparia Bank swallow	ST	--	Colonial nester, nests primarily in riparian and other lowland habitats west of the desert. Requires vertical banks/cliffs with fine textured/sandy soils near streams, rivers, lakes, ocean to dig nesting holes.	**Present**. This species is known to nest on the cliff face of Ocean Beach.
Baeolophus inornatus Oak titmouse	--	BCC	The oak titmouse is a common resident in a variety of habitats, but is primarily associated with oaks. Occurs in montane hardwood-conifer, montane hardwood, blue, valley, and coastal oak woodlands, and montane and valley foothill riparian habitats in cismontane California, from the Mexican border to Humboldt Co.	**Low.** There are no recent known nearby occurrences.
Ammodramus savannarum Grasshopper sparrow	SSC	--	Grasshopper Sparrows in California prefer short to middle-height, moderately open grasslands with scattered shrubs.	**Low.** Typical nesting habitat is not present in the Study Area.
Melospiza melodia pusillula Alameda song sparrow	SSC	BCC	The Alameda song sparrow is likely found historically where tidal marsh habitat was available within its described range.	**None.** This species is restricted to the fringes of south San Francisco Bay.
Passerculus sandwichensis alaudinus Bryant's savannah sparrow	SSC	--	This sparrow occupies low tidally influenced habitats, adjacent ruderal areas, moist grasslands within and just above the fog belt, and, infrequently, drier grasslands. This sparrow generally avoids drier upland grasslands, especially in the interior Coast Ranges (Roberson and Tenney 1993, Shuford 1993).	**Low.** This species is not known to breed near the Study Area.

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	**Federal/ State Status**	**Other Status**	**Habitat Association**	**Potential for Occurrence in the Study Area**
Birds (continued)				
Agelaius tricolor Tricolored blackbird	SSC	BCC	Highly colonial species, most numerous in Central Valley and vicinity. Largely endemic to California. Requires open water, protected nesting substrate, and foraging area with insect prey within a few km of the colony.	**Low.** No suitable habitat is present in the Study Area.
Dendroica petechia brewsteri Yellow warbler	SSC	BCC	Riparian plant associations. Prefers willows, cottonwoods, aspens, sycamores, and alders for nesting and foraging.	**Low.** Typical nesting habitat is not present in the Study Area. This species has not been observed breeding at Lake Merced in recent years.
Geothlypis trichas sinuosa Saltmarsh common yellowthroat	SSC	--	Resident of the San Francisco bay region, in fresh and saltwater marshes.	**Moderate.** This species is known to breed at Lake Merced.
Mammals				
Sorex vagrans halicoetes Salt marsh wandering shrew	SSC	--	Confined to small remnant stands of salt marsh found around the southern arm of the San Francisco Bay in San Mateo, Santa Clara, Alameda and Contra Costa counties (Ford 1986).	**None.** This species is restricted to the fringes of south San Francisco Bay.
Antrozous pallidus Pallid bat	SSC	--	Roosts in caves, mine tunnels, crevices in rocks, bridges, buildings, and hollowed trees.	**Low.** This species has not been detected near the Study Area.
Corynorhinus townsendii Townsend's big-eared bat	SSC	--	Requires caves, mines, tunnels, buildings, or other human-made structures for roosting. May use separate sites for night, day, hibernation, or maternity roosts.	**Low.** Typical roost habitat is not present in the Study Area but this species may forage in the Study Area.
Lasionycteris noctivagans Silver-haired bat	--	WBWG Medium Priority Species	Roosts in hollow trees, snags, buildings, rock crevices, caves, and under bark. Primarily a forest dweller, feeding over streams, ponds, and open brushy areas.	**Moderate.** This species has been detected at Fort Funston (Fellers 2005).
Eumops perotis californicus Western mastiff bat	SSC	--	Uncommon resident in southeastern San Joaquin Valley and Coastal Ranges from Monterey County southward through southern California, from the coast eastward to the Colorado Desert.	**Low.** This species has not been detected near the Study Area.

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	**Federal/ State Status**	**Other Status**	**Habitat Association**	**Potential for Occurrence in the Study Area**
Mammals (continued)				
Lasiurus blossevillii Western red bat	SSC	--	Roosts primarily in trees, less often in shrubs. Roost sites often are in edge habitats adjacent to streams, fields, or urban areas. Preferred roost sites are protected from above, open below, and located above dark ground-cover. Such sites minimize water loss. Roosts may be from 0.6-13 m (2-40 ft) above ground level.	**Moderate.** This species has been detected at Fort Funston (Fellers 2005).
Lasiurus cinereus Hoary bat	--	WBWG Medium Priority Species	The hoary bat is the most widespread North American bat. Generally roosts in dense foliage of medium to large trees. Solitary species - winters along the coast and in southern California, breeding inland and north of the winter range.	**Moderate.** This species has been detected at Fort Funston (Fellers 2005).
Myotis evotis Long-eared myotis	--	WBWG Medium Priority Species	This species has been found in nearly all brush, woodland, and forest habitats, from sea level to at least 2700 m (9000 ft), but coniferous woodlands and forests seem to be preferred. This species roosts in buildings, crevices, spaces under bark, and snags.	**Low.** This species has not been detected near the Study Area.
Myotis lucifugus Little brown bat	--	WBWG Medium Priority Species	Day roosts located in buildings, trees, under rocks or wood, or occasionally in caves. Nursery roosts usually in buildings, but also in other locations with suitable temperatures.	**Moderate.** This species has been detected at Fort Funston (Fellers 2005).
Myotis thysanodes Fringed myotis	--	WBWG High Priority Species	Most common in drier woodlands, they may roost in caves, mines, buildings, and crevices.	**Moderate.** This species has been detected at Fort Funston (Fellers 2005).
Myotis Volans Long-legged myotis	--	WBWG High Priority Species	The long-legged myotis roosts in rock crevices, buildings, under tree bark, in snags, mines, and caves. Separate day and night roosts may be used. Trees probably are the most important day roosts. Caves and mines are used only as night roosts.	**Low.** This species typically occurs at higher elevations.

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	Federal/ State Status	Other Status	Habitat Association	Potential for Occurrence in the Study Area
Mammals (continued)				
Nyctinomops macrotis Big free-tailed bat	SSC	--	Generally found in rugged, rocky habitats and arid landscapes, in desert shrub, woodlands, and evergreen forests. Roost in crevices of rocks in cliffs and occasionally in buildings, caves, and tree cavities.	**Low.** The big free-tailed bat is rare in California.
Erethizon dorsatum North American porcupine	--	--	This G5S3 status mammal was collected in Golden Gate Park in 1920.	**None.** This species is presumed extirpated from San Francisco.
Dipodomys heermanni berkeleyensis Berkeley kangaroo rat	--	--	This S1 status species typically lives in open grassy hilltops & open spaces in chaparral & blue oak/digger pine woodlands and requires fine, deep, well-drained soil for burrowing.	**Low.** No nearby known occurrences.
Neotoma fuscipes annectens San Francisco dusky-footed woodrat	SSC	--	Prefers forest habitats with moderate canopy, year-round greenery, a brushy understory, and suitable nest building materials. Feeds mainly on woody plants, especially live oak, maple, coffeeberry, alder, and elderberry when available (Linsdale and Tevis 1951).	**Low.** No nearby occurrences for this species.
Reithrodontomys raviventris Salt-marsh harvest mouse	FE, SE, FP	--	Found only in saline emergent wetlands of San Francisco Bay and its tributaries. The northern subspecies R. r. halicoetes is found on Marin Peninsula, through Petaluma, Napa, and Suisun Bay marshes, and in northern Contra Costa Co. The southern subspecies R. r. raviventris mostly is restricted to a band extending from San Mateo Co. and Alameda Co. south along both sides of San Francisco Bay to Santa Clara Co., but isolated populations occur in Marin and Contra Costa cos.	**None.** This species is restricted to the fringes of San Francisco Bay.
Taxidea taxus American badger	SSC	--	This species typically utilizes annual grasslands or grassy open stages with scattered shrubby vegetation and requires loose-textured sandy soils for burrowing, and for a suitable prey base.	**None.** No recent occurrences for this species.
Enhydra lutris nereis Southern sea otter	FT, SSC, FP	--	The southern sea otter currently occurs in only two areas of California, the mainland coastline from San Mateo County to Santa Barbara County and San Nicolas Island, Ventura County.	**Low.** This species is not typically observed at Ocean Beach.

APPENDIX B-2: FULL LIST OF SPECIAL-STATUS AND OTHER SENSITIVE WILDLIFE SPECIES POTENTIALLY PRESENT IN THE STUDY AREA				
Species	Federal/ State Status	Other Status	Habitat Association	Potential for Occurrence in the Study Area
Mammals (continued)				
Bassariscus astutus Ringtail	FP	--	This species is usually found under 1400m in elevation in a variety of habitats throughout the western US including: riparian areas, semi-arid country, deserts, chaparral, oak woodlands, pinyon pine woodlands, juniper woodlands and montane conifer forests.	**Low.** No recent occurrences for this species.
Arctocephalus townsendi Guadalupe fur-seal	FT, ST, FP	--	Guadalupe fur seals are rarely observed in California. Their entire breeding population is centered on Isla de Guadalupe, 256 km (159 mi) west of Baja California, Mexico.	**Low.** Typically occurs further south.
Eumetopias jubatus Steller (=northern) sea-lion	FD, SSC	--	Breeding rookeries are located at Ano Nuevo Island (San Mateo Co.), Farallon Islands, Pt. Saint George (Del Norte Co.), and Sugarloaf on Cape Mendocino.	**Low.** This species does not typically haul out on Ocean Beach.
Zalophus californianus California sea lion	MMPA	--	California sea lions are found from Vancouver Island, British Columbia to the southern tip of Baja California in Mexico. They breed mainly on offshore islands, ranging from southern California's Channel Islands south to Mexico, although a few pups have been born on Año Nuevo and the Farallon Islands in central California.	**Present.** This species is known to occur off shore of Ocean Beach.
Phoca vitulina richardii Pacific harbor seal	MMPA	--	In the northeast Pacific, they range from Alaska to Baja California, Mexico. They favor near-shore coastal waters and are often seen on rocky islands, sandy beaches, mudflats, bays, and estuaries.	**Present.** This species is known to occur off shore of Ocean Beach.
Mirounga angustirostris Northern elephant seal	MMPA	--	Northern elephant seals are found in the North Pacific, from Baja California, Mexico to the Gulf of Alaska and Aleutian Islands. During the breeding season, they live on beaches on offshore islands and a few remote spots on the mainland.	**Low.** This species is known to occur off shore of Ocean Beach, however, is more typically associated with the nearshore habitat of the Farallon Islands.

Status Legend

Federal:

FE	Listed as endangered under the Federal Endangered Species Act
FT	Listed as threatened under the Federal Endangered Species Act
FC	Listed as candidate species under the Federal Endangered Species Act
BCC	USFWS Bird of Conservation Concern

State:

SE	Listed as endangered under the California Endangered Species Act
ST	Listed as threatened under the California Endangered Species Act
SC	Species of special concern under the California Endangered Species Act
S1	Less than 6 element occurrences OR less than 1,000 individuals OR less than 2,000 acres S1.1 = very threatened S1.2 = threatened S1.3 = no current threats known

Other:

WBWG	Western Bat Working Group (High or Medium Priority Species)
CDFW WL	California Department of Fish and Wildlife Watch List
(IUCN) VU	International Union for Conservation of Nature: Vulnerable
IM	Xerces Society: Imperiled
MMPA	Marine Mammal Protection Act (1972) Species

GLOBAL RANKING

The global rank (G-rank) is a reflection of the overall status of an element throughout its global range. Both Global and State ranks represent a letter and number score that reflects a combination of Rarity, Threat, and Trend factors, with weighting being heavier on Rarity than the other two.

SPECIES OR NATURAL COMMUNITY LEVEL

G1 = Critically Imperiled—At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.

G2 = Imperiled—At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

G3 = Vulnerable—At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.

G4 = Apparently Secure—Uncommon but not rare; some cause for long-term concern due to declines or other factors.

G5 = Secure—Common; widespread and abundant.

STATE RANKING

The state rank (S-rank) is assigned much the same way as the global rank, but state ranks refer to the imperilment status only within California's state boundaries.

S1 = Critically Imperiled—Critically imperiled in the state because of extreme rarity (often 5 or fewer populations) or because of factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.

S2 = Imperiled—Imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.

S3 = Vulnerable—Vulnerable in the state due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation from the state.

S4 = Apparently Secure—Uncommon but not rare in the state; some cause for long-term concern due to declines or other factors.

S5 = Secure—Common, widespread, and abundant in the state.

Appendix C
List of Species Observed within the Study Area

APPENDIX C-1: PLANT SPECIES OBSERVED IN THE STUDY AREA				
Family	Scientific Name	Common Name	Native	Cal-IPC Rank[7]
NYCTAGINACEAE	***Abronia latifolia***[1]	**yellow sand verbena**	**yes**	
FABACEAE	*Acacia melanoxylon*	blackwood acacia		Limited
FABACEAE	*Acacia longifolia*	Sydney golden wattle		Watch
ROSACEAE	*Acaena novae-zelandiae*	biddy biddy		
ASTERACEAE	*Achillea millefolium*	yarrow	yes	
FABACEAE	***Acmispon heermannii* var. *orbicularis***[2]	**Heermann's bird's-foot trefoil**	**yes**	
FABACEAE	*Acmispon strigosus*	strigose bird's-foot-trefoil	yes	
POACEAE	*Ammophila arenaria*	European beach grass		High
ASTERACEAE	*Argyranthemum* sp.	marguerite		
AMARYLLIDACEAE	*Agapanthus* sp.	lily of the Nile		
MYRTACEAE	*Agonis flexuosa*	peppermint tree		
POACEAE	***Agrostis exarata***[2]	**spike bent grass**	**yes**	
FABACEAE	*Albizia lophantha*	plume acacia		Watch
ASTERACEAE	***Ambrosia chamissonis***[3]	**beach burr**	**yes**	
ASTERACEAE	*Argyranthemum frutescens*	marguerite daisy		
PLUMBAGINACEAE	*Armeria maritima* ssp. *californica*	thrift sea pink	yes	
ASTERACEAE	*Artemisia pycnocephala*	coastal sagewort	yes	
POACEAE	*Avena barbata*	slender wild oat		Moderate
POACEAE	*Avena fatua*	wild oat		Moderate
ASTERACEAE	*Baccharis pilularis* ssp. *pilularis*	coyote brush	yes	
BRASSICAEAE	*Brassica nigra*	black mustard		Moderate
POACEAE	*Briza maxima*	rattlesnake grass		Limited
POACEAE	*Briza minor*	little rattlesnake grass		
POACEAE	*Bromus carinatus* var. *carinatus*	California brome	yes	
POACEAE	*Bromus diandrus*	ripgut brome		Moderate
POACEAE	*Bromus hordeaceus*	soft chess		Limited
BRASSICAEAE	*Cakile maritima*	European sea rocket		Limited
CARYOPHYLLACEAE	*Cardionema ramosissimum*	sandmat	yes	
ASTERACEAE	*Carduus pycnocephalus* ssp. *pycnocephalus*	Italian thistle		Moderate
AIZOACEAE	*Carpobrotus chilensis*	sea fig		Moderate
AIZOACEAE	*Carpobrotus edulis*	ice plant		High
RHAMNACEAE	*Ceanothus* sp. (planted)	ceanothus	yes	
CHENOPODIACEAE	*Chenopodium album*	lamb's quarters		
ASTERACEAE	*Calendula officinalis*	calendula		
BRASSICACEAE	*Capsella bursa-pastoris*	shepherd's purse		
ONAGRACEAE	*Camissoniopsis cheiranthifolia* ssp. *cheiranthifolia*	beach evening-primrose	yes	

APPENDIX C-1: PLANT SPECIES OBSERVED IN THE STUDY AREA				
Family	Scientific Name	Common Name	Native	Cal-IPC Rank[7]
CISTACEAE	*Cistus* x *purpureus*	orchid rock rose		
POLYGONACEAE	***Chorizanthe cuspidata*** **var.** ***cuspidata***[4]	**San Francisco spineflower**	**yes**	
MONTIACEAE	*Claytonia perfoliata*	miner's lettuce	yes	
AIZOACEAE	*Conicosia pugioniformis*	pig's-root		Limited
APIACEAE	*Conium maculatum*	poison hemlock		Moderate
RUBIACEAE	*Coprosma* sp.	mirror bush		
POACEAE	*Cortaderia jubata*	Andean pampas grass		High
ASTERACEAE	*Cotula coronopifolia*	brass buttons		Limited
CRASSULACEAE	*Crassula connata*	sand pygmy weed	yes	
APIACEAE	*Daucus pusillus*	rattlesnake weed	yes	
ASTERACEAE	*Delairea odorata*	Cape ivy		High
CRASSULACEAE	*Dudleya farinosa*	live-forever	yes	
AIZOACEAE	*Drosanthemum floribundum*	showy dewflower		
BORAGINACEAE	*Echium candicans*	pride of Madeira		Limited
POACEAE	*Ehrharta erecta*	panic veldtgrass		Moderate
ONAGRACEAE	*Epilobium brachycarpum*	annual fireweed	yes	
ASTERACEAE	*Erigeron bonariensis*	flax-leaved horseweed		
ASTERACEAE	*Erigeron canadensis*	Canada horseweed	yes	
ASTERACEAE	*Erigeron glaucus*	seaside daisy	yes	
POLYGONACEAE	*Eriogonum latifolium*	coast buckwheat	yes	
GERANIACEAE	*Erodium cicutarium*	red stemmed filaree		Limited
GERANIACEAE	*Erodium moschatum*	whitestem filaree		
ASTERACEAE	*Eriophyllum staechadifolium*	lizard-tail	yes	
PAPAVERACEAE	*Eschscholzia californica*	California poppy	yes	
MYRTACEAE	*Eucalyptus* sp.	eucalyptus		
MYRTACEAE	*Eucalyptus globulus*	blue gum		Limited
EUPHORBIACEAE	*Euphorbia maculata*	spotted spurge		
POACEAE	*Festuca bromoides*	brome fescue		
POACEAE	*Festuca myuros*	rat's-tail fescue		Moderate
POACEAE	*Festuca perennis*	Italian rye grass		Moderate
POACEAE	*Festuca rubra*	red fescue	yes	
APIACEAE	*Foeniculum vulgare*	sweet fennel		Moderate
ROSACEAE	*Fragaria chiloensis*	beach strawberry	yes	
PAPAVERACEAE	*Fumaria parviflora*	fine leaved fumitory		
RUBIACEAE	*Galium aparine*	bedstraw	yes	
ASTERACEAE	*Gazania* sp.	gazania		
GERANIACEAE	*Geranium* sp.	geranium		
GERANIACEAE	*Geranium dissectum*	cutleaf geranium		Limited

APPENDIX C-1: PLANT SPECIES OBSERVED IN THE STUDY AREA				
Family	Scientific Name	Common Name	Native	Cal-IPC Rank[7]
GERANIACEAE	*Geranium molle*	crane's bill geranium		
GERANIACEAE	*Geranium robertianum*	Robert's geranium		
ASTERACEAE	***Grindelia hirsutula* var. *maritima*[5]**	**San Francisco gumplant**	**yes**	
ARALIACEAE	*Hedera helix*	English ivy		High
ASTERACEAE	*Hedypnois cretica*	crete weed		
ASTERACEAE	*Helminthotheca echioides*	bristly ox tongue		Limited
CUPRESSACEAE	*Hesperocyparis macrocarpa*[5]	Monterey cypress	yes	
BRASSICAEAE	*Hirschfeldia incana*	shortpod mustard		Moderate
POACEAE	*Holcus lanatus*	velvet grass		Moderate
POACEAE	*Hordeum murinum* ssp. *leporinum*	foxtail barley		Moderate
ASTERACEAE	*Hypochaeris glabra*	smooth cat's ear		Limited
JUNCACEAE	*Juncus bufonius*	toad rush	yes	
JUNCACEAE	*Juncus lescurii*	salt rush	yes	
POACEAE	*Lagurus ovatus*	hare's tail grass		
LAMIACEAE	*Lamium amplexicaule*	henbit		
BRASSICAEAE	*Lepidium didymum*	lesser swine cress		
BRASSICAEAE	*Lobularia maritima*	sweet alyssum		Limited
FABACEAE	*Lotus corniculatus*	bird’s foot trefoil		
FABACEAE	*Lupinus bicolor*	miniature lupine	yes	
FABACEAE	*Lupinus arboreus*	yellow bush lupine	yes	
FABACEAE	***Lupinus chamissonis*[3]**	**silver dune lupine**	**yes**	
ROSACEAE	*Lyonothamnus floribundus* ssp. *asplenifolius*[6]	Catalina ironwood	yes	
MYRSINACEAE	*Lysimachia arvensis*	scarlet pimpernel		
MALVACEAE	*Malva arborea*	tree mallow		
MALVACEAE	*Malva nicaeensis*	bull mallow		
FABACEAE	*Medicago polymorpha*	burclover		Limited
MYRTACEAE	*Melaleuca nesophila*	pink melaleuca		
FABACEAE	*Melilotus albus*	white sweet clover		
FABACEAE	*Melilotus indicus*	sourclover		
MYRTACEAE	*Metrosideros excelsa*	New Zealand Christmas tree		
MALVACEAE	*Modiola caroliniana*	Carolina bristle mallow		
SCROPHULARIACEAE	*Myoporum laetum*	ngaio tree		Moderate
ONAGRACEAE	*Oenothera elata* ssp. *hookeri*	Hooker's evening-primrose	yes	
BRASSICACEAE	*Cardamine oligosperma*	bitter cress	yes	
OXALIDACEAE	*Oxalis incarnata*	crimson woodsorrel		
OXALIDACEAE	*Oxalis pes-caprae*	Bermuda buttercup		Moderate

APPENDIX C-1: PLANT SPECIES OBSERVED IN THE STUDY AREA				
Family	Scientific Name	Common Name	Native	Cal-IPC Rank[7]
URTICACEAE	*Parietaria judaica*	pellitory		
POACEAE	*Parapholis incurva*	sickle grass		
POACEAE	*Pennisetum clandestinum*	Kikuyu grass		Limited
PINACEAE	*Pinus radiata*[5]	Monterey pine	yes	
PITTOSPORACEAE	*Pittosporum* sp.	pittosporum		
PLANTAGINACEAE	*Plantago coronopus*	cut-leaf plantain		
PLANTAGINACEAE	*Plantago lanceolata*	English plantain		
PLANTAGINACEAE	*Plantago major*	common plantain		
PLANTAGINACEAE	***Plantago maritima*[3]**	**Pacific seaside plantain**	**yes**	
POACEAE	*Poa annua*	annual bluegrass		
CARYOPHYLLACEAE	*Polycarpon tetraphyllum* var. *tetraphyllum*	four-leaved allseed		
POLYGONACEAE	*Polygonum aviculare*	prostrate knotweed		
POACEAE	*Polypogon monspeliensis*	rabbit's foot grass		Limited
ASTERACEAE	*Pseudognaphalium luteoalbum*	common cudweed		
ASTERACEAE	*Pseudognaphalium stramineum*	cottonbatting plant	yes	
BRASSICACEAE	*Raphanus sativus*	wild radish		Limited
ROSACEAE	*Rubus ursinus*	California blackberry	yes	
POLYGONACEAE	*Rumex acetosella*	sheep's sorrel		Moderate
POLYGONACEAE	*Rumex crispus*	curly dock		Limited
SALICACEAE	*Salix lasiolepis*	arroyo willow	yes	
SOLONACEAE	*Solanum nigrum*	black nightshade		
ASTERACEAE	*Soliva sessilis*	common soliva		
ASTERACEAE	*Sonchus asper* ssp. *asper*	prickly sow thistle		
ASTERACEAE	*Sonchus oleraceus*	common sow thistle		
CARYOPHYLLACEAE	*Spergula arvensis*	corn spurry		
CARYOPHYLLACEAE	*Spergularia rubra*	sand spurry		
CARYOPHYLLACEAE	*Stellaria media*	common chickweed		
AIZOACEAE	*Tetragonia tetragonoides*	New Zealand spinach		Limited
FABACEAE	*Trifolium campestre*	field clover		
FABACEAE	*Trifolium dubium*	shamrock clover		
FABACEAE	*Trifolium fragiferum*	strawberry clover		
TROPAEOLACEAE	*Tropaeolum majus*	garden nasturium		
URTICACEAE	*Urtica dioica*	nettle	yes	
URTICACEAE	*Urtica urens*	dwarf nettle		
PLANTAGINACEAE	*Veronica persica*	bird's eye speedwell		
FABACEAE	*Vicia sativa*	spring vetch		
APOCYNACEAE	*Vinca minor*	common periwinkle		
ARACEAE	*Zantedeschia aethiopica*	calla lily		Limited

Notes:

Nomenclature based on: Jepson Flora Project (eds.). 2019. The Jepson eFlora (online). Available at: http://ucjeps.berkeley.edu/eflora/. Accessed July 2019.

This list is not a comprehensive list of all ornamental plants in the Study Area, but it does include most ornamental trees and large shrubs.

Bold font indicates a plant species that is either a special-status plant species, CRPR 3 and 4 species, or a locally significant plant species.

California Native Plant Society (CNPS). 2015. Locally Significant Plant Species of San Francisco County, version dated July 4, 2015. Yerba Buena Chapter of CNPS.

Available at: http://cnps-yerbabuena.org/exploring/locally-significant/

[1]Plant species with a locally significant ranking of B.

[2]Plant species with a locally significant ranking of A2.

[3]Plant species with a locally significant ranking of C.

[4]Plant species with a CRPR of 1B.2 and a locally significant ranking of A1.

[5]Plant species with a CRPR of 3.2 and a locally significant ranking of A2.

[6]These species are native plant species but are not locally native species.

[7]California Invasive Plant Council (Cal-IPC). 2006. California Invasive Plant Inventory Database. Available at: http://www.cal-ipc.org/ip/inventory/index.php

Cal-IPC Ranks:

High: These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.

Moderate: These species have substantial and apparent-but generally not severe-ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.

Limited: These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

Alert: An Alert is listed on species with High or Moderate impacts that have limited distribution in California, but may have the potential to spread much further.

Watch: These species have been assessed as posing a high risk of becoming invasive in the future in California.

APPENDIX C-2: WILDLIFE SPECIES OBSERVED WITHIN THE STUDY AREA (Bold indicates special status)	
Common Name	Scientific Name
Birds	
Canada Goose	*Branta Canadensis*
Mallard	*Anas platyrhynchos*
Surf Scoter	*Melanitta perspicillata*
Pied-billed Grebe	*Podilymbus podiceps*
Clark's Grebe	*Aechmophorus clarkii*
Brown Pelican	*Pelecanus occidentalis*
Double-crested Cormorant	*Phalacrocorax auritus*
Great Blue Heron	*Ardea herodias*
Black-crowned Night-Heron	*Nycticorax*
Red-tailed Hawk	*Buteo jamaicensis*
American Coot	*Fulica americana*
Willet	*Tringa semipalmata*
Western Gull	*Larus occidentalis*
Rock Pigeon	*Columba livia*
Mourning Dove	*Zenaida macroura*
Anna's Hummingbird	*Calypte anna*
Downy Woodpecker	*Picoides pubescens*
Black Phoebe	*Sayornis nigricans*
Common Raven	*Corvus corax*
Tree Swallow	*Tachycineta bicolor*
Barn Swallow	*Hirundo rustica*
Chestnut-backed Chickadee	*Poecile rufescens*
Marsh Wren	*Cistothorus palustris*
California Towhee	*Pipilo crissalis*
Song Sparrow	*Melospiza melodia*
White-crowned Sparrow	*Zonotrichia leucophrys*
Dark-eyed Junco	*Junco hyemalis*
Brewer's Blackbird	*Euphagus cyanocephalus*
Brown-headed Cowbird	*Molothrus ater*
Reptiles	
Red-eared slider	*Trachemys scripta elegans*
Mammals	
Botta's pocket gopher	*Thomomys bottae*
Fox Squirrel	*Sciurus niger*
Raccoon	*Procyon lotor*

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F3 AQUATIC RESOURCES DELINEATION REPORT

OCEAN BEACH CLIMATE CHANGE ADAPTATION PROJECT

Aquatic Resources Delineation Report

Prepared for
San Francisco Public Utilities Commission

March 2021

OCEAN BEACH CLIMATE CHANGE ADAPTATION PROJECT

Aquatic Resources Delineation Report

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ACRONYMS AND ABBREVIATIONS

CFR	Code of Federal Regulations
CWA	Clean Water Act
CCC	California Coastal Commission
EL	Elevation in North American Vertical Datum of 1988
EPA	United States Environmental Protection Agency
FAC	Facultative plant species
FACU	Facultative upland plant species
FACW	Facultative wetland plant species
GIS	Geographic Information System
GPS	Global Positioning System
HTL	High Tide Line
MHW	Mean High Water
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resource Conservation Service
NWI	National Wetlands Inventory
OBL	Obligate wetland plant species
ORM	USACE Regulatory Data Management System
RHA	Rivers and Harbors Act
RWQCB	Regional Water Quality Control Board
SWRCB	State Water Resources Control Board
USACE	United States Army Corps of Engineers
UPL	Upland plant species
USDA	United States Department of Agriculture
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
WETS	Climate Analysis for Wetlands

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CHAPTER 1
Introduction

1.1 Objective

This report documents the results and conclusions of an aquatic resource delineation field survey conducted on December 9, 2020 by Environmental Science Associates (ESA) on behalf of the San Francisco Public Utilities Commission (SFPUC) for the Ocean Beach Climate Change Adaptation Project (project), located within limits of the City and County of San Francisco, California (**Figure 1-1**).

The purpose of this document is to identify features in the study area that may be subject to regulation under Sections 401 and 404 of the Clean Water Act (CWA), Section 10 of the Rivers and Harbors Act (RHA), and the California Coastal Act. This assessment is based on the best professional judgment of ESA investigators. All conclusions presented should be considered preliminary and subject to change pending official review and verification by the U.S. Army Corps of Engineers (USACE).

1.2 Summary of Results

A total of 214.41 acres (9,339,840 square feet) of aquatic resources were mapped in the approximately 258.3-acre study area, solely consisting of the Pacific Ocean.

A detailed summary of aquatic resources documented within the study area is presented in Table 4-1 (Chapter 4) and depicted in Figures 4-1a, 4-1b, and 4-1c. Wetland datasheets are in **Appendix A**; the precipitation summary information from a nearby weather station is in **Appendix B**; a soils report for the project study area is in **Appendix C**; the USACE Regulatory Data Management System data table for all features evaluated is included in **Appendix D;** and representative photographs are in **Appendix E**.

1.3 Responsible Party

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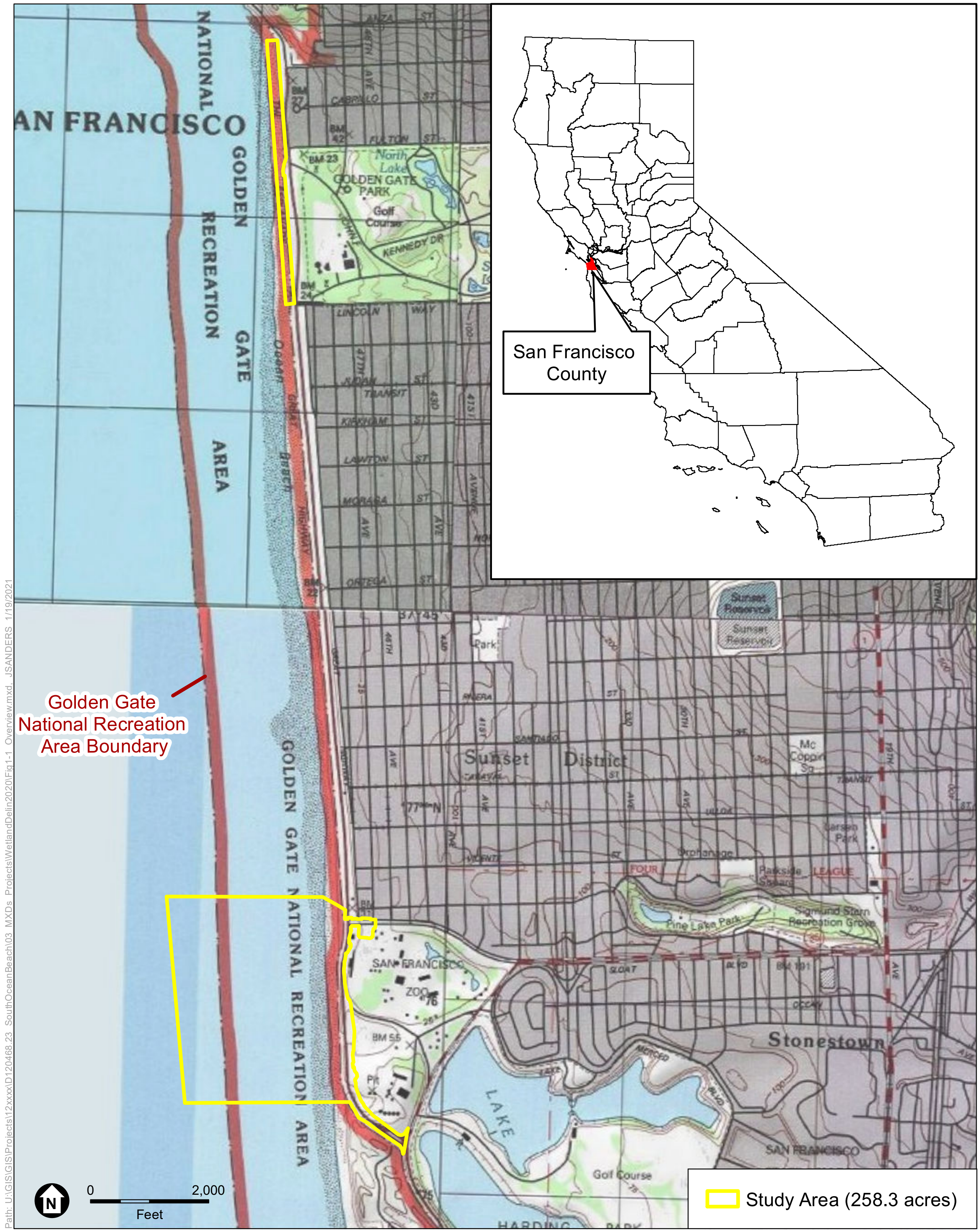

SOURCE: USGS, 2013; SFPUC, 2020; ESA, 2020

Ocean Beach Climate Change Adaptation Project

Figure 1-1
Study Area Overview

ESA

CHAPTER 2
Methods

2.1 Pre-field Review

Prior to conducting the field investigation, the following background tasks were performed:

- Review of the Point Bonito and San Francisco South OE W, California USGS 7.5-minute topographic quadrangle maps;
- Review of color aerial photography for vegetative, topographic, and hydrographic signatures;
- Review of the Custom Soil Resource Report for San Francisco County, California (USDA 2020), for information about soils and geomorphology;
- Review of the National Hydric Soils List for San Francisco County, California (USDA 2020) to determine if any soils mapped within the study area are considered hydric at the level of soil series;
- Review of the National Wetlands Inventory;[1]
- Review of a draft Biological Resources Assessment of the area prepared by BioMaAS[2] to understand vegetation communities present;
- Review of ESA's Ocean Beach Short-Term Erosion Protection Measures Project 2019-2020 Monitoring Report; and
- Review of the USACE's Antecedent Precipitation Tool for information about current climate conditions.

2.2 Field Survey Methods

2.2.1 Dates

ESA wetland ecologist J. Sanders conducted a routine delineation of aquatic features in the study area on December 9, 2020.

1 U.S. Department of the Interior, 2020. Fish and Wildlife Service, National Wetlands Inventory. Available: www.wetlands.fws.gov. Accessed on December, 2020.

2 BioMaAS, 2021. Biological Resources Assessment – Ocean Beach Climate Change Adaptation Project, San Francisco, California. February 2021.

2.2.2 Field Delineation Methods

2.2.2.1 Data Collection

All wetland and drainage signatures on study area aerial photographs were investigated, as were features identified as potential wetlands in the Biological Resources Assessment. The study area was walked such that visual coverage was 100 percent. The one aquatic resource mapped was using field-recorded data in conjunction with topographic and tidal data, which is discussed in more detail in Chapter 4. Field data was recorded using a sub-meter accurate global positioning system (GPS). The delineation used the "Routine Determination Method" described in the *1987 Corps of Engineers Wetland Delineation Manual*,[3] hereafter called the "1987 Manual." The 1987 Manual was used in conjunction with the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0)*,[4] hereafter called the "Arid West Supplement." For areas where the 1987 Manual and the Arid West Supplement differ, the Arid West Supplement was followed.

In accordance with the USACE guidance, sample points were taken at sites representative of the vegetation, hydrology, and physical characteristics across the study area. Arid West data sheets were used to record information at each data point. In addition, vegetation and hydrology information was collected at both sites, and high tide line (HTL) GPS points were taken at representative locations.

2.2.2.2 Determination of Hydrophytic Vegetation

At each sample point herbaceous vegetation was analyzed within a specified plot size. All species noted within the study plots were recorded on the data sheets. The indicator status of each species was confirmed in the field, to the extent feasible, with the *National Wetland Plant List: 2018 Wetland Ratings*[5] for the Arid West Region. Dominant species were assessed using the recommended "50/20" rule per the 1987 Manual. Dominance and/or prevalence calculations were generally performed in the field as well. When the vegetation passed either the dominance or prevalence test the point was considered to have hydrophytic vegetation.

2.2.2.3 Determination of Hydric Soils

Soils were analyzed in accordance with the USACE's *Arid West Regional Supplement.*[6] Soil pits were excavated to the depth needed to document the presence or absence of hydric indicators and

---

[3] Environmental Laboratory, 1987. Corps of Engineers Wetlands Delineation Manual.

[4] USACE, 2008. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0), December 2008, Final Report, [ERDC/EL TR-08-28], U.S. Army Engineer Research and Development Center, Vicksburg, MS.

[5] Lichvar, R.W., D.L. Banks, W.N. Kirchner, and N.C. Melvin, 2019. The National Wetland Plant List: 2019 wetland ratings. Phytoneuron 2016-30:1–17.

[6] USACE, 2008. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0), December 2008, Final Report, [ERDC/EL TR-08-28], U.S. Army Engineer Research and Development Center, Vicksburg, MS.

soil color was matched against a standard color chart.[7] Soils were also inspected for redoximorphic features and soil texture was determined. It was then possible to determine if the soils met any of the hydric soils criteria listed on the Arid West data sheets. Where soils did not exhibit hydric soil criteria consideration was given as to whether the sample point in question had the potential to be saturated, ponded or have a water table within 12 inches of the surface for 14 or more consecutive days during the growing season. With the presence of wetland vegetation and hydrology, this technical standard can be used to characterize a soil as hydric.[8]

2.2.2.4 Determination of Wetland Hydrology

The presence of wetland hydrology was assessed at each data point by the documentation of primary and/or secondary hydrology indicators, per guidance of the Arid West Supplement.

2.2.3 Mapping and Acreage Calculations

All features, including data points, aquatic feature extents and vegetation communities were recorded using a Global Positioning System (GPS) unit (EOS Arrow 100) with real-time differential correction and an instrument-rated mapping accuracy of less than one meter. In addition, existing elevations at the study area captured in April 2020 were also used to map aquatic resources boundaries in conjunction with field data. Acreage of aquatic features were calculated using ArcGIS.

7 Kollmorgen Instruments Corporation, Macbeth Division, 1990. Munsell Soil Color Charts. Baltimore, Maryland.

8 USACE, 2008. Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Arid West Region (Version 2.0), December 2008, Final Report, [ERDC/EL TR-08-28], U.S. Army Engineer Research and Development Center, Vicksburg, MS.

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CHAPTER 3
Setting

3.1 Study Area

The 258.3-acre study area is located along the City and County of San Francisco's Pacific Ocean coastline (**Figures 3-1a and 3-1b**), and is comprised of two distinct areas: North Ocean Beach and South Ocean Beach. They occur within U.S. Geological Survey's (USGS) Point Bonito and San Francisco South OE W 7.5-minute series quadrangles, respectively. The approximately 14-acre northern area is near Golden Gate Park, bordered by a seawall to the east and beach areas to the north, south, and west. The southern area is located between Sloat Boulevard and Fort Funston, and encompasses South Ocean Beach and bluffs, as well as the Great Highway, and lands within and adjacent to Sloat Boulevard, the San Francisco Zoo, and Fort Funston.

3.2 Climate

The climate in Northern California is Mediterranean, with the majority of precipitation occurring as rain in the winter months. The average annual temperature recorded at the San Francisco Oceanside climatic station is 55.6ºF, and mean annual rainfall is 19.6 inches.[9] No rain fell a week prior to the December survey. The previous winter recorded 7.81 inches of rainfall, which is approximately 40 percent of the average annual rainfall. The water surface elevation and HTL of the Pacific Ocean is not affected by rainfall patterns; this report also takes into account seasonal changes in the location of the HTL of the Pacific Ocean. A full Climate Analysis for Wetlands (WETS) table and the results of the Antecedent Precipitation Tool (see Methods section) can be found in **Appendix B**.

3.3 Soils

The United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey provides information about the soil units occurring in the study area. The Custom Soil Resource Report[10] identifies four map units in the study area which are briefly described below. The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. Appendix C has detailed soil maps and reference information. None of the four map units are listed as hydric by the NRCS.

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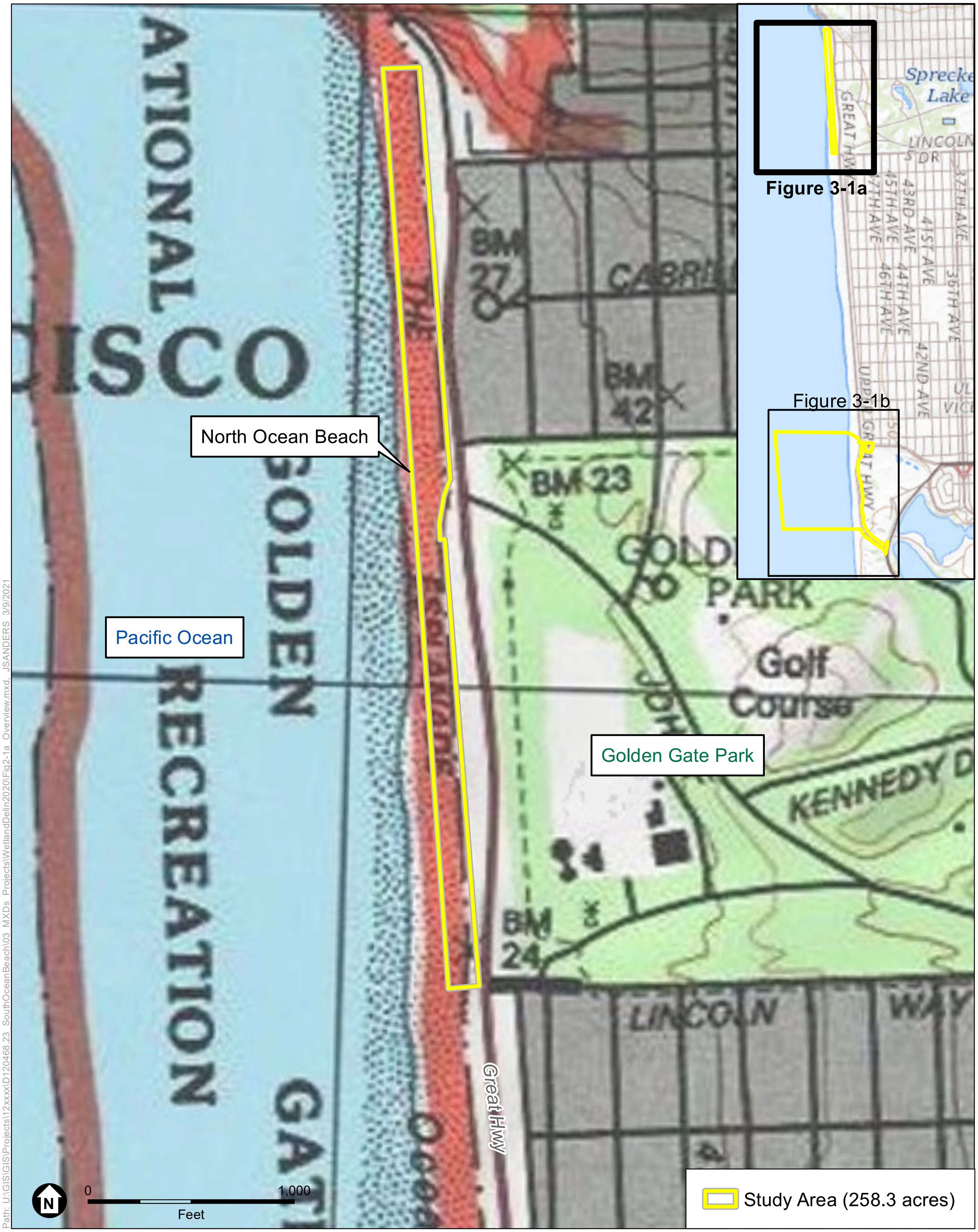
[9] AgACIS, 2020. Kentfield Station, CA. WETS, 1971-2020, NOAA Regional Climate Centers, accessed August, 2020. Available: http://agacis.rcc-acis.org/?fips=06001

[10] USDA NRCS, 2020. Custom Soil Resource Report for San Francisco County, California. Available: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. Accessed June 2020; included as Appendix C



SOURCE: USGS, 2013; SFPUC, 2020; ESA, 2020

Ocean Beach Climate Change Adaptation Project

Figure 3-1a
Aquatic Resources Delineation Study Area

ESA

Path: U:\GIS\GIS\Projects\12xxxx\D120468.23_SouthOceanBeach\03_MXDs_Projects\WetlandDelin2020\Fig2-1b_Overview.mxd, JSANDERS 3/10/2021

SOURCE: USGS, 2013; SFPUC, 2020; ESA, 2020

Ocean Beach Climate Change Adaptation Project

Figure 3-1b
Aquatic Resources Delineation Study Area

ESA

- **Sirdrak sand, 5 to 50 percent slopes**, is not listed as hydric by the NRCS. This map unit contains somewhat excessively drained sands found on dunes, and is formed from Eolian sands. It is comprised of approximately 85 percent Sirdrak and similar soils and eight percent minor components. Minor components include three percent beach, one percent unnamed, one percent dune land, one percent typic arguistolls, one percent of unnamed component found in tidal flats, and one percent urban land. The one percent of unnamed inclusion found in tidal flats is the only minor component listed as hydric.
- **Urban land**, is not listed as hydric by the NRCS. This map unit consists of approximately 85 percent urban land and 14 percent minor components. Minor components include seven percent reclaimed orthents and seven percent cut and fill orthents. Neither of these inclusions are listed as hydric.
- **Urban land-Sidrak complex, 2 to 50 percent slopes**, is not listed as hydric by the NRCS. This map unit consists of somewhat excessively drained sands found on beach terraces and dunes. It is comprised of approximately 45 percent urban land, 35 percent Sidrak and similar soils, and 20 percent of an unnamed component, which is not listed as hydric.
- **Beaches**, do not have a hydric rating by the NRCS.

3.4 Topography

Existing elevations described in this section within the study area are based on:

- the California Coastal Commission's 2009-2011 Lidar Coastal California dataset at the northern portion of the study area (North Ocean Beach):
- a digital elevation model dataset derived from a triangulated irregular network based on point cloud data collected at South Ocean Beach taken in April 2020 by ESA and,
- USGS Lidar taken in 2016 for the remainder of the site.

The vertical datums on elevation (EL) referred to in this document are in the North American Vertical Datum of 1988 (NAVD88), unless otherwise noted. The topography of the study area is static in many locations, but very dynamic in other locations.

The developed portions of the study area, including Great Highway, Sloat Boulevard, the San Francisco Zoo, and Fort Funston range from 18 feet in EL at the zoo south of Sloat Boulevard, increases to 32 feet EL at the intersection of Sloat Boulevard and the Great Highway, increases to 75 feet EL where the Great Highway runs along Fort Funston, and then drops down to 46 feet EL where the Great Highway intersects with Skyline Boulevard and the study area's southern-most extent ends.

The topography at South Ocean Beach is very dynamic. South Ocean Beach is generally characterized as an eroding shore composed of native and imported materials that were initially placed as fill during development of the Great Highway, and also as coastal armoring to manage the erosion hazards. Since then, several "soft armoring" efforts to prevent erosion of this area have included the placement of imported sand and sandbags.[11] The beach widths and elevations change seasonally at South Ocean Beach, with the widest and highest beach condition occurring during the late summer and fall, and the most eroded or narrow beach condition occurring during the late winter and through spring. ESA has documented the sandy beach elevation along portions of South Ocean Beach changing more than 10 feet in five months.[12] For the purposes of this delineation report, the elevation data utilized for South Ocean Beach was collected in April of 2020 to reflect seasonally eroded conditions, thereby capturing the extent of the water surface elevation in a typical year.

Additionally, the portion of North Ocean Beach that falls within the study area ranges from 15 feet EL to 20 feet EL. While North Ocean Beach generally experiences large seasonal deposition of sand, this portion of the beach is far enough away from the ocean that there is less seasonal change relative to South Ocean Beach. Overall, the elevations at North Ocean Beach are fairly static, and do not substantially change seasonally.

3.5 Hydrology

The study area falls within the San Francisco Coastal South USGS hydrologic unit (1805006), and within the Lake Merced Watershed. Much of the study area is impervious due to development, and so a large portion of the water that drains within this area is conveyed into the city's combined storm sewer system and treated at the Oceanside Water Pollution Control Plant before being discharged to the Pacific Ocean. Within the North Ocean Beach portion of the study area there are several scupper holes in the O'Shaughnessy Seawall which drain runoff from the adjacent sidewalk. Within the South Ocean Beach portion of the study area, there are also a few culverts and storm drains that discharge road runoff onto the beach. All of these drainage features were constructed in uplands, do not realign any natural features, do not support any wetland indicators, and solely convey storm water runoff and so are not considered aquatic resources and are not discussed further in this document.

3.6 Vegetation

The study area is in the San Francisco Bay Area subregion of the California Floristic Province.[13] Regional natural plant communities surrounding the study area include those that are common to the San Francisco Bay area such as grasslands, oak woodlands, chaparral, riparian woodlands, dune, and wetland communities, but these are not representative of the study area. Plant communities are assemblages of plant species that occur together, and are defined by species composition and relative abundance. The following upland communities occur within the study

[11] ESA, 2016. Memorandum of Approximate Sand Backpass Areas Relative to High Tide Line at South Ocean Beach; South Ocean Beach Short-Term Erosion Protection Measures Project (ESA Ref. #D120468.10).

[12] ESA, 2020. Ocean Beach Short-Term Erosion Protection Measures Project: 2019 – 2020 Monitoring Report. Prepared for San Francisco Public Utilities Commission.

[13] Baldwin, B.G., D.H. Goldman, D.J. Keil, R. Patterson, T.J. Rosatti, and D.H. Wilken, editors, 2012. The Jepson manual: Vascular plants of California, second edition. University of California Press, Berkeley, CA.

area, in addition to an unvegetated area associated with an aquatic feature, the Pacific Ocean, which is described in Chapter 4.

The beach and foredunes community occurs in the North Ocean Beach portion of the study area, and along a portion of South Ocean Beach inland of the high tide line and including on the terrace above the beach adjacent to the NPS parking lot. These areas are disturbed by tides and public access and consist primarily of barren sand, without vegetation.

The non-native dune mat community is dominated by the non-native, ice plant (*Carpobrotus edulis*; UPL), interspersed with bare sandy areas, as well as some non-native annual grasses and the native coast buckwheat (*Eriogonum latifolium*; UPL). This community is present along the Great Highway within the road medians and roadsides.

Developed and landscaped areas within and adjacent to the study area include roads, buildings, parking lots, paved surfaces, existing facilities and landscaping. These areas support a variety of ornamental trees and shrubs species that tolerate sandy soils. Monterey cypress (*Hesperocyparis macrocarpa*; UPL), a tree native to California but that is not locally native, is the most common species in this habitat. Additionally, the non-native ngaio (*Myoporum laetum*; FACU) and Australian tea tree (*Leptospermum laevigatum*; UPL) were noted. The understory of this habitat consists of litter and sparse vegetation in dense canopy areas and in more open canopy areas and on edges, the vegetation is similar to non-native dune mat community (annual grasses and ice plant).

3.7 Regulatory Setting

3.7.1 Rivers and Harbors Act of 1899

Section 10 of the Rivers and Harbors Act (RHA) (33 U.S.C. § 403) requires authorization from the USACE for work or structures in or affecting navigable waters of the U.S. The term "navigable waters of the U. S." generally includes those waters that are subject to the ebb and flow of the tide shoreward to the mean high water (MHW) and/or are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce. A determination of navigability, once made, applies laterally over the entire surface of the waterbody, and is not extinguished by later actions or events which impede or destroy navigable capacity (33 C.F.R. §329.4).

The MHW is the average of all of the daily tidal high water heights observed over the National Tidal Datum Epoch. The National Tidal Datum Epoch is the specific 19-year period adopted by the National Oceanic and Atmospheric Administration (NOAA) as the official time segment over which tide observations are taken and reduced to obtain mean values for tidal datums. The present National Tidal Datum Epoch is 1983 through 2001.

3.7.2 Waters of the U.S

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The basis of the CWA was enacted in 1948 and was called the Federal Water Pollution Control Act, but the Act was significantly reorganized and expanded in 1972. "Clean Water Act" became the Act's common name with amendments in 1972.

The code of federal regulations (CFR) defines features that are and are not waters of the U.S. and defines key terms at 33 CFR 328.3:

(a) ***Jurisdictional waters.*** For purposes of the Clean Water Act, 33 U.S.C. 1251 *et seq*. and its implementing regulations, subject to the exclusions in paragraph (b) of this section, the term "waters of the United States" means:

(1) The territorial seas, and waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including waters which are subject to the ebb and flow of the tide;

(2) Tributaries;

(3) Lakes and ponds, and impoundments of jurisdictional waters; and

(4) Adjacent wetlands.

(b) ***Non-jurisdictional waters.*** The following are not "waters of the United States":

(1) Waters or water features that are not identified in paragraph (a)(1), (2), (3), or (4) of this section;

(2) Groundwater, including groundwater drained through subsurface drainage systems;

(3) Ephemeral features, including ephemeral streams, swales, gullies, rills, and pools;

(4) Diffuse stormwater run-off and directional sheet flow over upland;

(5) Ditches that are not waters identified in paragraph (a)(1) or (2) of this section, and those portions of ditches constructed in waters identified in paragraph (a)(4) of this section that do not satisfy the conditions of paragraph (c)(1) of this section;

(6) Prior converted cropland;

(7) Artificially irrigated areas, including fields flooded for agricultural production, that would revert to upland should application of irrigation water to that area cease;

(8) Artificial lakes and ponds, including water storage reservoirs and farm, irrigation, stock watering, and log cleaning ponds, constructed or excavated in upland or in non-jurisdictional waters, so long as those artificial lakes and ponds are not impoundments of jurisdictional waters that meet the conditions of paragraph (c)(6) of this section;

(9) Water-filled depressions constructed or excavated in upland or in non-jurisdictional waters incidental to mining or construction activity, and pits excavated in upland or in non-jurisdictional waters for the purpose of obtaining fill, sand, or gravel;

(10) Stormwater control features constructed or excavated in upland or in non-jurisdictional waters to convey, treat, infiltrate, or store stormwater run-off;

(11) Groundwater recharge, water reuse, and wastewater recycling structures, including detention, retention, and infiltration basins and ponds, constructed or excavated in upland or in non-jurisdictional waters; and

(12) Waste treatment systems.

(c) ***Definitions.*** In this section, the following definitions apply:

(1) *High tide line*. The term *high tide line* means the line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the foreshore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency[14] but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds, such as those accompanying a hurricane or other intense storm.

(2) *Tidal waters* and *waters subject to the ebb and flow of the tide*. The terms *tidal waters* and *waters subject to the ebb and flow of the tide* mean those waters that rise and fall in a predictable and measurable rhythm or cycle due to the gravitational pulls of the moon and sun. Tidal waters and waters subject to the ebb and flow of the tide end where the rise and fall of the water surface can no longer be practically measured in a predictable rhythm due to masking by hydrologic, wind, or other effects.

(3) *Typical year*. The term *typical year* means when precipitation and other climatic variables are within the normal periodic range (*e.g.,* seasonally, annually) for the geographic area of the applicable aquatic resource based on a rolling thirty-year period.

(4) *Upland*. The term *upland* means any land area that under normal circumstances does not satisfy all three wetland factors (*i.e.,* hydrology, hydrophytic vegetation, hydric soils) identified in paragraph (c)(16) of this section, and does not lie below the ordinary high water mark or the high tide line of a jurisdictional water.

(5) *Wetlands*. The term *wetlands* means areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

The USACE determines areas that qualify as wetlands through the use of regional delineation manuals. Under normal circumstances, three indicators of wetlands must be present, hydric soils, hydrophytic vegetation, and wetland hydrology in order for an area to qualify as a wetland.[15]

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[14] For the analysis presented in this report, the high tide line is assumed to be equal to the annual astronomical high tide measured at the nearby San Francisco tide gage (NOAA Station 9414290) plus 0.1 feet to account for differences between the gage location and the study area. This 0.1 foot adjustment is consistent with the high tide height offset used by NOAA to convert high tide elevations from the San Francisco tide gage to the subsidiary "Ocean Beach, outer coast" tide station (NOAA Sta. 9414275).

[15] Environmental Laboratory, 1987. Corps of Engineers Wetlands Delineation Manual.

The limits of jurisdiction are identified in 33 CFR 328.4 as:

(a) ***Territorial Seas.*** The limit of jurisdiction in the territorial seas is measured from the baseline in a seaward direction a distance of three nautical miles. (See 33 CFR 329.12)

(b) ***Tidal Waters of the United States.*** The landward limits of jurisdiction in tidal waters:

(1) Extends to the high tide line, or

(2) When adjacent non-tidal waters of the United States are present, the jurisdiction extends to the limits identified in paragraph (c) of this section.

(c) ***Non-Tidal Waters of the United States.*** The limits of jurisdiction in non-tidal waters:

(1) In the absence of adjacent wetlands, the jurisdiction extends to the ordinary high water mark, or

(2) When adjacent wetlands are present, the jurisdiction extends beyond the ordinary high water mark to the limit of the adjacent wetlands.

(3) When the water of the United States consists only of wetlands the jurisdiction extends to the limit of the wetland.

3.7.3 Waters of the State

Section 401 of the CWA gives the state authority to grant, deny, or waive certification of proposed federally licensed or permitted activities resulting in discharge to waters of the U.S. The State Water Resources Control Board (SWRCB) directly regulates multi-regional projects and supports the Section 401 certification and wetlands program statewide. The Regional Water Quality Control Board (RWQCB) regulates activities pursuant to Section 401(a)(1) of the federal CWA, which specifies that certification from the State is required for any applicant requesting a federal license or permit to conduct any activity including but not limited to the construction or operation of facilities that may result in any discharge into navigable waters. The certification shall originate from the State or appropriate interstate water pollution control agency in/where the discharge originates or will originate. Any such discharge will comply with the applicable provisions of Sections 301, 302, 303, 306, and 307 of the CWA.

"Waters of the state" include all waters of the United States. In 2000, the SWRCB determined that all waters of the United States are also waters of the state by regulation, before any regulatory or judicial limitations on the federal definition of waters of the United States (California Code of Regulations Title 23, Section 3831(w)). This regulation has remained in effect despite subsequent changes to the federal definition.

Therefore, waters of the state include all of the following:

- Features determined by the U.S. Environmental Protection Agency or USACE to be "waters of the United States" in an approved jurisdictional determination.
- Waters of the United States upon which a USACE permitting decision was based.

- Features consistent with any current or historic final judicial interpretation of waters of the United States or any current or historic federal regulation defining waters of the United States under the federal CWA.

The SWRCB defines a wetland as follows:

> An area is wetland if, under normal circumstances, (1) the area has continuous or recurrent saturation of the upper substrate caused by groundwater, or shallow surface water, or both; (2) the duration of such saturation is sufficient to cause anaerobic conditions in the upper substrate; and (3) the area's vegetation is dominated by hydrophytes or the area lacks vegetation.

Based on the new statewide wetland definition, all of the following wetlands are defined as waters of the state:

1. Natural wetlands,
2. Wetlands created by modification of a surface water of the state, and
3. Artificial wetlands that meet any of the criteria within the California Code of Regulations Title 23, Section 3831(w).

3.7.4 California Coastal Act

Wetlands and other waters in California's Coastal Zone are regulated under the California Coastal Act (CCA) of 1976. The CCC broadly defines wetlands under the Coastal Act (Cal. Pub. Res. Code §30121) as follows:

> Wetland means lands within the coastal zone which may be covered periodically or permanently with shallow water and include saltwater marshes, freshwater marshes, open or closed brackish water marshes, swamps, mudflats, or fens.

The CCC regulations (California Code of Regulations Title 14 (14 CCR §13577)) provide further information regarding those aquatic features that are regulated as wetlands for purposes of the California Coastal Act:

> Wetland shall be defined as land where the water table is at, near, or above the land surface long enough to promote the formation of hydric soils or to support the growth of hydrophytes, and shall also include those types of wetlands where vegetation is lacking and soil is poorly developed or absent as a result of frequent and drastic fluctuations of surface water levels, wave action, water flow, turbidity or high concentrations of salts or other substances in the substrate. Such wetlands can be recognized by the presence of surface water or saturated substrate at some time during each year and their location within, or adjacent to, vegetated wetlands or deep-water habitats.

The Coastal Act policies govern the types of developments and uses allowed within wetlands and other waters within the Coastal Zone, including open coastal waters. Along the Pacific Ocean coast, open coastal waters extend from the MHW line to the State's outer limit of jurisdiction (approximately 3 miles offshore).

CHAPTER 4
Results

Results of the field delineation, tidal information used to derive the MHW and HTL, and mapping of aquatic resources are presented below and in **Figures 4-1a**, **4-1b**, **and 4-1c**. Supporting information, such as Arid West data sheets, a soils report, a rainfall summary, the Aquatic Resources Upload Sheet (ORM data sheet), and representative photographs for the delineation study area are in **Appendices A** through **E**.

The only aquatic resource that occurs within the study area is the Pacific Ocean. Four sample points were taken at sites representative of the vegetation, hydrology, and physical characteristics (the three wetland parameters) across the study area. All data collected outside of the Pacific Ocean resulted in all such areas being classified as upland, not aquatic features. Additionally, no sample point met any of the three wetland parameters.

4.1 The Pacific Ocean

The Pacific Ocean is classified as *Marine* (M) using the *Classification of Wetlands and Deepwater Habitats of the United States* ("Cowardin Classification").[16] Portions of the Pacific Ocean that occur within the study area (South Ocean Beach) can be considered subtidal or intertidal, depending on the elevation and time of year.

Based on the tidal information from the San Francisco tide gage (NOAA Station 9414290), a HTL elevation of 7.4 feet was selected for the study area by adjusting the highest astronomical tide of 7.3 feet EL at the San Francisco tide gage upward by 0.1 feet, consistent with the high tide height offset used by NOAA to convert high tide elevations to the subsidiary "Ocean Beach, outer coast" tide station (NOAA Sta. 9414275). Refer to Section 3.7.2 for additional information about the HTL. Collected field data corresponded with this elevation mapped on topographic data captured in April of 2020. Because the location of a wrack line, which can indicate the location of the HTL, can also be influenced by storm surges, field observations of the HTL mainly focused on drainage patterns and saturation. The topographic data (captured in April of 2020) and field observations (captured in December 2020) support a mapping of a HTL at 7.4 feet EL which is reflective of the normal and predicted reach of the HTL in a given year. The MHW elevation of 5.3 feet identified in this report is the value calculated by NOAA for the San Francisco tide gage, adjusted as described for the HTL (refer to Section 3.8.1 for information about NOAA's

[16] Federal Geographic Data Committee (FGDC), 2013. Classification of wetlands and deepwater habitats of the United States. FGDC-STD-004-2013. Second Edition. Wetlands Subcommittee, Federal Geographic Data Committee and U.S. Fish and Wildlife Service, Washington DC.

calculation of MHW). MHW was used to calculate the subset area of the Pacific Ocean detailed in the next section.

It is important to note the beach widths and elevations change seasonally in this area, with the widest and highest beach condition occurring during the late summer and fall, and the most eroded or narrow beach condition occurring during the late winter and through spring. If the Pacific Ocean were to be mapped during the late summer or fall, also utilizing topographic data captured around the same time, the fall HTL/MHW would be mapped to the west of where it was in this report and would not occur within the study area. Because the seasonal changes in topography occur within a typical year, the HTL/MHW mapped in this report should reflect the normal and predicted reach of the tide in a given year and thus account for such seasonal changes in topography.

4.2 Analysis of Jurisdiction

Besides the Pacific Ocean, there are no other mapped aquatic features within the study area, not even features that support one wetland indicator (see **Appendix A** for Wetland Delineation Data Forms). The mapped portion of the Pacific Ocean in the study area is a waters of the U.S. pursuant to 33 CFR 328.3(a)(1) up to the HTL, which accounts for 214.41 acres (9,339,840 square feet). Waters of the state include all waters of the U.S., and so this mapped portion of the Pacific Ocean within the study area is also considered a waters of the state. Thus, this area is subject to USACE and RWQCB jurisdiction under CWA Sections 404 and 401. Additionally, a subset of this mapping, up to the MHW, is considered a navigable waters of the state, which accounts for 212.16 acres (9,241,620 square feet). As such, this area falls under USACE's RHA Section 10 jurisdiction, and would also be subject to CCC's Coastal Act jurisdiction over open coastal waters. This assessment is based on the best professional judgment of ESA investigators. All conclusions presented should be considered preliminary and subject to change pending official review and verification in writing by the agency with relevant jurisdiction.

SOURCE: Maxar Imagery, 09/24/2019; CCC, 2011; ESA, 2021

Ocean Beach Climate Change Adaptation Project

Coordinate System: NAD 83
Projection: Lambert Confromal Conic
Datum: CA SP III, US foot
Vertical Datum: NAVD88

Study Area (258.3 ac)
Reference Points
High Tide Line (7.4 feet EL)
Mean Higher Water (5.3 Feet EL)
Photo Location/Orientation

Aquatic Resources Outside the Study Area
Pacific Ocean

ESA

Figure 4-1a (North OB)
Delineation of Wetlands and Other Waters of the U.S.

Delineated by: J. Sanders
Mapping by: J. Sanders
Created on: 01/06/2021

SOURCE: Maxar Imagery, 09/24/2019; ESA, 2020; ESA, 2021

Ocean Beach Climate Change Adaptation Project

Coordinate System: NAD 83
Projection: Lambert Confromal Conic
Datum: CA SP III, US foot
Vertical Datum: NAVD88

Study Area (258.3 ac)
Reference Points
High Tide Line (7.4 feet EL)
Mean Higher Water (5.3 Feet EL)
Photo Location/Orientation

Aquatic Resources Within the Study Area
Pacific Ocean (area mapped to HTL: 214.41 ac; 9,339,840 sqft)
Aquatic Resources Outside the Study Area
Pacific Ocean

ESA

Figure 4-1b (South OB)
Delineation of Wetlands and Other Waters of the U.S.

Delineated by: J. Sanders
Mapping by: J. Sanders
Created on: 01/06/2021

Path: U:\GIS\GIS\Projects\12xxx\D120468.23_SouthOceanBeach\03_MXDs_Projects\WetlandDelin2020\Fig4-1c.mxd, JSANDERS 3/10/2021

SOURCE: Maxar Imagery, 09/24/2019; ESA, 2020; ESA, 2021

Coordinate System: NAD 83
Projection: Lambert Confromal Conic
Datum: CA SP III, US foot
Vertical Datum: NAVD88

Study Area (258.3 ac)

Aquatic Resources Within the Study Area

Pacific Ocean (area mapped to HTL: 214.41 ac; 9,339,840 sqft)

Aquatic Resources Outside the Study Area

Pacific Ocean

ESA

Ocean Beach Climate Change Adaptation Project

Figure 4-1c (Pacific Ocean)
Delineation of Wetlands and Other Waters of the U.S.

Delineated by: J. Sanders
Mapping by: J. Sanders
Created on: 01/06/2021

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CHAPTER 5
Report Preparers

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Appendix A
Wetland Delineation Datasheets

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Ocean Beach Climate Adaptation Project City/County: San Francisco Sampling Date: 12/09/2020

Applicant/Owner: SFPUC State: CA Sampling Point: 001

Investigator(s): Joseph Sanders Section, Township, Range: ______

Landform (hillslope, terrace, etc.): hill slope Local relief (concave, convex, none): convex Slope (%): 2

Subregion (LRR): C Lat: 37.72625352 Long: -122.50458887 Datum: NAD83

Soil Map Unit Name: Sirdrak sand, 5 to 50 percent slopes NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No ✔
Hydric Soil Present?	Yes ___	No ✔
Wetland Hydrology Present?	Yes ___	No ✔

Is the Sampled Area within a Wetland? **Yes** ___ **No** ✔

Remarks:

while this area is at the toe of a slope, its more microtopography is convex

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
= Total Cover	0		
Sapling/Shrub Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
5.			
= Total Cover	0		
Herb Stratum (Plot size: 1x1m)			
1. Juncus lescurii	4	Yes	FACW
2. Carpobrotus edulis	2		UPL
3. Hordeum marinum	3	Yes	FACU
4. Medicago polymorpha	5	Yes	FACU
5. Plantago maritima	1		FACW
6.			
7.			
8.			
= Total Cover	15		
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
= Total Cover	0		

% Bare Ground in Herb Stratum ___ % Cover of Biotic Crust ___

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 1 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 33 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species		x 2 = 0
FAC species		x 3 = 0
FACU species		x 4 = 0
UPL species		x 5 = 0
Column Totals:	0 (A)	0 (B)

Prevalence Index = B/A = NaN

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ___ **No** ✔

Remarks:

SOIL

Sampling Point: 001

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR 3/2	100					sand	
5-18	10YR3/2	100					sand	70% sand, 30% gravel

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ______ No ✔

Remarks:

no hydric soils indicators present

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ______ No ✔ Depth (inches): ______

Water Table Present? Yes ______ No ✔ Depth (inches): ______

Saturation Present? (includes capillary fringe) Yes ______ No ✔ Depth (inches): ______

Wetland Hydrology Present? Yes ______ No ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

no signs of hydrology present

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Ocean Beach Climate Adaptation Project City/County: San Francisco Sampling Date: 12/09/2020

Applicant/Owner: SFPUC State: CA Sampling Point: 002

Investigator(s): Joseph Sanders Section, Township, Range: ______

Landform (hillslope, terrace, etc.): road median Local relief (concave, convex, none): concave Slope (%): 0

Subregion (LRR): C Lat: 37.73098047 Long: -122.50653053 Datum: NAD83

Soil Map Unit Name: beaches NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___ No ✔	Is the Sampled Area within a Wetland? Yes ___ No ✔
Hydric Soil Present?	Yes ___ No ✔	
Wetland Hydrology Present?	Yes ___ No ✔	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ___)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	0 = Total Cover		
Sapling/Shrub Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
5.			
	0 = Total Cover		
Herb Stratum (Plot size: 1x1m)			
1. Carpobrotus edulis	60	No	UPL
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	60 = Total Cover		
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum ______ % Cover of Biotic Crust ______

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species		x 2 = 0
FAC species		x 3 = 0
FACU species		x 4 = 0
UPL species		x 5 = 0
Column Totals:	0 (A)	0 (B)

Prevalence Index = B/A = NaN

Hydrophytic Vegetation Indicators:

___ Dominance Test is >50%

___ Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ___ No ✔

Remarks:

SOIL

Sampling Point: 002

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-12	10YR 3/2	100					sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ___ **No** ✔

Remarks:

no signs of hydric soils

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✔ Depth (inches): ______

Water Table Present? Yes ___ No ✔ Depth (inches): ______

Saturation Present? (includes capillary fringe) Yes ___ No ✔ Depth (inches): ______

Wetland Hydrology Present? **Yes** ___ **No** ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

no signs of hydrology

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Ocean Beach Climate Adaptation Project City/County: San Francisco Sampling Date: 12/09/2020

Applicant/Owner: SFPUC State: CA Sampling Point: 003

Investigator(s): Joseph Sanders Section, Township, Range: ______

Landform (hillslope, terrace, etc.): flat Local relief (concave, convex, none): concave Slope (%): 0

Subregion (LRR): C Lat: 37.76723723 Long: 37.76723723 Datum: NAD83

Soil Map Unit Name: none NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No ____ (If no, explain in Remarks.)

Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No ____

Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No ✔
Hydric Soil Present?	Yes ____	No ✔
Wetland Hydrology Present?	Yes ____	No ✔

Is the Sampled Area within a Wetland? **Yes** ____ **No** ✔

Remarks:

open beach, uphill of the HTL

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ____)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	0 = Total Cover		
Sapling/Shrub Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
	0 = Total Cover		
Herb Stratum (Plot size: ____)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
	0 = Total Cover		
Woody Vine Stratum (Plot size: ____)			
1.			
2.			
	0 = Total Cover		

% Bare Ground in Herb Stratum ____ % Cover of Biotic Crust ____

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 0 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: NaN (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species		x 2 = 0
FAC species		x 3 = 0
FACU species		x 4 = 0
UPL species		x 5 = 0
Column Totals:	0 (A)	0 (B)

Prevalence Index = B/A = NaN

Hydrophytic Vegetation Indicators:

- ___ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ____ **No** ✔

Remarks:

no vegetation present

SOIL

Sampling Point: 003

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
0-12	10YR 3/2	100					sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ____________

Depth (inches): ____________

Hydric Soil Present? **Yes** ______ **No** ✔

Remarks:

no signs of hydric soils

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ______	No ✔	Depth (inches): ______
Water Table Present?	Yes ______	No ✔	Depth (inches): ______
Saturation Present? (includes capillary fringe)	Yes ______	No ✔	Depth (inches): ______

Wetland Hydrology Present? **Yes** ______ **No** ✔

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

no signs of hydrology

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Ocean Beach Climate Adaptation Project City/County: San Francisco Sampling Date: 12/09/2020

Applicant/Owner: SFPUC State: CA Sampling Point: 004

Investigator(s): Joseph Sanders Section, Township, Range: ______

Landform (hillslope, terrace, etc.): road median, hill slope Local relief (concave, convex, none): concave Slope (%): 2

Subregion (LRR): C Lat: 37.72557402 Long: -122.50379210 Datum: NAD83

Soil Map Unit Name: Sirdrak sand, 5 to 50 percent slopes NWI classification: none

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No ✔
Hydric Soil Present?	Yes ___	No ✔
Wetland Hydrology Present?	Yes ___	No ✔

Is the Sampled Area within a Wetland? **Yes** ___ **No** ✔

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ______)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
= Total Cover	0		
Sapling/Shrub Stratum (Plot size: ______)			
1.			
2.			
3.			
4.			
5.			
= Total Cover	0		
Herb Stratum (Plot size: 1x1m)			
1. Carpobrotus edulis	60	Yes	UPL
2. Eriogonum linatum	3		UPL
3.			
4.			
5.			
6.			
7.			
8.			
= Total Cover	63		
Woody Vine Stratum (Plot size: ______)			
1.			
2.			
= Total Cover	0		

% Bare Ground in Herb Stratum ______ % Cover of Biotic Crust ______

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	0	(A)
Total Number of Dominant Species Across All Strata:	1	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	0	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 = 0
FACW species		x 2 = 0
FAC species		x 3 = 0
FACU species		x 4 = 0
UPL species		x 5 = 0
Column Totals:	0 (A)	0 (B)

Prevalence Index = B/A = NaN

Hydrophytic Vegetation Indicators:

- ___ Dominance Test is >50%
- ___ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ___ **No** ✔

Remarks:

SOIL

Sampling Point: 004

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-12	10YR 3/2	100					sand	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5) (**LRR C**)
___ 1 cm Muck (A9) (**LRR D**)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Loamy Mucky Mineral (F1)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)
___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

___ 1 cm Muck (A9) (**LRR C**)
___ 2 cm Muck (A10) (**LRR B**)
___ Reduced Vertic (F18)
___ Red Parent Material (TF2)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______________________

Depth (inches): ______________________

Hydric Soil Present? Yes ______ No ✔

Remarks:

no signs of hydric soils

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1) (**Nonriverine**)
___ Sediment Deposits (B2) (**Nonriverine**)
___ Drift Deposits (B3) (**Nonriverine**)
___ Surface Soil Cracks (B6)
___ Inundation Visible on Aerial Imagery (B7)
___ Water-Stained Leaves (B9)
___ Salt Crust (B11)
___ Biotic Crust (B12)
___ Aquatic Invertebrates (B13)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres along Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Thin Muck Surface (C7)
___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

___ Water Marks (B1) (**Riverine**)
___ Sediment Deposits (B2) (**Riverine**)
___ Drift Deposits (B3) (**Riverine**)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Shallow Aquitard (D3)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ______ No ✔ Depth (inches): ____________

Water Table Present? Yes ______ No ✔ Depth (inches): ____________

Saturation Present? (includes capillary fringe) Yes ______ No ✔ Depth (inches): ____________

Wetland Hydrology Present? Yes ______ No ✔

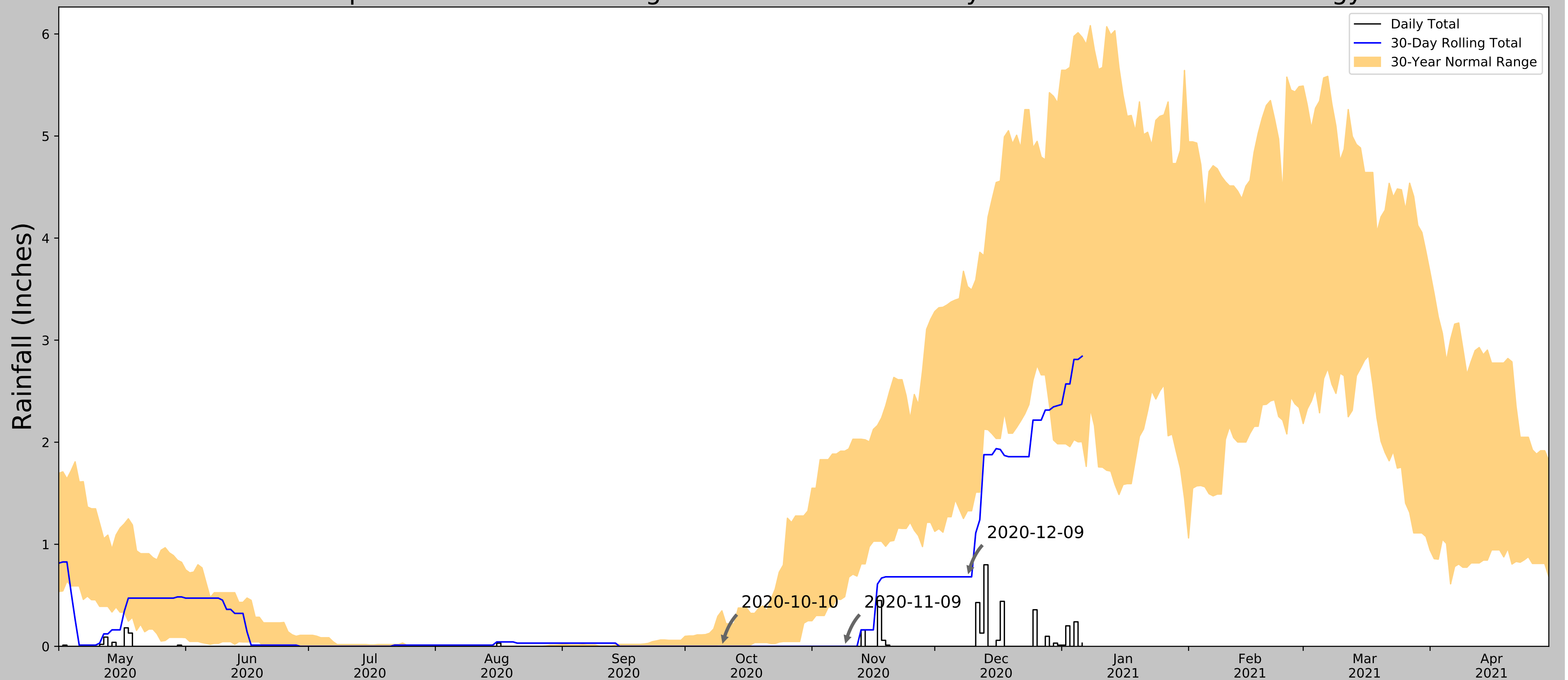
Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

no signs of hydrology

Appendix B
Antecedent Precipitation Tool Results and WETS Table

Antecedent Precipitation vs Normal Range based on NOAA's Daily Global Historical Climatology Network



Coordinates	37.72597399, -122.50296237
Observation Date	2020-12-09
Elevation (ft)	45.73
Drought Index (PDSI)	Moderate drought
WebWIMP H_2O Balance	Wet Season

30 Days Ending	30^{th} %ile (in)	70^{th} %ile (in)	Observed (in)	Wetness Condition	Condition Value	Month Weight	Product
2020-12-09	1.327953	3.525197	0.681102	Dry	1	3	3
2020-11-09	0.48622	1.912205	0.0	Dry	1	2	2
2020-10-10	0.01378	0.348032	0.0	Dry	1	1	1
Result							Drier than Normal - 6

Figure and tables made by the **Antecedent Precipitation Tool** Version 1.0

Written by Jason Deters
U.S. Army Corps of Engineers

Weather Station Name	Coordinates	Elevation (ft)	Distance (mi)	Elevation Δ	Weighted Δ	Days (Normal)	Days (Antecedent)
SAN FRANCISCO OCEANSIDE	37.7281, -122.5053	7.874	0.195	37.856	0.095	10466	81
SAN FRANCISCO 3.0 W	37.7776, -122.4741	205.053	3.9	159.323	2.376	16	0
SAN FRANCISCO 2.8 WNW	37.7834, -122.4701	172.9	4.355	127.17	2.514	168	0
SAN FRANCISCO 1.1 SW	37.765, -122.4348	193.898	4.598	148.168	2.75	253	9
SAN FRANCISCO DWTN	37.7706, -122.4269	149.934	5.174	104.204	2.868	450	0

WETS Table

WETS Station: SAN FRANCISCO OCEANSIDE, CA

Requested years: 1971 - 2019

Month	Avg Max Temp	Avg Min Temp	Avg Mean Temp	Avg Precip	30% chance precip less than	30% chance precip more than	Avg number days precip 0.10 or more	Avg Snowfall
Jan	58.1	44.4	51.2	3.51	1.53	4.15	6	0.0
Feb	59.9	46.1	53.0	3.76	1.83	4.53	7	0.0
Mar	60.3	47.0	53.7	2.91	1.09	3.32	6	0.0
Apr	60.3	47.8	54.1	1.24	0.52	1.44	3	0.0
May	60.4	49.8	55.1	0.50	0.10	0.43	1	0.0
Jun	61.7	51.6	56.7	0.10	0.00	0.08	0	0.0
Jul	62.5	53.6	58.0	0.02	0.00	0.00	0	0.0
Aug	63.7	54.8	59.2	0.06	0.00	0.02	0	0.0
Sep	65.5	54.3	59.9	0.15	0.00	0.13	1	0.0
Oct	65.9	52.3	59.1	0.87	0.32	0.88	2	0.0
Nov	62.8	48.5	55.6	2.50	1.08	3.04	5	0.0
Dec	58.3	44.6	51.5	3.94	1.88	4.75	7	0.0
Annual:					14.62	22.16		
Average	61.6	49.6	55.6	-	-	-	-	-
Total	-	-	-	19.55			38	0.0

GROWING SEASON DATES

Years with missing data:	24 deg = 30	28 deg = 32	32 deg = 30
Years with no occurrence:	24 deg = 19	28 deg = 17	32 deg = 12
Data years used:	24 deg = 19	28 deg = 17	32 deg = 19
Probability	24 F or higher	28 F or higher	32 F or higher
50 percent *	Insufficient data	Insufficient data	Insufficient data
70 percent *	Insufficient data	Insufficient data	Insufficient data

* Percent chance of the growing season occurring between the Beginning and Ending dates.

STATS TABLE - total precipitation (inches)

Yr	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annl
1948							0.00	0.01	0.03	0.24	0.93	4.93	6.14
1949	2.19	M2.42	5.20	0.00	1.68	0.00	0.05	0.02	0.00	0.15	1.65	2.44	15.80
1950	6.63	M2.77	1.90	1.09	0.29	0.11	0.00	0.00	0.00	2.99	5.35	5.86	26.99
1951	3.86	3.10	1.45	0.73	0.66		0.00		0.05				9.85
1952													
1953													
1954													
1955													
1956													
1957													
1958												1.80	1.80
1959	3.75	4.74	0.39	0.74	0.03	0.00	0.00	0.00	2.05	0.06	0.00	1.61	13.37

1960	4.25	3.25	2.09	1.24	1.05	0.00	0.00	0.00	0.00	0.48	2.85	2.59	17.80
1961	2.42	1.35	2.59	0.82	0.68	0.00	0.00	0.03	0.20	0.09	4.70	2.14	15.02
1962	1.33	7.17	2.36	0.54	T	0.00	T	0.00	0.15	7.94	0.00	3.75	23.24
1963	4.45	2.00	4.65	3.23	0.55	0.00	0.00	0.00	0.36	1.78	3.12	0.86	21.00
1964	3.45	0.29	1.79	0.02	0.18	0.52	0.06	T	0.00	1.58	3.75	5.25	16.89
1965	4.49	0.96	2.71	3.57	T	0.01	T	1.20	0.00	T	5.19	3.81	21.94
1966	3.35	3.30	0.70	0.72	0.25	0.22	0.02	0.31	0.10	T	4.82	3.74	17.53
1967	10.17	0.45	4.26	5.24	0.15	1.89	0.00	0.00	0.05	0.68	1.02	2.11	26.02
1968	5.02	2.77	3.41	0.26	0.16	T	0.01	0.10	0.05	0.73	3.26	4.87	20.64
1969	7.36	7.20	1.00	1.87	0.02	0.05	0.00	0.00	0.10	2.84	0.93	5.96	27.33
1970	7.67	2.15	1.94	0.03	0.12	0.80	0.00	0.00	0.00	0.79	6.58	5.62	25.70
1971	2.22	0.38	3.25	0.97	0.42	0.04	0.01	0.01	0.22	0.13	1.66	4.42	13.73
1972	1.24	1.50	0.29	0.99	0.00	0.14	0.00	0.04	0.80	4.87	5.97	3.06	18.90
1973	9.26	6.29	2.44	0.01	0.08	0.00	0.00	T	0.33	1.64	7.30	4.11	31.46
1974	3.96	1.84	5.35	2.30	0.00	0.14	0.55	0.00	0.00	0.65	0.35	2.25	17.39
1975	2.41	4.91	5.48	0.93	0.04	0.00	0.22	0.03	0.00	2.10	0.46	0.45	17.03
1976	0.40	2.02	1.07	2.68	0.08	0.01	0.00	0.69	0.15	0.48	1.20	3.02	11.80
1977	1.53	0.72	2.22	0.04	0.64	0.00	0.00	0.02	0.49	0.15	2.57	3.38	11.76
1978			4.98	3.91	T	0.00	0.00	0.00	0.00	0.00	1.13	0.62	10.64
1979	M0.00			M0.00	M0.00	0.00	0.00	0.00	0.00	1.58			1.58
1980				1.15	M0.00	0.00	0.00	0.00	0.00	0.00	0.47	1.79	3.41
1981	4.74	1.99	4.36	0.10	0.20	0.00		0.00	0.33	M0.00	5.04	5.53	22.29
1982		M0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54		5.82		6.36
1983	5.64	7.83	9.74	2.83	0.56		M0.00	0.16	0.28	0.82	2.19	6.15	36.20
1984	0.60	2.07	0.00				M0.21				6.75	M2.07	11.70
1985				M0.00	0.03	0.00	M0.05					M1.59	1.67
1986	4.80	7.99	M5.71		M0.14	0.00	0.00		0.00				18.64
1987													
1988					M0.66	0.35	0.00	M0.00	0.00	M0.68		M4.09	5.78
1989	1.22	1.32	5.11	0.68	0.02	0.10	0.00	M0.07	M1.13	M1.21	1.45	0.00	12.31
1990	2.98	1.96	1.04	M0.46	1.90	0.00	0.00	0.00	0.02	0.14	0.52	1.71	10.73
1991	0.48	3.76	6.03	1.01	0.50	0.12	0.00	0.48	0.00	1.80	0.33	3.08	17.59
1992	1.34	5.35	4.41	0.45	0.00	M0.32	0.00	M0.02	M0.00		0.38	4.65	16.92
1993	9.97	4.08	M1.83	0.55	M0.84		0.00			0.30	M2.22	M2.09	21.88
1994	2.01	3.37	0.15	0.91	1.24	0.05	0.00	0.00	0.	0.	4.74	3.	15.

									10	06		02	65
1995	9.06	0.74	6.87	1.43	0.61	0.53	0.00	0.00	0.00	0.05	0.02	6.88	26.19
1996	5.58	4.75	1.27	1.80	1.66	0.00	0.00	0.00	0.02	0.95	3.19	6.72	25.94
1997	8.00	0.22	0.30	0.32	0.15	0.32	0.00	0.75	0.06	0.76	6.69	2.39	19.96
1998	9.15	13.90	2.48	1.31	3.68	0.03	0.00	0.00	0.03	0.70	3.57	0.95	35.80
1999	3.67	5.47	1.98	2.09	0.06	0.06	0.00	0.02	0.04	0.67	1.31	0.38	15.75
2000	5.97	8.24	2.00	2.07	1.29	0.10	0.00	0.00	0.24	2.21	M0.69	0.53	23.34
2001	3.05	5.70	1.14	1.54	0.00	M0.08	0.00	0.00	M0.10	0.30	M4.86	M9.44	26.21
2002	1.81	2.03	1.90	0.33	0.65	0.00	0.00	0.00	0.00	0.00	M1.96	10.33	19.01
2003	1.58	2.19	1.34	2.50	0.81	0.00	0.00	0.00	0.00	0.00	0.82	6.34	15.58
2004	3.19	5.29	0.86				0.00	0.00	M0.00			4.21	13.55
2005	M2.26	M3.14	4.01	1.85	1.48	1.12	0.01	0.02	0.03	0.31	1.72	9.93	25.88
2006	2.93	M2.65	8.20			M0.00	M0.00	0.00	0.00	0.48	2.60	4.65	21.51
2007	0.62	M3.72	M0.29	M1.10	0.35	0.00	0.06	0.00	M0.07	2.75	1.86	M3.96	14.78
2008	M6.73	2.14	0.11	0.16	0.00	0.00	0.01	0.04	0.00	0.00	2.27	2.93	14.39
2009	0.78	7.74	0.00	0.31	0.85	0.00	0.04	0.00	0.38	3.39	0.54	2.80	16.83
2010	7.83	M3.46		3.14	M0.32	M0.03	0.00	0.00	0.00		M3.07	M7.36	25.21
2011	1.00	M4.38	7.28		M1.14	M2.38	M0.09	M0.01	0.00	M2.03	M2.88	M0.24	21.43
2012	M2.85	M0.95	M6.54	M1.28	0.02	0.10	0.00	0.00	0.00	1.59	5.98	8.75	28.06
2013	0.56	0.86	M0.41	0.85	M0.05	0.23	0.00	0.06	0.55	0.00	0.95	0.42	4.94
2014	0.08	5.43	3.06	1.44	0.20	0.00	0.00	0.00	0.39	0.55	1.75	12.16	25.06
2015	0.00	1.48	0.04	1.27	0.03	0.10	0.04	0.02	M0.05	0.00	M0.97	M3.50	7.50
2016	5.79	0.94	5.75	0.96	0.10	0.02	0.00	M0.00	0.00	2.95	1.82	4.98	23.31
2017	8.40	7.76	3.74	2.31	0.00	0.20	0.00	0.00	0.34	0.00	3.28	0.17	26.20
2018	4.46	0.46	4.16	3.81	0.02	0.00	0.00	0.01	0.06	0.37	3.24	1.81	18.40
2019	0.00	8.37	4.36	0.36	1.83	0.00	0.00	0.00	0.00	0.00	1.21	2.78	18.91
2020	0.00	0.00	3.34		0.48	0.00	0.01	0.03	0.00	0.00	0.68		4.54

Notes: Data missing in any month have an "M" flag. A "T" indicates a trace of precipitation.

Data missing for all days in a month or year is blank.

Creation date: 2016-07-22

Appendix C
Soils Report

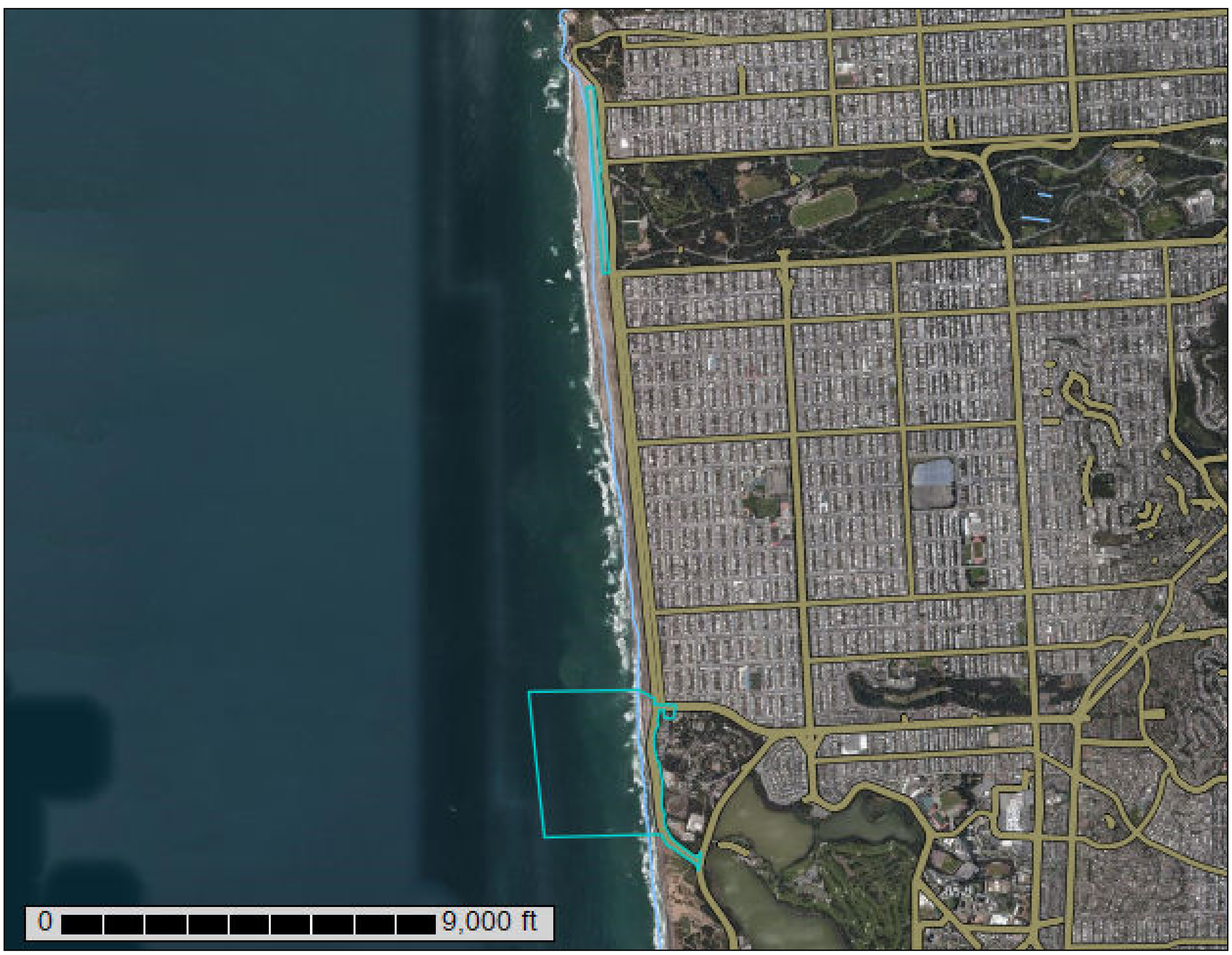
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for San Francisco County, California



January 19, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:33,500 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 450, 900, 1800, 2700

Feet: 0, 1500, 3000, 6000, 9000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Mateo County, Eastern Part, and San Francisco County, California
Survey Area Data: Version 16, May 29, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 29, 2019—Jun 5, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
129	Sirdrak sand, 5 to 50 percent slopes	4.9	1.9%
131	Urban land	4.7	1.8%
136	Urban land-Sirdrak complex, 2 to 50 percent slopes	5.3	2.0%
138	Beaches	27.8	10.7%
Totals for Area of Interest		**258.4**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Mateo County, Eastern Part, and San Francisco County, California

129—Sirdrak sand, 5 to 50 percent slopes

Map Unit Setting

National map unit symbol: h9hc
Elevation: 20 to 700 feet
Mean annual precipitation: 20 to 25 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 300 to 350 days
Farmland classification: Not prime farmland

Map Unit Composition

Sirdrak and similar soils: 85 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sirdrak

Setting

Landform: Dunes
Landform position (three-dimensional): Tread
Down-slope shape: Convex
Across-slope shape: Concave
Parent material: Eolian sands

Typical profile

H1 - 0 to 17 inches: sand
H2 - 17 to 60 inches: sand

Properties and qualities

Slope: 5 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Beaches

Percent of map unit: 3 percent
Landform: Beaches
Hydric soil rating: Yes

Unnamed

Percent of map unit: 1 percent
Hydric soil rating: No

Dune land

Percent of map unit: 1 percent
Hydric soil rating: No

Typic argiustolls

Percent of map unit: 1 percent
Hydric soil rating: No

Unnamed

Percent of map unit: 1 percent
Landform: Tidal flats
Hydric soil rating: Yes

Urban land

Percent of map unit: 1 percent
Hydric soil rating: No

131—Urban land

Map Unit Setting

National map unit symbol: h9hf
Elevation: 10 to 320 feet
Mean annual precipitation: 15 to 30 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 275 to 350 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 85 percent
Minor components: 14 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform position (two-dimensional): Toeslope

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: No

Minor Components

Orthents, reclaimed

Percent of map unit: 7 percent
Hydric soil rating: No

Orthents, cut&fill

Percent of map unit: 7 percent
Hydric soil rating: No

136—Urban land-Sirdrak complex, 2 to 50 percent slopes

Map Unit Setting

National map unit symbol: h9hl
Elevation: 10 to 800 feet
Mean annual precipitation: 15 to 25 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 300 to 350 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 45 percent
Sirdrak and similar soils: 35 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform: Beach terraces, dunes

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydric soil rating: No

Description of Sirdrak

Setting

Landform: Beach terraces, dunes
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

H1 - 0 to 17 inches: sand
H2 - 17 to 60 inches: sand

Properties and qualities

Slope: 2 to 50 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Unnamed

Percent of map unit: 10 percent
Hydric soil rating: No

Unnamed

Percent of map unit: 10 percent
Hydric soil rating: No

138—Beaches

Map Unit Composition

Beaches: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Beaches

Setting

Landform: Beaches
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Convex

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Appendix D

U.S. Army Corps of Engineers Regulatory Data Management System Spreadsheet

ESA

Waters_Name	State	Cowardin_Code	HGM_Code	Meas_Type	Amount	Units	Waters_Type	Latitude	Longitude	Local_Waterway
Pacific Ocean	CALIFORNIA	M2US	ESTUARINEF	Area	214.41	ACRE	TNW	37.73199217	-122.5461529	

Appendix E

Representative Photographs (Figures 4-1a and 4-1b depict photo locations)

ESA

Photograph 1 (P1)
Photo of developed/landscaped areas.

Photograph 2 (P2)
Photo of South Ocean Beach

Photograph 3 (P3)
Photo of South Ocean Beach

Photograph 4 (P4)
Photo of upland data point 002.

Photograph 5 (P5)
Photo of upland data point 001.

Photograph 6 (P6)
Photo of upland data point 004.

Photograph 7 (P7)
Photo of upland data point 003.

APPENDIX G
AIR QUALITY TECHNICAL MEMORANDUM AND HEALTH RISK ASSESSMENT

ESA

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Technical Memorandum

date November 3, 2021

to Julie Moore, San Francisco Planning Department

from Matt Fagundes, Sarah Patterson, and Elijah Davidian, ESA

subject Ocean Beach Climate Change Adaptation Project - Air Quality Technical Memorandum and Health Risk Assessment

1. Introduction

1.1 Project Understanding

The City and County of San Francisco (the city) is proposing a coastal adaptation and sea level rise resiliency project to improve the portion of Ocean Beach from Sloat Boulevard to Fort Funston known as "South Ocean Beach." The Ocean Beach Climate Change Adaptation Project (the project) is needed to address shoreline erosion, severe coastal storm and wave hazards, and sea level rise, which threaten city infrastructure, coastal access and recreational facilities, and public safety. Major project components include: (1) permanently closing the Great Highway between Sloat and Skyline boulevards, and reconfiguring affected intersections and San Francisco Zoo parking access; (2) removing pavement, rock and sandbag revetments,[1] rubble and debris, re-contouring the bluff, and planting dune vegetation; (3) improving public access, maintaining coastal parking and continuing to provide restroom facilities; (4) constructing a buried wall to protect existing sewer infrastructure from shoreline erosion; and (5) long-term *beach nourishment*.[2]

The project area generally encompasses the portion of San Francisco's Ocean Beach extending south from Sloat Boulevard to the northern edge of the Fort Funston bluffs, and the Great Highway from Sloat Boulevard to Skyline Boulevard, along with a portion of Ocean Beach north of Lincoln Boulevard where sand is harvested for placement south of Sloat Boulevard. The project location is shown in **Figure 1**.

---

1 In coastal engineering, revetments are sloping structures placed on the shoreline to protect the shoreline from erosion or other modification by waves.

2 Beach nourishment is the practice of adding large quantities of sand or sediment to beaches to slow erosion, increase beach width, and provide for continued public beach access and recreation opportunities.

SOURCE: ESA, 2019; Google Earth, 2019

Ocean Beach Climate Change Adaptation Project

Figure 1
Project Location and Existing Roadway Configuration

ESA

1.2 Memorandum Purpose

Both construction and operation of the proposed project would result in criteria air pollutant emissions and potential risk to human health from the emissions of toxic air contaminants. This air quality technical memorandum estimates criteria pollutant and potential health risks for the proposed project. Health risks are estimated from emissions of diesel particulate matter and $PM_{2.5}$ from diesel-powered construction equipment, haul truck travel and idling, and vendor truck traveling and idling; and for operational activity including mobile exhaust and road dust from vehicles diverted due to the closure of the Great Highway. For operational activity, most automobile traffic is gasoline-powered and generates considerably less risk than diesel engines; nevertheless, the incremental risk from traffic is also calculated to ensure a full health risk profile is assessed.

1.3 Memorandum Organization

This memorandum is organized into three main sections. Section 1 summarizes the project and memorandum organization. Section 2 details the emissions modeling methods and assumptions used to generate the results, which are provided in Section 3. **Appendices A and B** include the detailed air quality and health risk calculations.

2. Modeling Methods and Assumptions

2.1 Construction Emissions Modeling

Construction emissions were estimated primarily using the California Emissions Estimator Model (CalEEMod) version 2016.3.2. On-road vehicle emissions calculations were prepared outside of CalEEMod, using California Air Resources Board's 2017 EMission FACtor (EMFAC2017) model, to supplement the analysis. EMFAC 2017 utilizes more current data to calculate mobile emissions and is used for that purpose in this analysis. The primary assumptions used to model construction emissions are explained in the subsections below. **Table 1** presents a summary of project materials, including cubic yards of materials to be imported to the site and exported from the site.

TABLE 1
PROJECT MATERIAL CHARACTERISTICS SUMMARY

Description	Quantify
Demolition, pavement, and excavation debris export	100,600 cy
Imported concrete, steel, asphalt, and aggregate	33,997 cy
Imported pavement for new road surfaces	17,800 cy
Parking and Roads	For a conservative analysis it is assumed that up to 10 acres of the project site would be paved.
ABBREVIATIONS: cy = cubic yards	

Primary Emissions Modeling Input Assumptions

Primary emissions modeling input and assumptions for the project schedule, off-road construction, on-road construction vehicles, asphalt paving, painting, and control measures for off-road equipment are presented below.

Anticipated Schedule

The proposed project's construction schedule and phasing was based on project-specific data provided by the San Francisco Public Utilities Commission (SFPUC). The air quality analysis assumed the construction phasing would consist of five phases as shown below in **Table 2**. The SFPUC provided a construction schedule and number of workdays (referred to as production days by SFPUC) for each of the five phases.[3] The schedule and workdays estimates assume work, during a standard week, would occur on all five days; however, work may proceed up to seven days a week. SFPUC's schedule also identifies shortened weeks of four or less days to account for holiday weeks and days with bad weather that would prevent construction activities from occurring. The CalEEMod model does not allow the user to factor in non-workday holidays, or days when bad weather would prevent work, into the phase schedules input files. Therefore, in order to incorporate the accurate number of workdays for each phase provided by SFPUC, the phase end-date schedules provided by SFPUC were accordingly shortened to capture an accurate number of production days within the modeling analysis.

TABLE 2
CONSTRUCTION SCHEDULE

Phase	Start Date	End Date SFPUC-Provided	End Date Adjusted for Modeling[a]	Workdays
Pre-Construction Mobilization: Contractor sets up staging areas and trailers.	1/2/2023	3/18/2023	3/9/2023	49
Phase 1: Modify Sloat Boulevard/Great Highway intersection, remove National Park Service restroom, reconfigure San Francisco zoo parking access, reroute Muni 23 Monterey bus layover and turn-around, and then permanently close Great Highway	3/18/2023	3/26/2024	12/22/2023	200
Phase 2: Remove Great Highway southbound lanes, construct a buried wall and slope stabilization	3/27/2024	4/21/2026	1/27/2026	480
Phase 3: Remove revetments and rubble from beach, place sand on beach and slope stabilization	11/6/2024	4/21/2026	7/15/2025	180
Phase 4: Remove or repurpose Great Highway northbound lanes, install multi-use trail and service road, construct Skyline coastal access parking lot, new restroom, and beach access stairs, and install landscaping along multi-use trail, and restripe Great Highway/Skyline intersection	11/5/2025	7/28/2026	6/16/2026	160
Phase 5: Install dune landscaping and temporary irrigation (as needed) and undertake site clean-up activities	8/1/2026	1/12/2027	12/18/2026	100
Post-Construction Closeout	1/12/2027	4/12/2027		90 (calendar days)

NOTE:

a The CalEEMod model does not allow the user to factor in non-workday holidays or weather delays into the phase schedules; therefore, in order to incorporate the number of workdays for each phase provided by SFPUC, the end-date schedules provided by SFPUC had to be shortened to reflect the actual "production days."

SOURCE: San Francisco Public Utilities Commission, 2020. Resource Allocation Responses to Request for Information (RFI) 6.

[3] San Francisco Public Utilities Commission, 2020. Resource Allocation Responses to Request for Information (RFI) 6. June 9, 2020.

Off-road Construction Equipment

Off-road equipment types and quantities are based on project-specific data provided by the SFPUC. Off-road equipment engine tier status and associated emission factors for the uncontrolled scenario are CalEEMod defaults, which are average emissions factors for the equipment inventory for the given calendar year of construction, assumed to be 2023 through 2026.[4] The off-road construction equipment was modeled with Tier 4 Final engine emission standards for all equipment greater than 125 hp under the controlled scenario. Equipment hp are CalEEMod defaults with the exceptions of the larger of the two types of bore/drill rigs. It is assumed that the larger drill rig would be twice as large as the CalEEMod default of 221 hp. Equipment load factors are also CalEEMod defaults.

The SFPUC conducted a trucking detail analysis to identify the number of truck loads that would be associated with the project. For Phase 2, the SFPUC identified the need for 5,429 "on-site" truck loads that would transport material from one location to another within the project site but would not leave the project site. Emissions associated with these loads were modelled as an off-road off-highway truck. It was assumed that one off-highway truck would operate six hours each workday, delivering approximately 11 to 12 on-site truck loads per day.

Off-road equipment quantities, engine horsepower, and load factor assumptions are shown in **Table 3**. The construction equipment fleet, including equipment types, amounts, and average daily use hours for each of the construction phases are provided in **Table 4**.

On-road Construction Vehicles

Vendor and Haul Truck Travel

Daily vendor trips delivering materials and supplies to the project site would occur during Phases 1, 2, 4, and 5. Vendor trips would be required to deliver concrete, steel, aggregate, pavement, and other materials to the project site. Vendor trip lengths were based on the CalEEMod default value of 7.3 miles. Vendor truck emissions were estimated using EMFAC2017 emission factors calculated for a mix of heavy medium duty trucks (HMDT) and heavy-heavy duty trucks (HHDT) (i.e., an even HMDT/HHDT split).

The proposed project would use HHDTs to export 100,600 cubic yards (CY) of various types of debris, including demolition materials, rock, pavement, requiring approximately 9,930 haul truck loads. It was assumed exported debris would be hauled to the Ox Mountain Sanitary Landfill in Half Moon Bay, which would require 25-mile one-way trips. The proposed project also would result in the import of approximately 51,800 CY of various types of materials for the slope stabilization layer, access road sublayer, and asphalt, requiring HHDTs for approximately 3,420 haul truck loads. It was assumed imported materials would be hauled from San Francisco's Pier 94, which would require 11-mile one-way trips.

The haul truck trip lengths discussed above were used as modeling inputs to estimate weighted average haul trip mileage lengths for each construction phase. Refer to **Table 5** for the construction vehicle trips amounts, trip lengths, and vehicle classes used to estimate the project's on-road truck emissions associated with construction.

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[4] The city's Clean Construction Requirement Ordinance (Chapter 25 of the Environmental Code) establishes minimum requirements for off-road construction equipment engines based on whether a project is in or out of the "Air Pollutant Exposure Zone" as mapped by the San Francisco Health Department. As discussed below the project is not in the APEZ. However, as approved by the planning department, this analysis uses the CalEEMod defaults for equipment engines instead. This is because the available equipment inventory estimated for the construction period on which the CalEEMod default emission factors are based result in a more representative equipment scenario for the project compared to the city's minimum requirements for the project area.

TABLE 3
CONSTRUCTION EQUIPMENT FLEET

Equipment Type	Number of Equipment	Engine Horsepower[a]	Load Factor[a]
Air Compressors	10	78	0.48
Bore/Drill Rigs	3	221-442	0.50
Cement and Mortar Mixers	1	9	0.56
Concrete/Industrial Saws	1	81	0.73
Cranes	8	231	0.29
Crawler Tractors	10	212	0.43
Excavators	10	158	0.38
Forklifts	5	89	0.20
Generator Sets	10	84	0.74
Graders	5	174	0.41
Off-Highway Tractors	12	124	0.44
Off-Highway Trucks (Hauling and Water)	13	402	0.38
Other Construction Equipment [b]	3	172	0.42
Paving Equipment	2	132	0.36
Plate Compactors	4	8	0.43
Pumps	14	84	0.74
Rollers	2	80	0.38
Rubber Tired Loaders	5	203	0.36
Signal Boards	20	6	0.82
Tractors/Loaders/Backhoes	6	97	0.37

ABBREVIATIONS: CalEEMod = California Emissions Estimator Model

NOTES:

a Project sponsor did not provide engine horsepower or load factor ratings; therefore, CalEEMod default values were used with the exception of for the larger of the two types of bore/drill rigs. It is assumed that the larger drill rig would be twice as large as the CalEEMod default of 221 hp.
b Other Construction Equipment represents Heavy Duty Breaker Hammers, which are not a listed CalEEMod equipment type.

SOURCE: San Francisco Public Utilities Commission. Resource Allocation Responses to Request for Information (RFI) 6.

TABLE 4
CONSTRUCTION VEHICLE TRIPS, TRIP LENGTHS, AND VEHICLE CLASS

	Trip Amounts			Trip Lengths			EMFAC Vehicle Class		
Phase	Worker Trips/day	Vendor Trips/day	Hauling Total Trips	Worker	Vendor	Hauling	Worker	Vendor	Hauling
Pre-Construction Mobilization	20	0	14	10.8	7.3	20	LDT1	HMDT/HHDT	HHDT
Phase 1	100	4	7,368	10.8	7.3	13	LDT1	HMDT/HHDT	HHDT
Phase 2	120	26	13,000	10.8	7.3	25	LDT1	HMDT/HHDT	HHDT
Phase 3	40	0	5,000	10.8	7.3	25	LDT1	HMDT/HHDT	HHDT
Phase 4	100	12	1,146	10.8	7.3	23	LDT1	HMDT/HHDT	HHDT
Phase 5	100	18	178	10.8	7.3	11	LDT1	HMDT/HHDT	HHDT

ABBREVIATIONS:
LDT1 = light duty truck 1; HMDT = heavy medium duty truck; HHDT = heavy-heavy duty truck.

Trips are one-way trips.

TABLE 5
CONSTRUCTION EQUIPMENT FLEET BY PHASE SCHEDULE

Pre-Construction Mobilization

	No. of Equipment	Average hours/ workday
Off-Highway Tractors	2	1.4
Signal Boards	2	9.8
Signal Boards	2	9.8
Tractors/Loaders/ Backhoes	1	2.4

Phase 1 – Improvements needed prior to Great Highway closure

	No. of Equipment	Average hours/ workday
Air Compressors	2	2.4
Crawler Tractors	2	2.1
Excavators	2	2.5
Forklifts	1	2.0
Generator Sets	2	5.0
Graders	1	3.0
Off-Highway Tractors	2	2.6
Off-Highway (Water) Trucks	2	1.5
Other Construction Equipment (Heavy Duty Breaker Hammer)	1	3.0
Paving Equipment	1	2.1
Plate Compactors	2	1.8
Pumps	3	2.4
Rollers	1	3.6
Rubber Tired Loaders	1	2.3
Signal Boards	2	12.0
Signal Boards	2	12.0
Tractors/Loaders/ Backhoes	1	3.0

Phase 2 – Construction of secant pile seawall

	No. of Equipment	Average hours/ workday
Air Compressors	2	2.1
Average Bore/Drill Rigs	2	2.6
Large Bore/Drill Rigs	1	3.1
Cement and Mortar Mixers	1	5.1
Concrete/Industrial Saws	1	3.1
Cranes	2	0.8
Crawler Tractors	2	0.7
Excavators	2	1.1
Forklifts	1	1.3
Generator Sets	2	4.2
Graders	1	3.1
Off-Highway Tractors	2	3.6
Off-Highway (Water) Trucks	2	1.3
Off-Highway On-site Haul Trucks	1	6.0
Other Construction Equipment	1	0.6
Pumps	3	8.3
Pumps	1	0.6
Rubber Tired Loaders	1	2.6
Signal Boards	2	6.0
Tractors/Loaders/ Backhoes	1	3.1

Phase 3 – Remove rock and revetments from beach, sand placement on beach

	No. of Equipment	Average hours/ workday
Air Compressors	2	1.3
Cranes	2	0.6
Crawler Tractors	2	1.9
Excavators	2	1.9
Forklifts	1	0.6
Generator Sets	2	1.4
Graders	1	2.3
Off-Highway Tractors	2	3.9
Off-Highway (Water) Trucks	2	1.7
Other Construction Equipment (Heavy Duty Breaker Hammer)	1	1.7
Pumps	3	4.4
Rubber Tired Loaders	1	2.8
Signal Boards	2	6.7
Signal Boards	2	3.3
Tractors/Loaders/ Backhoes	1	3.3

Phase 4 – Remove northbound lanes of the Great Highway

	No. of Equipment	Average hours/ workday
Air Compressors	2	2.5
Cranes	2	0.3
Crawler Tractors	2	2.2
Excavators	2	1.1
Forklifts	1	1.3
Generator Sets	2	1.6
Graders	1	6.0
Off-Highway Tractors	2	2.2
Off-Highway (Water) Trucks	2	3.0
Paving Equipment	1	2.0
Plate Compactors	2	1.1
Pumps	1	0.8
Pumps	3	2.5
Rollers	1	2.3
Rubber Tired Loaders	1	2.8
Signal Boards	2	11.3
Signal Boards	2	7.5
Tractors/Loaders/ Backhoes	1	3.8

Phase 5 – Dune landscaping and beach restoration

	No. of Equipment	Average hours/ workday
Air Compressors	2	2.4
Cranes	2	0.2
Crawler Tractors	2	3.5
Excavators	2	1.8
Forklifts	1	1.0
Generator Sets	2	2.5
Graders	1	6.0
Off-Highway Tractors	2	3.5
Off-Highway (Water) Trucks	2	3.0
Rubber Tired Loaders	1	4.0
Signal Boards	2	12.0
Tractors/Loaders/ Backhoes	1	3.0

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Haul Truck Idling

The California Air Resources Board has adopted regulations for on-road vehicles with a gross vehicular weight rating of 10,000 pounds or greater to require that they not idle for longer than five minutes at any location (Title 13 California Code of Regulations (CCR) section 2485). Therefore, for purposes of this analysis, it was assumed that truck idling would total 15 minutes per trip, representing three separate 5-minute idling occurrences for check-in to the site or queuing at the site boundary upon arrival, on-site idling during loading/unloading, and check-out of the site or queuing at the site boundary upon departure.

Idling emission rates for the HHDT category were generated using EMFAC2017 model.

Worker Trips

Daily worker trips traveling to the project site would occur during all phases of construction. The number of workers that would be required for each phase was provided by SFPUC.[5] It is assumed that each worker would generate two one-way trips per day, generating between 20 and 120 one-way trips per day per construction phase. When construction phases overlap, the total number could be up to 260 one-way trips per day.

Worker trip lengths were based on the CalEEMod default of 10.8 miles.

Great Highway Closure-related Vehicular Mileage Increases

With respect to increased vehicular mileage, based on the traffic analysis conducted for the project, closing the Great Highway south of Sloat Boulevard would result in the daily re-routing of approximately 14,600 trips along Sloat and Skyline boulevards. This re-routing would increase the length of a trip by 0.46 mile, compared to the length for existing trips along the affected segment of Great Highway, and would increase the total daily vehicular mileage by 6,716 miles per day. The on-road vehicle emission factors from the EMFAC2017 model for years 2024 through 2026, the years during construction when the Great Highway would be closed, and the estimated increase in vehicular mileage per day for each vehicle type based on on-road vehicle data for the San Francisco region, were multiplied by the EMFAC2017 criteria pollutant and precursor running emission factors to obtain the average daily emission estimates for each vehicle category. Annual emissions for 2024 through 2026 were estimated by multiplying the average daily emissions by 365 days per year. In addition to exhaust emissions, PM_{10} and $PM_{2.5}$ emissions associated with tire and brake wear were estimated using EMFAC2017 emissions factors for the vehicle emissions splits described below.

Re-routed Vehicle Split and Daily Vehicular Mileage Increases by Vehicle Category

To estimate the vehicle split percentage that would be associated with the re-routed traffic, EMFAC2017 model output for average daily vehicular mileage in the San Francisco region for passenger car (LDA), light duty truck less than 3,750 pounds (LDT1), light-duty truck between 3,750 pounds and 5,750 pounds (LDT2), and motorcycle (MCY) vehicle classification categories by fuel type were divided by the total average daily vehicular mileage for those vehicle classification categories for the San Francisco region. The Great Highway south of Lincoln Way is restricted to vehicles that are three tons or less.[6] Therefore, medium-duty and heavy-duty trucks, motorhomes, buses, and other vehicles in this category are not currently permitted to travel the portion of the Great Highway that

5 San Francisco Public Utilities Commission, 2020. Resource Allocation Responses to Request for Information (RFI) 6. June 9, 2020.
6 San Francisco Transportation Agency, 2017. San Francisco Street Restrictions Effective December 2017. Available at: https://www.sfmta.com/sites/default/files/pdf_map/2017/12/streetrestrictions.pdf

would be closed, and those vehicle classification types would not be re-routed. The estimated vehicle split percentage for each vehicle category was then multiplied by the total re-routed daily vehicular mileage of 6,716 miles per day to obtain the re-routed daily vehicular mileage for each vehicle type. The re-routed vehicle split and daily vehicular mileage by vehicle split for years 2024 through 2026 are shown in **Table 6**.

TABLE 6
RE-ROUTED VEHICLE SPLIT AND DAILY VEHICULAR MILEAGE INCREASE DURING CONSTRUCTION BY VEHICLE CATEGORY

Vehicle Category	Fuel	Vehicle Split			Daily Vehicular Mileage Increase		
		2024	2025	2026	2024	2025	2026
Passenger Cars	Gasoline	67.81%	67.43%	67.13%	4,554.3	4,528.6	4,508.4
	Diesel	0.90%	0.89%	0.88%	60.7	59.8	59.0
	Electric	2.40%	2.75%	3.00%	161.5	184.9	201.5
Light-duty Trucks (less than 3,750 pounds)	Gasoline	6.62%	6.63%	6.65%	444.7	445.5	446.6
	Diesel	0.00%	0.00%	0.00%	0.1	0.1	0.1
	Electric	0.10%	0.13%	0.15%	6.8	8.5	9.9
Light-duty Trucks (3,750 to 5,750 pounds)	Gasoline	20.74%	20.72%	20.72%	1,392.8	1,391.6	1,391.5
	Diesel	0.23%	0.23%	0.23%	15.7	15.7	15.6
	Electric	0.31%	0.36%	0.41%	21.0	24.4	27.7
Motorcycle	Gasoline	0.87%	0.85%	0.83%	58.4	56.9	55.7

Asphalt Paving

Fugitive ROG emissions from asphalt paving was calculated using CalEEMod assuming up to 10 acres of the site would be paved with asphalt.

Painting

The analysis calculated emissions of reactive organic gases (ROG) from applications of paint assuming that these coatings would meet Bay Area Air Quality Management District (BAAQMD) standards for volatile organic compounds (VOC) content limits (Regulation 8, Rule 3).

Control Measures

All off-road construction equipment greater than 125 hp was modeled with Tier 4 Final engine emission standards.

2.2 Operational Emissions Modeling

The SFPUC proposes to implement a shoreline monitoring and beach nourishment program, in which sand would be placed along the shoreline as deemed needed per the results of annual monitoring. There are two placement types proposed: large sand placements and small sand placements, as described below. Under the large sand placements, the U.S. Army Corps of Engineers (USACE) would place dredged sand at regular intervals (approximately 500,000 cubic yards). Under the small sand placements, the city would place sand from North Ocean Beach at regular intervals (approximately 85,000 cubic yards). These activities are considered maintenance and therefore are analyzed as part of the project’s operational phase.

Large Sand Placements

Large sand placements would require the use of diesel fuel for dredge pump and tug operations, as well as diesel- and gasoline-fueled equipment and vehicles. The USACE presently dredges the Main Ship Channel and transports the dredged material to a nearshore location near the project site where the material is dumped from the dredge's hull into the ocean. This would continue independent of the proposed project, and therefore is not considered a component of the project for purposes of this air pollutant emissions analysis. Under the proposed project, rather than disposing of the dredged material at the nearshore site, the dredge would anchor approximately 0.5 mile offshore of the project site and emissions would be generated from equipment pumping approximately 575,000 cubic yards (beach fill is designed for 500,000 cubic yards and 15 percent is estimated for placement loss) of sand in a slurry onto the beach.

Similar to construction emissions, operational on-shore emissions associated with large sand placements were estimated primarily using the CalEEMod version 2016.3.2 emissions model and EMFAC2017. On-road emission estimates (for worker trips) were prepared outside of CalEEMod, for accuracy purposes, to supplement the analysis. The primary assumptions, used to model operational emissions associated with the large sand placements, are based on a previous analysis conducted for the city for a different project by the SFPUC and the Army Corps of Engineers referred to as the South Ocean Beach Nourishment Project.[7] Those operational assumptions are presented below.

The emissions associated with the dredge equipment and tug boats are based on emission factors for a hopper dredge obtained from the 2013 Port of Long Beach inventory,[8] adjusted to reflect California Air Resources Board's Harborcraft Engine Replacement Rule.[9] Emissions for the tug boat were estimated using emission factors obtained from an analysis of Beneficial Use of Sand Dredged from the San Francisco Main Ship Channel for Storm-Damage Reduction at Ocean Beach Project.[10]

Offshore Activities

Anticipated Schedule

Offshore large sand placement beach nourishment activities are anticipated to take 33 consecutive days, with the first action taken five years after completion of project construction, and then every 10 years thereafter. The first beach nourishment activities are estimated to occur in 2031. The project duration is based on the assumption that approximately 575,000 cubic yards of sand would be pumped onto the beach and that a hopper dredge can pump approximately 5,000 cubic yards per load. This equates to 115 total loads and it is anticipated that there would be three to four loads pumped per day.

Vessel and Engine Types

Offshore project activities would require the use of a hopper dredge and tugboat. **Table 7** presents the dredge and tug engine specifications used for calculating emissions. There are three primary activities for the tug, the details of

[7] Environmental Science Associates, 2020. Memo to Julie Moore, San Francisco Environmental Planning Division, from Sarah Patterson and Elijah Davidian, Environmental Science Associates, Subject: Air Quality Technical Memorandum and Health Risk Assessment, December 2, 2020.

[8] Starcrest Consulting Group LLC. 2014. Port of Long Beach Air Emission Inventory - 2013, July 2014. Available at https://thehelm.polb.com/download/14/emissions-inventory/6572/2013-air-emissions-inventory.pdf.

[9] State of California, 2008. 17 CCR § 93118.5 Airborne Toxic Control Measure for Commercial Harbor Craft. October 2008. Available at: https://govt.westlaw.com/calregs/Document/I0FD137A0A3C111E0BACCB30E82542E24?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=%28sc.Default%29

[10] ICF, 2020. Memorandum: Offshore Equipment Details and Assumptions for Air Emissions Analysis of Beneficial Use of Sand Dredged from the San Francisco Main Ship Channel for Storm-Damage Reduction at Ocean Beach, San Francisco, California. March 2020.

which are summarized in **Table 8**. As the table indicates, the analysis assumes approximately nine hours of operation related to transporting the slurry pipe to/from the project site (Operation 1), 11 hours of operation related to assisting the dredge in attaching the slurry pipe (Operation 2), and up to 29 hours of operation aiding the dredge during pump ashore during each day of rough weather (Operation 3). In the latter case (Operation 3), for a given rough weather event, a tug would be called out and spend about an hour nearshore every six or seven hours. The remainder of the time, it would idle offshore, returning to the Bay when the weather improves.

TABLE 7
OFFSHORE EQUIPMENT SPECIFICATIONS

Vessel	Activity	Engine Type	Engine Size (hp)	Number of Engines	Load Factor	Model Year	Vessel Assumptions
Dredge	Pumping	Main engine	4,891[a]	2	0.7	2017	Both propulsion and auxiliary engines were replaced with Tier III engines in 2017.[b]
		Auxiliary Engines	2,547	2	0.6	2017	
Tugboat	(1) Pipe to Site	Main engine	596	2	0.5	2009	Terri L. Brusco: propulsion and auxiliary engines were replaced with Tier II engines in 2009.[b]
		Auxiliary Engines	50	2	0.31		
Tugboat	(2) Pipe to Hopper	Main engine	596	2	0.5/0.0[c]	2009	
		Auxiliary Engines	50	2	0.31		
Tugboat	(3) Rough Weather	Main engine	596	2	0.5/0.0[c]	2009	
		Auxiliary Engines	50	2	0.31		

NOTES:
a Only 4,100 horsepower per engine is available for pipeline pumping.
b Required under the California Air Resources Board's Harborcraft Engine Replacement Rule[11]
c Load factor of 0.5 for propulsion and 0.0 for idling.

TABLE 8
SCHEDULE OF TUG OPERATIONS

Operation		Load Factor	Trips/ Occurrences	Distance (miles)[a]	Speed (mph)	hours/trip	Total Hours
(1)	Active-1	0.5	4	20	9.2	2.2	8.7
(2)	Active-2	0.5	4	1	9.2	0.1	2.3
	Idling	0.1	2	NA	NA	4.5	9.0
(3)[b]	Active-1	0.5	2	20	9.2	2.2	4.3
	Active-2	0.5	6	1	9.2	0.1	0.7
	Idling[c]	0.1	3	NA	NA	7.8	23.3

NOTES:
a Distance for Active-1 assumed from Port of Oakland to Ocean Beach. Distance for Active-2 assumed from Ocean Beach to Hopper Dredge
b Activity assumed per day of "rough weather"
c Idling time for Operation 3 includes idling to assist the dredge and the idling near the shoreline

SOURCE: Environmental Science Associates, 2020. Memo to Julie Moore, San Francisco Environmental Planning Division, from Sarah Patterson and Elijah Davidian, Environmental Science Associates, Subject: Air Quality Technical Memorandum, October 13, 2020.

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11 State of California, 2008. 17 CCR § 93118.5 Airborne Toxic Control Measure for Commercial Harbor Craft. October 2008. Available at: https://govt.westlaw.com/calregs/Document/I0FD137A0A3C111E0BACCB30E82542E24?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=%28sc.Default%29

Off-road Equipment

Anticipated Schedule

The on-shore activity schedule would be similar to the off-shore activity schedule, although on-shore work would likely begin staggered after the commencement of the off-shore activities. Large sand placement beach nourishment off-road equipment activities are anticipated to last approximately 29 to 38 consecutive days. The first large sand placement would occur as soon as five years after construction of the project is complete, with first beach nourishment activities estimated to occur in 2031. Thereafter, the large sand placements would occur on intervals of approximately once every 10 years.

Equipment

Off-road equipment types and quantities are based on project-specific data provided by the USACE. Off-road equipment engine tier status and associated emission factors for the uncontrolled scenario are CalEEMod defaults, which are average emissions factors for the equipment inventory for the given calendar year of construction, assumed to be 2031. The off-road construction equipment greater than 25 hp was modeled with Tier 4 Final engine emission standards for the controlled scenario. Equipment hp are CalEEMod defaults, with the exception of the small generator sets that would be required for lighting and power, which are assumed to be 10 hp. Equipment load factors are also CalEEMod defaults. Off-road equipment quantities, engine horsepower, load factors, and average daily use hours are shown in **Table 9**.

TABLE 9
OPERATIONAL ONSHORE LARGE SAND PLACEMENT EQUIPMENT FLEET

Equipment Type	Number of Equipment	Engine Horsepower	Load Factor	Average hours/workday
Excavators	1	158	0.38	18.0
Rubber Tired Dozers	2	247	0.40	18.0
Rubber Tired Loaders	1	203	0.36	18.0
Generator Sets	5	10	0.74	12.0

On-road Construction Vehicles

Worker Trips

Twelve workers would travel to the onshore project site during beach nourishment activities. The number of workers that would be required for each phase were provided by USACE. It is assumed that each worker would generate two one-way trips per day, generating 24 one-way trips per day. Worker trip lengths were based on the CalEEMod default of 10.8 miles.

Small Sand Placements

For the small sand placements, all activities would be onshore. Equipment operational emissions were estimated primarily using the CalEEMod version 2016.3.2 emissions model and EMFAC2017. Emission estimates from on-road sources were prepared outside of CalEEMod to supplement the analysis with more current emissions rates. The off-road equipment types and duration of activities assumptions used to model operational emissions are based on a previous analysis conducted by SFPUC for the Ocean Beach Sand Maintenance Project.[12] Those operational assumptions are presented below.

Off-road Equipment

Anticipated Schedule

Small sand placement beach nourishment activities are anticipated to take 6 weeks (1 week of mobilization and demobilization and 25 production days). The first action would occur five years after construction of the project is complete and then approximately every four years thereafter. The first beach nourishment activities are estimated to occur in 2031.

Equipment

Off-road equipment types and quantities are based on project-specific data provided by the SFPUC. Off-road equipment engine tier status and associated emission factors for the uncontrolled scenario are CalEEMod default value, which are average emissions factors for the equipment inventory for the given calendar year of operation, assumed to be 2031. The off-road construction equipment was modeled with Tier 4 Final engine emission standards for the controlled scenario. Equipment horsepower are CalEEMod defaults. Equipment load factors are also CalEEMod defaults. Off-road equipment quantities, engine horsepower, load factors, and average daily use hours are shown in **Table 10**.

TABLE 10
OPERATIONAL SMALL SAND PLACEMENT OFF-ROAD EQUIPMENT FLEET

Equipment Type	Number of Equipment	Engine Horsepower	Load Factor	Average hours/workday
Excavators	1	158	0.38	7.0
Rubber Tired Dozers	4	247	0.40	6.0
Rubber Tired Loaders	1	203	0.36	5.0

On-road Construction Vehicles

Haul Truck Travel

For the small sand placements, the analysis assumed that sand would be sourced from North Ocean Beach and deposited along South Ocean Beach, requiring approximately 2,890 haul truck loads. Each one-way trip would be 3 miles in length.

Haul Truck Idling

It was assumed that truck idling would total 15 minutes per trip, representing three separate 5-minute idling occurrences for check-in to the site or queuing at the site boundary upon arrival, on-site idling during loading/unloading, and check-out of the site or queuing at the site boundary upon departure.

[12] San Francisco Public Utilities Commission, 2012. Letter to Diana Sokolove, San Francisco Environmental Planning Division, from Irina P. Torrey, SFPUC Bureau of Environmental Management, RE: CEQA Exemption Request for the Ocean Beach Sand Maintenance Project, SFPUC Index Code CWWRNRTF47.

Idling emission rates for the heavy-heavy duty truck (HHDT) category were generated using the EMFAC2017 model.

Worker Trips

Fourteen workers would travel to the project site during beach nourishment activities. The number of workers that would be required for each phase were provided by the SFPUC. It is assumed that each worker would generate two one-way trips per day, generating 28 one-way trips per day. Worker trip lengths were based on the CalEEMod default value of 10.8 miles.

Great Highway Closure-related Vehicular Mileage Increases

Similar to as discussed for the construction phase of the project, permanently closing the Great Highway south of Sloat Boulevard would result in the daily re-routing of approximately 14,600 trips along Sloat and Skyline boulevards. This re-routing would increase the length of a trip by 0.46 mile, compared to the length for existing trips along the affected segment of Great Highway, and would increase the total daily vehicular mileage by 6,716 miles per day. The on-road vehicle emission factors from the EMFAC2017 model for 2027, the first year of operation, and the estimated increase in vehicular mileage per day for each vehicle type based on on-road vehicle data for the San Francisco region, were multiplied by the EMFAC2017 criteria pollutant and precursor running emission factors to obtain the average daily emission estimates for each vehicle category. Annual emissions for 2027 were estimated by multiplying the average daily emissions by 365 days per year.

In addition to exhaust emissions, fugitive road dust PM_{10} and $PM_{2.5}$ emissions that would be associated with the re-routed vehicular mileage increase were estimated using methods and silt loading factors published by the California Air Resources Board in Miscellaneous Process Methodology 7.9 — Entrained Road Travel, Paved Road Dust, and U.S. Environmental Protection Agency in AP-42, Paved Roads, section 13.2.1. In addition, PM_{10} and $PM_{2.5}$ emissions associated with tire and brake wear were estimated using EMFAC2017 emissions factors for the vehicle emissions splits described below.

Re-routed Vehicle Split and Daily Vehicular Mileage Increases by Vehicle Category

To estimate the vehicle split percentage that would be associated with the re-routed traffic during the first year of operation, EMFAC2017 model output for average daily vehicular mileage in the San Francisco region for passenger car (LDA), light duty truck less than 3,750 pounds (LDT1), light-duty truck between 3,750 pounds and 5,750 pounds (LDT2), and motorcycle (MCY) vehicle classification categories by fuel type were divided by the total average daily vehicular mileage for those vehicle classification categories for the San Francisco region. The Great Highway south of Lincoln Way is restricted to vehicles that are three tons or less.[13] Therefore, medium-duty and heavy-duty trucks, motorhomes, buses and other vehicles in this category, are not currently permitted to travel the portion of the Great Highway that would be closed, and those vehicle classification types would not be re-routed. The estimated vehicle split percentage for each vehicle category was then multiplied by the total re-routed daily vehicular mileage of 6,716 miles per day to obtain the re-routed daily vehicular mileage for each vehicle type. The re-routed vehicle split and daily vehicular mileage by vehicle split are shown in **Table 11**.

[13] San Francisco Transportation Agency, 2017. San Francisco Street Restrictions Effective December 2017. Available at: https://www.sfmta.com/sites/default/files/pdf_map/2017/12/streetrestrictions.pdf

TABLE 11
RE-ROUTED VEHICLE SPLIT AND DAILY VEHICULAR MILEAGE INCREASE BY VEHICLE CATEGORY

Vehicle Category	Fuel	Vehicle Split	Daily Vehicular Mileage Increase
Passenger Cars	Gasoline	66.86%	4,490.5
	Diesel	0.87%	58.3
	Electric	3.22%	216.5
Light-duty Trucks (less than 3,750 pounds)	Gasoline	6.66%	447.4
	Diesel	0.00%	0.1
	Electric	0.17%	11.2
Light-duty Trucks (3,750 to 5,750 pounds)	Gasoline	20.71%	1,391.2
	Diesel	0.23%	15.5
	Electric	0.46%	30.7
Motorcycle	Gasoline	0.81%	54.6

2.3 Health Risk Assessment

The Health Risk Assessment (HRA) was prepared using technical information and HRA guidance and protocol from the BAAQMD, California Air Pollution Control Officer's Association, California Air Resources Board, Office of Environmental Health Hazard Assessment (OEHHA), and the U.S. Environmental Protection Agency (U.S. EPA). The HRA evaluates the estimated incremental increase in lifetime cancer risks[14] from exposure to emissions of diesel particulate matter and the annual average $PM_{2.5}$ concentrations associated with combustion (i.e., exhaust) that would be emitted by project-related construction sources and project-related operational sources. Evaporative and exhaust toxic air contaminants, speciated from total organic gases (TOGs) emissions from on-road gasoline vehicles, that would be rerouted after construction is complete, (i.e., during operations), were also included in the cancer risk analysis. The speciation profiles were developed using BAAQMD's Recommended Methods for Screening and Modeling Local Risks and Hazards.[15] Concentrations were estimated using the American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC) regulatory air dispersion model (AERMOD version 19191).

Large sand placement beach nourishment activities are anticipated to take 29 to 38 consecutive days and small sand placement beach nourishment activities are anticipated to take 25 workdays[16]. Further, sand placement activities would only occur every four to 10 years. Offshore large sand placement beach nourishment activities would occur more than 1 mile from the nearest sensitive receptor. On-shore activities, for both the large and small sand placement beach nourishment, would occur along the shoreline, spanning from Sloat Boulevard to over 0.5 mile south along the shore. The nearest sensitive receptor is towards the north of the project site, at Sloat Boulevard and Great Highway. At the nearest point, the onshore activities would be 250 feet to the nearest sensitive receptor and at their furthest, more

[14] The incremental increase is in reference to the increase in risk from the project over the existing conditions.

[15] Bay Area Air Quality Management District, Recommended Methods for Screening and Modeling Local Risks and Hazards, May 2012, Table 14, Toxic Speciation of TOG due to Tailpipe Emissions. Available: https://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CEQA/Risk%20Modeling%20Approach%20May%202012.ashx?la=en. Accessed: October 2020.

[16] OEHHA does not recommend a HRA for exposures less than 2 months in duration. Office of Environmental Health Hazard Assessment, Air Toxics Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments, February 2015, *http://oehha.ca.gov/air/hot_spots/hotspots2015.html*, accessed October 2021.

than 3,000 feet. Because of the sand placement beach nourishment's durations, emissions rates, and frequency as well as its proximity to sensitive receptors, impacts would be negligible on sensitive receptors. Therefore, the health risk impact from emissions associated with future sand placements were not considered in the HRA.

Additionally, the HRA estimates existing conditions plus the project's incremental increase in lifetime excess cancer risk and annual average exhaust $PM_{2.5}$ concentrations by considering the project's impact in aggregate with existing sources. The existing sources are attributable to other mobile and stationary sources as calculated in the San Francisco Citywide Health Risk Assessment (referred to as the Citywide-HRA).

The primary assumptions used to model health risks are presented below.

Toxic Air Contaminant Concentrations

Inputs to the model include general modeling parameters that account for atmospheric conditions, emission rates for each contaminant from the project sources, source parameters that characterize the activities generating emissions, variable phase durations to characterize construction schedule, and sensitive receptor characteristics (e.g., resident child, school age child, child care facility).

General AERMOD Parameters

General AERMOD modeling parameters are presented in **Table 12**. Meteorological data from the Mission Bay (Site ID# 5803) monitoring site was used, consistent with the Citywide-HRA. Terrain and elevation data was imported from the United States Geological Survey's National Elevation Dataset (NED);[17] the horizontal datum of NED 83 with a 1/3 arc-second resolution was used.

Emission Rates

Emission rates of diesel particulate matter, exhaust and fugitive[18] $PM_{2.5}$, and exhaust and evaporative TOG from the various emission sources (e.g., construction equipment, vehicles on roadways) were based on the anticipated hours of activity for each source and other information as described above. It was assumed that all haul trucks and all vendor trucks are diesel.

Each source was modeled with a unitized emission rate of 1 gram/second (g/s). The modeled concentration at each receptor (micrograms per cubic meter [μ/m^3]/[g/s]) represents a "dispersion factor," which was then multiplied by the actual emission rate of each source to determine actual concentrations, and the final result from all the sources was superimposed.

Annual average ambient air concentrations were determined by multiplying the annual average dispersion factors by the annual average emission rates for each source. For simplicity, the model assumed a constant annual emission rate for each year.

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[17] United States Geological Survey, National Elevation Dataset, 2016. Available at www.mrlc.gov/viewerjs/. Accessed September 2020.

[18] Fugitive emissions include brake wear and tire wear obtained from EMFAC2017 and entrained paved road dust derived from CARB recommendation for estimating emissions following an approach consistent with USEPA AP-42. California Air Resource Board, California Air Resources Board, Miscellaneous Process Methodology 7.9 — Entrained Road Travel, Paved Road Dust. Revised and updated March 2018, <https://ww3.arb.ca.gov/ei/areasrc/fullpdf/full7-9_2018.pdf> Accessed: October 2020.

TABLE 12
OVERALL AERMOD MODELING PARAMETERS

Pathway	Characteristic	Parameter
Control Pathway	Averaging Time	Period average
	Urban vs Rural	Rural[a]
	Model Version	AERMOD v 19191
Source Pathway	Spacing	*See Table 13*
	Release Height	*See Table 13*
	Initial Vertical Dimension	*See Table 13*
	Initial Lateral Dimension	*See Table 13*
	Variable Emission Factor	7:00 a.m. to 8:00 p.m. construction; diurnal traffic profiles[b] for operations
Receptor Pathway	Receptor Height	1.8 m[b]
	Grid	20 m x 20 m[b]
Receptor Pathway	Surface Data	Mission Bay (Site ID# 5803) monitoring site[b]
	Upper Air	Oakland International Airport (Site ID# 23230)
	Station Elevation	2 m

ABBREVIATIONS:

m = meters
HRA = Health Risk Assessment
AERMOD = American Meteorological Society/Environmental Protection Agency regulatory air dispersion model

NOTES:

a From Recommended Methods for Screening and Modeling Local Risk and Hazards (BAAQMD, 2012).
b From the Citywide-HRA (SF DPH & SF Planning, 2020).

SOURCES:

Bay Area Air Quality Management District, Recommended Methods for Screening and Modeling Local Risks and Hazards, May 2012, Table 6, Urban Land Use. Available at: <http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CEQA/Risk%20Modeling%20Approach%20May%202012.ashx?la=en>. Accessed: October 2020.

San Francisco Department of Public Health, and San Francisco Planning Department, *The San Francisco Citywide Health Risk Assessment: Technical Support Documentation*, September 2020.

Source Parameters

Table 13 presents AERMOD source parameters used in the model. Construction sources were modeled as an area source within AERMOD using the same release parameters used in the Citywide-HRA, including a release height of 5 meters and an initial vertical dimension of 1.4 meters.

Haul truck and vendor trips associated to construction were modeled as line-area sources. The line-area source width corresponds to the roadway width, while the modeled release height was 2.55 meters and the initial vertical dimension was 2.37 meters, consistent with the Citywide-HRA modeling and U.S. EPA Haul Road Guidance.[19]

[19] United States Environmental Protection Agency, *Haul Road Workgroup Final Report Submission to EPA-OAQPS,* March 2012. Available at: https://www3.epa.gov/scram001/reports/Haul_Road_Workgroup-Final_Report_Package-20120302.pdf. Accessed: January 2019.

TABLE 13
AERMOD SOURCE MODELING PARAMETERS

Parameter	Off-Road Construction Equipment	On-Road Trucks	Haul/Vendor On-site Idling	Mobile Source Exhaust	Mobile Source Dust
Construction Period					
Source Type[a]	Area	Line Area	Area	Line Area	Line Area
Source Dimension	Project Area	Variable	Project Area	Variable	Variable
Number of Sources[b]	5	Variable	1	Variable	Variable
Release Height (m)[c]	5.0	2.55	2.55	1.7	0.0
Initial Vertical Dimension (m)[d]	1.4	2.37	2.37	1.58	1.0
Hours per Day	13 (7:00 a.m.–8:00 p.m.)	13 (7:00 a.m.–8:00 p.m.)	13 (7:00 a.m.–8:00 p.m.)	24	24
Days per Week	7	7	7	7	7

ABBREVIATIONS:

m = meters

NOTES:

a Construction was modeled as area sources covering the project site, consistent with the Citywide-HRA (SF DPH & SF Planning, 2020).

b Construction was modeled as five separate sources and combined into two source groups: one source group for Pre Construction and Phase 1, and one source group for Phase 2 through Phase 5. The number of on-road mobile sources is based on the geometry of the truck or traffic routes. Onsite idling from haul truck and vendor deliveries during construction were modeled at the main construction area along the Great Highway.

c Release height for off-road construction equipment and on-road operational mobile sources are from the Citywide-HRA (SF DPH & SF Planning, 2020). For on-road construction trucks and operational loading truck idling, the release height is equal to 0.5 * top of plume height, which is equal to 1.7 * the vehicle height, which is equal to 3 meters; equation = 0.5 * 1.7 * 3 = 2.55 meters (U.S. EPA 2012). Operational mobile exhaust release heights are from the Citywide- HRA (SF DPH & SF Planning, 2020). Road dust (i.e., resuspended dust of entrained surface materials), brakewear, and tireware were modeled with release heights consistent with fugitive dust modeling in SCAQMD's Final Localized Significance Threshold Methodology (SCAQMD, 2008).

d Initial vertical dimension for off-road construction equipment and on-road operational mobile sources are from the Citywide-HRA (SF DPH & SF Planning, 2020). Initial vertical dimension for on-road construction trucks and operational loading truck idling is equal to the top of the plume height ÷ 2.15 = 1.7 * 3 / 2.15 = 2.37 meters. Road dust, brakewear, and tireware were modeled with initial vertical dimensions consistent with fugitive dust modeling in SCAQMD's Final Localized Significance Threshold Methodology (SCAQMD 2008).

SOURCES:

United States Environmental Protection Agency. 2012. Haul Road Workgroup Final Report Submission to EPA-OAQPS. March. Available at: https://www3.epa.gov/scram001/reports/Haul_Road_Workgroup-Final_Report_Package-.20120302.pdf. Accessed September 2020.

San Francisco Department of Public Health, and San Francisco Planning Department, *The San Francisco Citywide Health Risk Assessment: Technical Support Documentation*, September 2020.

South Coast Air Quality Management District, 2008. Final Localized Significance Threshold Methodology. Available http://www.aqmd.gov/docs/default-source/ceqa/handbook/localized-significance-thresholds/final-lst-methodology-document.pdf Accessed October 2020.

Onsite idling during construction from haul truck and vendor deliveries was modeled as an area source with the same release height and initial vertical dimensions as the haul truck and vendor trips, that are 2.55 meters and 2.37 meters, respectively.

Operational traffic associated with the project's closure of the Great Highway was modeled as line area sources along roads with increased traffic. Exhaust from operational traffic was modeled with a release height of 1.7 meters and an initial vertical dimension of 1.58 meters, consistent with the modeling in the Citywide-HRA. Road dust generated from the traffic was modeled with a release height of 0 meters and an initial vertical dimension of 1 meter.

Variable Emissions

For all construction sources, hour-of-day variable emissions were applied from the hours of 7 a.m. to 8 p.m. For the hours between 7 a.m. and 8 p.m., a factor of 1.85 was entered with the remaining hours zeroed out (1.85 x 13 hours + 0 x 11 hours = ~24 hours).

Diurnal traffic profiles were modeled as variable emissions for operational exposure consistent with the Citywide-HRA.[20]

Receptors

A 20-meter receptor modeling grid extended 1,000 meters from the project boundary was modeled within AERMOD to represent sensitive receptors; this is the same receptor grid as used in the Citywide-HRA.

Receptors were placed at a height of 1.8 meters above terrain height, which represents the default breathing height for ground floor receptors (i.e., human residents).

Sensitive receptor locations include residential areas (based on residential land use and/or zoning data), daycares, and schools (for children under 16 years of age). **Table 14** presents the location of schools within 1,000 meters of the project site. No child day care centers were identified within 1,000 meters of the project boundary, however, the Pomeroy Recreation and Rehabilitation Center offers programs and resources to children and therefore was also evaluated as a sensitive receptor. All sensitive receptors modeled in the HRA are presented in **Figure 2**, Sensitive Receptors.

To determine whether each receptor within the modeling domain is located in the Air Pollutant Exposure Zone (APEZ)[21], Google Earth and GIS files from EP were analyzed. From the APEZ map and GIS file, it was determined that no sensitive receptors within the modeling domain were designated as in the APEZ.

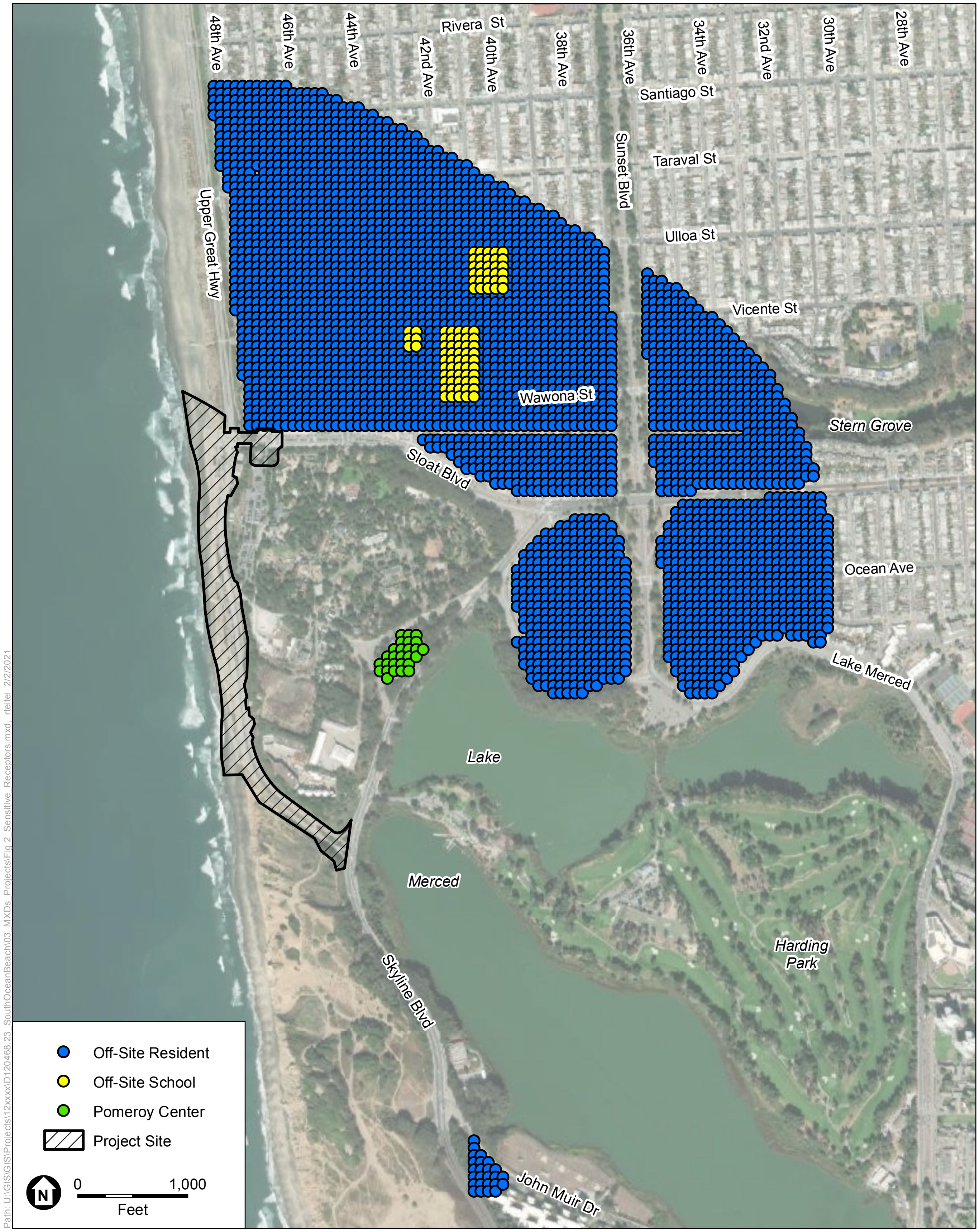
TABLE 14
OFF-SITE NON-RESIDENTIAL SENSITIVE RECEPTOR LOCATIONS

Sensitive Receptor	Address	Distance from Project Boundary (feet)	Direction	In Air Pollutant Exposure Zone?
Schools				
Pomeroy Recreation and Rehabilitation Center	207 Skyline Boulevard	1,250	East	No
Ark Christian Pre-School	3141 Vicente Street	1,450	Northeast	No
St Gabriel Catholic Elementary School	2550 41st Avenue	1,600	Northeast	No
Ulloa Elementary School	2650 42nd Avenue	2,200	Northeast	No

SOURCE: Google Earth, SF APEZ Data

20 San Francisco Department of Public Health, San Francisco Planning Department, Ramboll, Draft San Francisco Citywide Health Risk Assessment: Technical Support Documentation – Figure 1. Diurnal Traffic Profiles, September, 2020.

21 In an effort to identify areas of San Francisco most adversely affected by sources of TACs, San Francisco partnered with BAAQMD to inventory and assess air pollution and exposures from mobile, stationary, and area sources within San Francisco. Areas with poor air quality, termed the "Air Pollutant Exposure Zone," were identified based on the following health-protective criteria: (1) excess cancer risk greater than 100 per one million population from the contribution of emissions from all modeled sources, or (2) cumulative annual average $PM_{2.5}$ concentrations greater than 10 $\mu g/m^3$.



SOURCE: ESA, 2020; ESRI, 2020

Ocean Beach Climate Change Adaptation Project

Note: Emissions from beach nourishment activities would involve short exposure durations and would be infrequent; therefore, North Ocean Beach project area not shown on figure.

Figure 2
Sensitive Receptors

Health Risks

Table 15 lists the exposure parameters used in the model, by receptor and scenario. Health risks were estimated for construction activity including off-road construction equipment, haul truck travel and idling, and vendor truck traveling and idling; and for operational activity including mobile exhaust and road dust from vehicles diverted due to the closure of the Great Highway.

Pollutants Modeled

Diesel particulate matter, exhaust and fugitive $PM_{2.5}$, and TOG from construction and operational mobile sources were included in the modeling.

TOG exhaust and evaporative emissions include speciated toxic air contaminant emissions of acetaldehyde, acrolein, benzene, 1,3-butadiene, ethylbenzene, formaldehyde, hexane, methanol, methyl ethyl ketone, naphthalene, propylene, styrene, toluene, and xylenes.

For operational exhaust and evaporative emissions, calendar year 2027 emission factors and fleet mix from EMFAC2017 were conservatively applied to all future years evaluated in the exposure assessment. EMFAC assumes reductions annually into the future; therefore, using 2027 conservatively accounts for emissions in years beyond 2027 as it is assumed that emissions factors will decrease in future years due to implementation of more stringent emissions regulations.

Exposure Assessment

Receptor types assessed in the HRA include existing resident and school student receptors. Table 14 presents the location of school student receptors included in the analysis.

Exposure Scenarios and Assumptions

Two exposure scenarios were needed to identify the sensitive receptor location where maximum health risk values would occur because toxic air contaminant (TAC) emissions vary substantially with each year of construction and operation. OEHHA guidance recommends evaluating the excess cancer risk from exposure to pollutants over a 30-year exposure period. The exposure duration for Scenario 1 receptors represent four years of exposure to construction emissions (the entire construction period for the proposed project) followed by 26 years of exposure to operations emissions (full 30 years of exposure). The exposure duration for Scenario 2 receptors represent 30 years of exposure to operational emissions.

> **Scenario 1:** off-site receptors (residents and students) evaluated starting when construction commences (July 2023) and exposed to all construction emissions (four years, ending in January 2027). Exposure continues through operations starting in January 2027, and continuing for a total of 30 years for residents[22] and nine years for school exposure (approximately 26 years of operational exposure for residents beginning after construction is completed, five years for students).[23]

[22] Pomeroy Center receptors were conservatively analyzed under the same exposure period conditions as a resident.

[23] BAAQMD recommends, as a default, cancer risk estimates for children at school sites will be calculated based on a 9-year exposure duration as opposed to a resident which requires 30-year exposure for cancer risk estimates. Bay Area Air Quality Management District, *Air Toxics NSR Program Health Risk Assessment (HRA) Guidelines,* January 2016. Available at http://www.baaqmd.gov/~/media/files/planning-and-research/rules-and-regs/workshops/2016/reg-2-5/hra-guidelines_clean_jan_2016-pdf.pdf?la=en. Accessed October 2020.

TABLE 15
EXPOSURE PARAMETERS

Receptor Type	Age Group (construction or operations)	Daily Breathing Rate (L/kg day or L/kg 8hrs)[a]	Exposure Duration (years)[b]	Fraction of Time at Home (unitless)[c]	Exposure Frequency (days/year)[d]	Averaging Time (days)[e]	Model Adjustment Factor (unitless)[f]	Age Sensitivity Factor (unitless)[g]
Scenario 1: Construction + Operations								
Off-Site Resident	Third Trimester	361	0.25	0.85	350	25,550	1	10
	Age 0–2 Years	1,090	2	0.85	350	25,550	1	10
	Age 2–16 Years	572	14	0.72	350	25,550	1	3
	Age 16–30 Years	261	14	0.73	350	25,550	1	1
Pomeroy Center	Age 2–16 Years	520	14	1.0	350	25,550	1	3
	Age 16–30 Years	240	16	1.0	350	25,550	1	1
Off-Site School	Age 2–16 Years[h]	520	9	n/a	180	25,550	1.4	3
Scenario 2: Operations								
Off-Site Resident	Third Trimester	361	0.25	0.85	350	25,550	1	10
	Age 0–2 Years	1,090	2	0.85	350	25,550	1	10
	Age 2–16 Years	572	14	0.72	350	25,550	1	3
	Age 16–30 Years	261	14	0.73	350	25,550	1	1
Pomeroy Center	Age 2–16 Years	520	14	1.0	350	25,550	1	3
	Age 16–30 Years	240	16	1.0	350	25,550	1	1
Off-Site School	Age 2–16 Years[h]	520	9	n/a	180	25,550	1.4	3

ABBREVIATIONS:

kg = kilogram
L = liter
m^3 = cubic meters

SOURCES:

Office of Environmental Health Hazard Assessment, *Air Toxics Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments*, February 2015. Available at: http://oehha.ca.gov/air/hot_spots/hotspots2015.html. Accessed October 2020.

Bay Area Air Quality Management District, San Francisco Department of Public Health, and San Francisco Planning Department. 2012. *The San Francisco Community Risk Reduction Plan: Technical Support Documentation*. December. Available at http://www.gsweventcenter.com/Appeal_Response_References/2012_1201_BAAQMD.pdf. Accessed March 2017.

Bay Area Air Quality Management District. 2016. *Air Toxics NSR Program Health Risk Assessment (HRA) Guidelines*, January. Available at http://www.baaqmd.gov/~/media/files/planning-and-research/rules-and-regs/workshops/2016/reg-2-5/hra-guidelines_clean_jan_2016-pdf.pdf?la=en. Accessed October 2020.

NOTES:

a Daily breathing rates are from OEEHA (2015) based on BAAQMD guidance (2016) as follows: for residents, 95th percentile 24-hour breathing rates (OEHHA Table 5.6) for third trimester and age 0–2 years and 80th percentile 24-hour breathing rates (OEHHA Table 5.7) for age 2–9 years, age 2–16 years, and age 16–30 years; for school, 95th percentile 8-hour moderate-intensity breathing rates (OEHHA Table 5.8) for age 2–16 years.

b The exposure duration for Scenario 1 receptors represent 4 years of exposure to construction emissions (the entire construction period for the proposed project) followed by 26 years of exposure to operations emissions (full 30 years of exposure). The exposure duration for Scenario 2 receptors represent 30 years of exposure to operational emissions.

c Fraction of time at home are set to 0.85 for all age groups less than 2 years and 0.72 for age group 2 to 16, since there are no schools within cancer risk isopleths of one in a million or greater, per BAAQMD guidance (2016). For age groups greater than 16 years, values from OEHHA (2015) Table 8.4 were used.

d Exposure frequency represents default residential exposure frequency from BAAQMD guidance (2016).

e Averaging time represents 70 years for lifetime cancer risk, per OEHHA (2015).

f The Model Adjustment Factor is applied to adjust the annual average concentration (24 hours per day, 7 days per week) from AERMOD associated with construction emissions (for construction); which assumes emissions occur seven days per week; to the actual construction emission schedule and receptor exposure for school receptors, which is based on 5 days per week of both construction emissions and receptor exposure (equation = [7 days / 5 days] = 1.4).

g Age sensitivity factors from OEHHA (2015) Table 8.3

h The earliest age at the school is assumed to be 2 years and based on a 9 year exposure duration, based on BAAQMD guidance (2016).

Scenario 2: off-site receptors (residents and students) evaluated starting when construction is over and operations begins (January 2027) and lasting for the full exposure period of 30 years for a resident and nine years at a school.

All exposure assumptions are presented in Table 15, and are based on risk assessment guidelines from OEHHA (2015)[24] and BAAQMD (2016).[25]

Toxicity Assessment

The toxicity values used in the analysis for diesel particulate matter and gasoline-related toxic air contaminants associated with TOG emissions from light-duty operational vehicles are from OEHHA (2020)[26] and BAAQMD (2012).[27] These toxicity values are for carcinogenic (cancer) effects; the primary pathway for exposures is assumed to be inhalation. The incremental risks were determined for each toxic air contaminant emission source (diesel particulate matter for construction and operation and TOG for operation) and summed to obtain an estimated total incremental cancer health risk. **Table 16** presents these values. $PM_{2.5}$ toxicity is correlated directly to ambient air concentrations and presented and summarized in Section 3, below.

Age Sensitivity Factors

Cancer risk estimates were weighted by a factor of 10 for exposures that occur from the third trimester of pregnancy to two years of age and by a factor of three for exposures that occur from two years through 15 years of age. No weighting factor (i.e., an age sensitivity factor of one, which is equivalent to no adjustment) is applied to ages 16 and over for the 30-year exposure period.

Modeling Adjustment Factors

For exposure to construction emissions, since construction represents a non-continuous source, a modeling adjustment factor was used for school receptors to determine the long-term average daily concentration the student may be breathing during their time at daycare and school. This is consistent with OEHHA (2015) protocol.

For school receptors, a model adjustment factor of 1.4 was used (equation = [7 days / 5 days] = 1.4).

No modeling adjustment factors were used for operational exposure, because operational emissions occur 24 hours a day.

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24 Office of Environmental Health Hazard Assessment, *Air Toxics Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments*, February 2015. Available at http://oehha.ca.gov/air/hot_spots/hotspots2015.html. Accessed: October 2020.

25 Bay Area Air Quality Management District, *Air Toxics NSR Program Health Risk Assessment (HRA) Guidelines,* January 2016. Available at http://www.baaqmd.gov/~/media/files/planning-and-research/rules-and-regs/workshops/2016/reg-2-5/hra-guidelines_clean_jan_2016-pdf.pdf?la=en. Accessed October 2020.

26 California Air Resources Board, *Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values*. Last Updated: October 2, 2020. Available: <https://ww2.arb.ca.gov/sites/default/files/classic//toxics/healthval/contable.pdf >. Accessed: October 2020.

27 Bay Area Air Quality Management District, Recommended Methods for Screening and Modeling Local Risks and Hazards, May 2012, Table 14, Toxic Speciation of TOG due to Tailpipe Emissions. Available: <http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CEQA/Risk%20Modeling%20Approach%20May%202012.ashx?la=en>. Accessed: October 2020.

TABLE 16
CARCINOGENIC TOXICITY VALUES FOR DIESEL PARTICULATE MATTER AND TOXIC AIR CONTAMINANTS FROM TOTAL ORGANIC COMPOUND EMISSIONS FROM GASOLINE VEHICLES

Chemical/Toxic Air Contaminant	EMFAC Gasoline TOG Speciation (% TOG)	Inhalation Cancer Potency Factors $(mg/kg\text{-}day)^{-1}$	Weighted Inhalation Cancer Potency Factor
Diesel Exhaust (Diesel Vehicles)			
Diesel Particulate Matter	n/a	1.1	n/a
TOG Exhaust (Gasoline Vehicles)			
Acetaldehyde	0.28%	1.0E-02	2.80E-05
Benzene	2.47%	1.0E-01	2.47E-03
1,3-Butadiene	0.55%	6.0E-01	3.30E-03
Ethylbenzene	1.05%	8.7E-03	9.14E-05
Formaldehyde	1.58%	2.1E-02	3.32E-04
Naphthalene	0.05%	1.2E-01	6.00E-05
Weighted Total Toxicity Factor	—	—	6.28E-03
TOG Evaporative (Gasoline Vehicles)			
Benzene	0.36%	1.0E-01	3.60E-04
Ethylbenzene	0.12%	8.70E-03	1.04E-05
Weighted Total Toxicity Factor	—	—	3.70E-04

ABBREVIATIONS:

n/a = not applicable
TOG = total organic compounds
mg = milligram
kg = kilogram
EMFAC = California Air Resources Board **EM**ission **FAC**tor **M**odel.

SOURCES:

Bay Area Air Quality Management District, *Recommended Methods for Screening and Modeling Local Risks and Hazards*, May 2012, Table 14, Toxic Speciation of TOG due to Tailpipe Emissions. Available at: http://www.baaqmd.gov/~/media/Files/Planning%20and%20Research/CEQA/Risk%20Modeling%20Approach%20May%202012.ashx?la=en. Accessed October 2020.

California Air Resources Board. 2020. *Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values*. Last Updated: October 2, 2020. Available at: http://www.arb.ca.gov/toxics/healthval/contable.pdf. Accessed October 2020.

Calculation of Intake

The dose estimated for each exposure pathway is a function of the concentration of a chemical and the intake of that chemical. The intake factor for inhalation was calculated as follows using **Equation 1**. The values used in this equation are presented in Table 15.

$$\textbf{Equation 1}: IF_{inh} = \frac{DBR * FAH * EF * ED * MAF * ASF * CF}{AT}$$

Where:

IF_{inh} = Intake Factor for Inhalation (m^3/kg-day)
DBR = Daily Breathing Rate (L/kg-day)
FAH = Frequency of time at home (unitless)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
AT = Averaging Time (days)
MAF = Model Adjustment Factor (unitless)
ASF = Age Sensitivity Factor (unitless)
CF = Conversion Factor, 0.001 (m^3/L)

Calculation of Cancer Risk

Excess lifetime cancer risk is estimated as the upper-bound incremental probability that an individual will develop cancer over a lifetime as a direct result of exposure to carcinogens. Excess lifetime cancer risk is expressed as a unitless probability, and is calculated as the number of cancer incidences per million individuals. The cancer risk for each chemical is calculated by multiplying the chemical intake or dose at the human exchange boundaries (e.g., lungs) by the chemical-specific cancer potency factor. Excess lifetime cancer risk occurs exclusively through the inhalation pathway and is calculated according to **Equation 2**.

Equation 2: $Risk_{inh} = C_i * IF_{inh} * CPF_i * CF_1 * CF_2$

Where:

$Risk_{inh}$ = Cancer risk; the incremental probability of an individual developing cancer as a result of inhalation exposure to a particular carcinogen (per million)
C_i = Average annual air concentration of chemical, from AERMOD (μ/m^3)
IF_{inh} = Intake Factor for Inhalation (m^3/kg-day)
CPF_i = Cancer potency factor for chemical (mg chemical/kg body weight-day)$^{-1}$
CF_1 = Conversion factor, micrograms to milligrams (mg/μg)
CF_2 = Risk per million individuals
i = Chemical

Background Risk

This analysis relied on the Citywide-HRA for background data for the year 2020, including lifetime excess cancer risk and annual average $PM_{2.5}$ concentrations. Because the Citywide-HRA was completed in 2020, it is assumed that background risk is recent enough to represent the background risk for this project.

Cumulative Risk

Projects considered in the cumulative analysis include: Fort Funston Trail Connection, Westside Pump Station Reliability Improvements, Vista Grande Drainage Basin Improvement Project, Reconfiguration of the Sloat Boulevard and State Route 35 (Skyline Boulevard) Intersection, Oceanside Treatment Plant Improvements - Biosolids Cake Hopper Reliability Upgrade, Oceanside Treatment Plant Improvements - Seismic Retrofits, Caltrans Signalization of State Route 35, San Francisco Zoo Recycled Water Pipeline Project, Lake Merced West Project - 520 John Muir Drive, Westside Force Main Reliability Project, and 2700 Sloat Boulevard. Both the Westside Pump Station Reliability Improvements and Caltrans Signalization of State Route 35 qualify as Categorical Exempt under CEQA and were not required to complete an HRA. Of the remaining nine projects, only one has undergone environmental review, Vista Grande Drainage Basin Improvement Project, and in the Environmental Impact Report/Environmental Impact Statement, SCH No. 2013032001, impacts from health risk would only occur from construction emissions and they were analyzed qualitatively. Because of the lack of available emissions data for the nearby projects, cumulative health risks were not evaluated quantitatively.

Risk Analysis

This analysis evaluates the existing[28] plus project excess lifetime cancer risk and annual average exhaust $PM_{2.5}$ concentrations at all modeled sensitive receptor locations in order to:

- determine the project's impact in relation to existing health risks in the area, and
- identify the maximum lifetime excess cancer risks and annual average $PM_{2.5}$ exhaust concentration contributions from the proposed project, for those off-site receptors not located in the APEZ during existing conditions, but which could be brought into the APEZ during existing plus proposed project conditions.

[28] Existing risk does not include cumulative projects since they were not evaluated quantitatively.

For determining whether the proposed project would bring off-site receptors (i.e., those not located in the APEZ during existing conditions) into the APEZ with the proposed project's contribution to lifetime excess cancer risks and annual average $PM_{2.5}$ exhaust concentrations, the following health-protective criteria were used (BAAQMD, 2009; SF DPH, 2014):[29,30]

- Cumulative annual average $PM_{2.5}$ exhaust concentrations greater than 10 μg/m^3; and/or
- Excess cancer risk from the contribution of emissions from all modeled sources greater than 100 per one million population.

3. Results

This section presents the results of the construction and operations emissions analysis and HRA for the proposed project.

3.1 Construction Emissions

The following tables present average daily uncontrolled and controlled construction emissions by source (e.g., off-road equipment). The tables presented below include:

- **Table 17:** detailed average daily uncontrolled and controlled construction emissions for the proposed project by year.
- **Table 18:** summary average daily uncontrolled and controlled construction emissions for the proposed project by year.
- **Table 19:** construction-phase emissions for Great Highway closure increased construction vehicle (trucks and worker trips) mileage.

TABLE 17
DETAILED AVERAGE DAILY UNCONTROLLED AND CONTROLLED CONSTRUCTION EMISSIONS BY SOURCE

Year/Source[a]	Average Daily Emissions (pounds/day) Uncontrolled				Average Daily Emissions (pounds/day) Controlled[b]			
	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust
2023								
Off-Road Equipment	2.84	23.81	1.09	1.04	2.11	15.72	0.72	0.70
Paving	0.13	0.00	0.00	0.00	0.26	0.00	0.00	0.00
Painting	15.14	0.00	0.00	0.00	15.14	0.00	0.00	0.00
Haul Trucks – Travel and Idling	0.09	5.35	0.03	0.03	0.09	5.35	0.03	0.03
Vendor Trucks – Travel and Idling	0.00	0.29	0.00	0.00	0.00	0.29	0.00	0.00
Worker Trips	0.36	0.23	0.01	0.01	0.36	0.23	0.01	0.01
Subtotal	18.56	29.68	1.12	1.07	17.96	21.59	0.75	0.73

29 Bay Area Air Quality Management District, *Revised Draft Options and Justification Report, California Environmental Quality Act Thresholds of Significance*. October 2009, p. 7. Available at: http://www.baaqmd.gov/~/media/files/planning-and-research/ceqa/revised-draft-ceqa-thresholds-justification-report-oct-2009.pdf?la=en. Accessed April 2017

30 San Francisco Department of Public Health, Environmental Health, Planning, *Memorandum to File regarding 2014 Air Pollutant Exposure Zone Map*, April 9, 2014.

TABLE 17 (CONTINUED)
DETAILED AVERAGE DAILY UNCONTROLLED AND CONTROLLED CONSTRUCTION EMISSIONS BY SOURCE

	Average Daily Emissions (pounds/day) Uncontrolled				Average Daily Emissions (pounds/day) Controlled[b]			
Year/Source[a]	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust
2024								
Off-Road Equipment	5.01	42.27	1.77	1.70	3.61	27.01	1.18	1.17
Paving	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Painting	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Haul Trucks – Travel and Idling	0.18	13.38	0.07	0.07	0.18	13.38	0.07	0.07
Vendor Trucks – Travel and Idling	0.03	1.84	0.01	0.01	0.03	1.84	0.01	0.01
Worker Trips	0.44	0.28	0.01	0.01	0.44	0.28	0.01	0.01
Increased Great Highway Closure Vehicular Miles [d]	0.49	0.67	0.68	0.28	0.49	0.67	0.68	0.28
Subtotal	6.15	58.44	2.55	2.07	4.75	43.18	1.96	1.54
2025								
Off-Road Equipment	6.72	54.86	2.19	2.10	4.78	34.91	1.42	1.40
Paving	0.16	0.00	0.00	0.00	0.33	0.00	0.00	0.00
Painting	18.93	0.00	0.00	0.00	18.93	0.00	0.00	0.00
Haul Trucks – Travel and Idling	0.20	14.54	0.08	0.08	0.20	14.54	0.08	0.08
Vendor Trucks – Travel and Idling	0.04	2.63	0.01	0.01	0.04	2.63	0.01	0.01
Worker Trips	0.67	0.41	0.01	0.01	0.67	0.41	0.01	0.01
Increased Great Highway Closure Vehicular Miles [d]	0.47	0.62	0.68	0.28	0.47	0.62	0.68	0.28
Subtotal	27.19	73.05	2.98	2.48	25.41	53.10	2.21	1.79
2026								
Off-Road Equipment	6.78	55.45	2.18	2.08	3.57	32.53	1.32	1.30
Paving	0.16	0.00	0.00	0.00	0.33	0.00	0.00	0.00
Painting	18.93	0.00	0.00	0.00	18.93	0.00	0.00	0.00
Haul Trucks – Travel and Idling	0.11	7.93	0.05	0.04	0.11	7.93	0.05	0.04
Vendor Trucks – Travel and Idling	0.06	3.78	0.01	0.01	0.06	3.78	0.01	0.01
Worker Trips	0.77	0.45	0.01	0.01	0.77	0.45	0.01	0.01
Increased Great Highway Closure Vehicular Miles [d]	0.44	0.57	0.68	0.28	0.44	0.57	0.68	0.28
Subtotal	27.26	68.18	2.94	2.44	24.21	45.27	2.07	1.65

ABBREVIATIONS:

ROG = reactive organic gases
NO_X = oxides of nitrogen
PM_{10} = particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter
CalEEMod = CALifornia Emissions Estimator MODel

SOURCE: ESA, 2021.

NOTES:

a Source categories defined as follows:
Off-Road Equipment = operating emissions from heavy-duty equipment, such as bulldozers, cranes, and excavators. Refer to Tables 3 and 4 for equipment activity assumptions. Emissions were modeled using CalEEMod.
Paving = Fugitive ROG emissions from asphalt paving. Emissions were modeled using CalEEMod.
Painting = Fugitive ROG emissions from the application of paint. Emissions were modeled using CalEEMod.
Haul Trucks = Travel and idling emissions from heavy-duty on-road haul trucks. Emissions were modeled using EMFAC2017.
Vendor Trucks = Travel emissions from heavy-duty and medium-duty on-road haul trucks. Emissions were modeled using EMFAC2017.
Worker Trips = Operating emission from employee vehicles, assumed to be light-duty trucks. Emissions were modeled using EMFAC2017.
Great Highway Closure = Operational emissions from increased Great Highway closure vehicular miles. Emissions were modeled using EMFAC2017.

b Controlled emissions were modelled assuming all off-road construction equipment greater than 125 hp would meet Tier 4 Final engine emission standards.

c Uncontrolled equipment scenario incorporates CalEEMod defaults, which are average emissions factors for the equipment inventory for the given calendar year of construction, assumed to be 2023 through 2026.

d Particulate emissions from Increased Great Highway Closure Vehicular Miles include fugitive dust (i.e. brake-wear, tire-wear, and road dust) in addition to the tailpipe exhaust emissions.

TABLE 18
AVERAGE DAILY UNCONTROLLED AND CONTROLLED CONSTRUCTION EMISSIONS

Year	Average Daily Emissions (pounds/day) Uncontrolled				Average Daily Emissions (pounds/day) Controlled[a]			
	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust
2023	18.56	29.68	1.12	1.07	17.96	21.59	0.75	0.73
2024	6.15	58.44	2.55	2.07	4.75	43.18	1.96	1.54
2025	27.19	73.05	2.98	2.48	25.41	53.10	2.21	1.79
2026	27.26	68.18	2.94	2.44	24.21	45.27	2.07	1.65

ABBREVIATIONS:

ROG = reactive organic gases
NO_X = oxides of nitrogen
PM_{10} = particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter
VOC = volatile organic compounds

NOTES:

a Controlled emissions modeling: all off-road construction equipment with greater than 125 hp would meet Tier 4 Final engine emission standards.

SOURCE: ESA, 2021.

TABLE 19
CONSTRUCTION-PHASE EMISSIONS FOR GREAT HIGHWAY CLOSURE RESULTING IN VEHICULAR MILEAGE INCREASE

Year	ROG	NO_X	PM_{10} Exhaust	PM_{10} Non-Exhaust[a]	Total PM_{10}	$PM_{2.5}$ Exhaust	$PM_{2.5}$ Non- Exhaust[a]	Total $PM_{2.5}$
Average Daily Emissions (pounds/day)								
2024	0.49	0.67	0.03	0.66	0.68	0.02	0.26	0.28
2025	0.47	0.62	0.02	0.66	0.68	0.02	0.26	0.28
2026	0.44	0.57	0.02	0.66	0.68	0.02	0.26	0.28

ABBREVIATIONS:

ROG = reactive organic gases
NO_X = oxides of nitrogen
PM_{10} = particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter
VOC = volatile organic compounds

NOTES:

a PM_{10} and $PM_{2.5}$ non-exhaust emissions are particulates associated with tire and break wear.

SOURCE: ESA, 2021.

3.2 Operational Emissions

The following tables present average daily and total annual uncontrolled operational emissions by source (e.g., area). The tables presented below include:

- **Table 20:** Detailed total operational emissions (pounds) for uncontrolled and controlled large sand placement beach nourishment by source.
- **Table 21:** Detailed annual operational emissions (tons) for proposed large sand placement beach nourishment by source.
- **Table 22:** Detailed total operational emissions (pounds) for proposed small sand placement beach nourishment by source.
- **Table 23:** Detailed annual operational emissions (tons) for proposed small sand placement beach nourishment by source.
- **Table 24:** Operation-phase Emissions for Great Highway closure increased vehicular mileage.
- **Table 25:** average daily emissions (pounds) for proposed large or small sand placement beach nourishments and increased Great Highway closure vehicular mileage emissions combined.
- **Table 26:** Annual operational emissions (annual) for proposed large or small sand placement beach nourishments and increased Great Highway closure vehicular mileage emissions combined.

TABLE 20
DETAILED OPERATIONAL LARGE SAND PLACEMENT TOTAL EMISSIONS (POUNDS) BY SOURCE

Year/Source[a]	Total Uncontrolled Emissions (pounds)[b]				Total Controlled Emissions (pounds)[c]			
	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust
2031								
Dredge Equipment	2,035.70	17,332.67	863.97	838.05	2,035.70	17,332.67	863.97	838.05
Tug Boat	138.51	890.71	25.95	25.17	138.51	890.71	25.95	25.17
Off-Road Equipment	165.60	820.00	31.20	31.20	53.40	285.40	10.20	10.18
Worker Trips	1.58	0.90	0.03	0.03	1.58	0.90	0.03	0.03
Total Pounds	2,341.38	19,044.28	921.14	894.44	2,229.18	18,509.68	900.14	873.42
Total Average Daily Pounds[d]	6.41	52.18	2.52	2.45	6.11	50.71	2.47	2.39

ABBREVIATIONS:
ROG = reactive organic gases
NO_X = oxides of nitrogen
PM_{10} = particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter

NOTES:
a Categories defined as follows:
Dredge Equipment = operating emissions from dredge main and auxiliary pumps, Refer to Table 7.
Tug Boat = operating emissions from tug boat main and auxiliary engines, Refer to Table 7.
Off-Road Equipment = operating emissions from heavy-duty equipment, including bulldozers, loaders, and excavators. Refer to Table 9 for equipment activity assumptions. Emissions were modeled using CalEEMod.
Worker Trips = Operating emission from employee vehicles, assumed to be light-duty trucks. Emissions were modeled using EMFAC2017.
b Uncontrolled equipment scenario incorporates CalEEMod defaults, which are average emissions factors for the equipment inventory for the first calendar year of operation, assumed to be 2031.
c Controls include: all off-road construction equipment greater than 25 hp were modeled with Tier 4 Final engine emission standards.
d Total average daily pounds are estimated by dividing the total pounds by 365 days.

SOURCE: ESA, 2021.

TABLE 21
DETAILED ANNUAL OPERATIONAL LARGE SAND PLACEMENT EMISSIONS (TONS/YEAR) BY SOURCE

Year/Source[a]	Uncontrolled (tons/year)[b]				Controlled (tons/year)[c]			
	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust
2031								
Dredge Equipment	1.02	8.67	0.43	0.42	1.02	8.67	0.43	0.42
Tug Boat	0.07	0.45	0.01	0.01	0.07	0.45	0.01	0.01
Off-Road Equipment	0.08	0.41	0.02	0.02	0.03	0.14	0.01	0.01
Worker Trips	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Total	1.17	9.52	0.46	0.45	1.11	9.25	0.45	0.44

ABBREVIATIONS:

ROG = reactive organic gases
NO_X = oxides of nitrogen
PM_{10} = particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter

SOURCE: ESA, 2021.

NOTES:
a Categories defined as follows:
Off-Road Equipment = operating emissions from heavy-duty equipment, including bulldozers, loaders, and excavators. Refer to Table 10 for equipment activity assumptions. Emissions were modeled using CalEEMod.
Haul Trucks = Travel and idling emissions from heavy-duty on-road haul trucks. Emissions were modeled using EMFAC2017.
Worker Trips = Operating emission from employee vehicles, assumed to be light-duty trucks. Emissions were modeled using EMFAC2017.
b Uncontrolled equipment scenario incorporates CalEEMod defaults, which are average emissions factors for the equipment inventory for the first calendar year of operation, assumed to be 2031.
c Controls include: all off-road construction equipment greater than 25 hp were modeled with Tier 4 Final engine emission standards.

TABLE 22
DETAILED OPERATIONAL SMALL SAND PLACEMENT EMISSIONS (POUNDS) BY SOURCE

Year/Source[a]	Annual Uncontrolled Emissions (pounds)[b]				Annual Controlled Emissions (pounds)[c]			
	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust
2031								
Off-Road Equipment	53.00	264.20	10.00	10.00	10.44	45.20	1.40	1.40
Haul Trucks – Travel and Idling	8.52	262.42	0.90	0.86	8.52	262.42	0.90	0.86
Worker Trips	0.05	0.69	0.02	0.02	0.05	0.69	0.02	0.02
Total Pounds	61.57	527.30	10.93	10.88	19.01	308.30	2.33	2.28
Total Average Daily Pounds[d]	0.17	1.44	0.03	0.03	0.05	0.84	0.01	0.01

ABBREVIATIONS:

ROG = reactive organic gases
NO_X = oxides of nitrogen
PM_{10} = particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter

SOURCE: ESA, 2021.

NOTES:
a Categories defined as follows:
Off-Road Equipment = operating emissions from heavy-duty equipment, including bulldozers, loaders, and excavators. Refer to Table 10 for equipment activity assumptions. Emissions were modeled using CalEEMod.
Haul Trucks = Travel and idling emissions from heavy-duty on-road haul trucks. Emissions were modeled using EMFAC2017.
Worker Trips = Operating emission from employee vehicles, assumed to be light-duty trucks. Emissions were modeled using EMFAC2017.
b Uncontrolled equipment scenario incorporates CalEEMod defaults, which are average emissions factors for the equipment inventory for the first calendar year of operation, assumed to be 2031.
c Controls include: all off-road construction equipment were modeled with Tier 4 Final engine emission standards.
d Total average daily pounds are estimated by dividing the total pounds by 365 days.

TABLE 23
DETAILED ANNUAL OPERATIONAL SMALL SAND PLACEMENT EMISSIONS (TONS/YEAR) BY SOURCE

Year/Source[a]	Annual Uncontrolled Emissions (tons/year)[b]				Annual Controlled Emissions (tons/year)[c]			
	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust	ROG	NO_X	PM_{10} Exhaust	$PM_{2.5}$ Exhaust
2031								
Off-Road Equipment	0.03	0.13	0.01	0.01	0.01	0.02	<0.01	<0.01
Haul Trucks – Travel and Idling	0.01	0.13	<0.01	<0.01	<0.01	0.13	<0.01	<0.01
Worker Trips	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Grand Total	0.03	0.26	0.01	0.01	0.01	0.15	<0.01	<0.01

ABBREVIATIONS:

ROG = reactive organic gases
NO_X = oxides of nitrogen
PM_{10} = particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter

SOURCE: ESA, 2021.

NOTES:
a Categories defined as follows:
Off-Road Equipment = operating emissions from heavy-duty equipment, including bulldozers, loaders, and excavators. Refer to Table 10 for equipment activity assumptions. Emissions were modeled using CalEEMod.
Haul Trucks = Travel and idling emissions from heavy-duty on-road haul trucks. Emissions were modeled using EMFAC2017.
Worker Trips = Operating emission from employee vehicles, assumed to be light-duty trucks. Emissions were modeled using EMFAC2017.
b Uncontrolled equipment scenario incorporates CalEEMod defaults, which are average emissions factors for the equipment inventory for the first calendar year of operation, assumed to be 2031.
c Controls include: all off-road construction equipment were modeled with Tier 4 Final engine emission standards.

TABLE 24
OPERATION-PHASE EMISSIONS FOR GREAT HIGHWAY CLOSURE RESULTING IN VEHICULAR MILEAGE INCREASE

Source	ROG	NO_X	PM_{10} Exhaust	PM_{10} Non-Exhaust[a]	Total PM_{10}	$PM_{2.5}$ Exhaust	$PM_{2.5}$ Non-Exhaust[a]	Total $PM_{2.5}$
Annual Emissions (tons/year)								
Increased Great Highway Closure Vehicular Mileage	0.08	0.10	0.00	0.40	0.40	0.00	0.09	0.09
Average Daily Emissions (pounds/day)								
Increased Great Highway Closure Vehicular Mileage	0.42	0.54	0.02	2.17	2.19	0.02	0.49	0.51

ABBREVIATIONS:

ROG = reactive organic gases
NO_X = oxides of nitrogen
PM_{10} = particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter
VOC = volatile organic compounds

NOTES:

a PM_{10} and $PM_{2.5}$ non-exhaust emissions are particulates associated with entrained paved road dust and tire and break wear.

SOURCE: ESA, 2021.

TABLE 25
AVERAGE DAILY OPERATIONAL LARGE OR SMALL SAND PLACEMENT AND GREAT HIGHWAY CLOSURE RESULTING IN VEHICULAR MILEAGE INCREASE EMISSIONS COMBINED (POUNDS/DAY)

Year/Source	Uncontrolled Emissions (pounds/day)				Controlled Emissions (pounds/day)			
	ROG	NO_X	PM_{10}	$PM_{2.5}$	ROG	NO_X	PM_{10}	$PM_{2.5}$
Maximum Average Daily Emissions with Large Sand Placements (pounds/day)								
Large Sand Placement	6.41	52.18	2.52	2.45	6.11	50.71	2.47	2.39
Increased Great Highway Closure Vehicular Mileage	0.42	0.54	2.19	0.51	0.42	0.54	2.19	0.51
Total	6.84	52.71	4.71	2.96	6.53	51.25	4.65	2.90
Maximum Average Daily Emissions with Small Sand Placements (pounds/day)								
Small Sand Placement	0.17	1.44	0.03	0.03	0.05	0.84	0.01	0.01
Increased Great Highway Closure Vehicular Mileage	0.42	0.54	2.19	0.51	0.42	0.54	2.19	0.51
Total	0.59	1.98	2.22	0.54	0.48	1.38	2.19	0.51

ABBREVIATIONS:
ROG = reactive organic gases
NO_X = oxides of nitrogen
PM_{10} = particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter

SOURCE: ESA, 2021.

TABLE 26
ANNUAL OPERATIONAL LARGE OR SMALL SAND PLACEMENT AND GREAT HIGHWAY CLOSURE RESULTING IN VEHICULAR MILEAGE INCREASE EMISSIONS COMBINED (TONS/YEAR)

Year/Source	Annual Uncontrolled Emissions (tons/year)				Annual Controlled Emissions (tons/year)			
	ROG	NO_X	PM_{10}	$PM_{2.5}$	ROG	NO_X	PM_{10}	$PM_{2.5}$
Maximum Annual Emissions with Large Sand Placements (tons/year)								
Large Sand Placement	1.17	9.52	0.46	0.45	1.11	9.25	0.45	0.44
Increased Great Highway Closure Vehicular Mileage	0.08	0.10	0.40	0.09	0.08	0.10	0.40	0.09
Total	1.25	9.62	0.86	0.54	1.19	9.35	0.85	0.53
Maximum Annual Emissions with Small Sand Placements (tons/year)								
Small Sand Placement	0.03	0.26	0.01	0.01	0.01	0.15	0.00	0.00
Increased Great Highway Closure Vehicular Mileage	0.08	0.10	0.40	0.09	0.08	0.10	0.40	0.09
Total	0.11	0.36	0.40	0.10	0.09	0.25	0.40	0.09

ABBREVIATIONS:
ROG = reactive organic gases
NO_X = oxides of nitrogen
PM_{10} = particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter

SOURCE: ESA, 2021.

3.3 Health Risk Assessment

This section addresses $PM_{2.5}$ exposure and cancer risk from diesel particulate matter and gasoline TOG as a result of uncontrolled and controlled emissions. Health risks are evaluated by combining background cancer risk and annual average $PM_{2.5}$ concentrations for existing conditions (2020) from the Citywide-HRA with cancer risk and annual average $PM_{2.5}$ concentrations for the proposed project.

Table 27 presents a summary of the maximum health risk results for the proposed project. The table includes health risk information at the maximally impacted sensitive receptor for each exposure scenario (construction plus operations, and operations) for the incremental increase in lifetime excess cancer risk (chances per million) and average annual $PM_{2.5}$ exhaust concentrations ($\mu g/m^3$). No receptors were located within the APEZ under existing conditions. No receptors were brought into the APEZ during existing plus proposed project conditions.

TABLE 27
SUMMARY OF INCREMENTAL INCREASE IN LIFETIME EXCESS CANCER RISK AND ANNUAL AVERAGE $PM_{2.5}$ CONCENTRATIONS PLUS EXISTING

Scenario/ Receptor Type	Uncontrolled				Controlled[a]			
	Lifetime Excess Cancer Risk (chances per million)		Annual Average $PM_{2.5}$ Concentrations (µg/m^3)		Lifetime Excess Cancer Risk (chances per million)		Annual Average $PM_{2.5}$ Concentrations (µg/m^3)	
	Receptor Location[b] (UTM X, UTM Y)	Project/Existing Contribution[c]	Receptor Location[b] (UTM X, UTM Y)	Project/Existing Contribution[c]	Receptor Location[b] (UTM X, UTM Y)	Project/Existing Contribution[c]	Receptor Location[b] (UTM X, UTM Y)	Project/Existing Contribution[c]
Scenario 1 – Construction + Operations								
Resident								
Construction	(543520, 4176620)	3.6	(543520, 4176620)	0.02	(543520, 4176620)	2.4	(543520, 4176620)	0.01
Operations	(543520, 4176620)	0.8	(543520, 4176620)	0.11	(543520, 4176620)	0.8	(543520, 4176620)	0.11
Total Project[d]		4.4		0.11		3.2		0.11
Existing	(543520, 4176620)	42.2	(543520, 4176620)	8.51	(543520, 4176620)	42.2	(543520, 4176620)	8.51
Existing + Project		46.6		8.62		45.4		8.62
Pomeroy Center								
Construction	(543880, 4175940)	1.5	(543880, 4175940)	0.03	(543880, 4175940)	1.0	(543880, 4175940)	0.02
Operations	(543880, 4175940)	0.5	(543880, 4175940)	0.08	(543880, 4175940)	0.5	(543880, 4175940)	0.08
Total Project[d]		2.1		0.08		1.6		0.08
Existing	(543880, 4175940)	28.8	(543880, 4175940)	8.34	(543880, 4175940)	28.8	(543880, 4175940)	8.34
Existing + Project		30.9		8.42		30.3		8.42
School								
Construction	(544060, 4176700)	0.3	(544060, 4176700)	0.01	(544060, 4176700)	0.2	(544060, 4176700)	<0.01
Operations	(544060, 4176700)	0.1	(544060, 4176700)	0.06	(544060, 4176700)	0.1	(544060, 4176700)	0.06
Total Project[d]		0.4		0.06		0.3		0.06
Existing	(544060, 4176700)	20.9	(544060, 4176700)	8.14	(544060, 4176700)	20.9	(544060, 4176700)	8.14
Existing + Project		21.3		8.19		21.2		8.19

TABLE 27 (CONTINUED)
SUMMARY OF INCREMENTAL INCREASE IN LIFETIME EXCESS CANCER RISK AND ANNUAL AVERAGE $PM_{2.5}$ CONCENTRATIONS PLUS EXISTING

Scenario/ Receptor Type	Uncontrolled				Controlled[a]			
	Lifetime Excess Cancer Risk (chances per million)		Annual Average $PM_{2.5}$ Concentrations ($\mu g/m^3$)		Lifetime Excess Cancer Risk (chances per million)		Annual Average $PM_{2.5}$ Concentrations ($\mu g/m^3$)	
	Receptor Location[b] (UTM X, UTM Y)	Project/Existing Contribution[c]	Receptor Location[b] (UTM X, UTM Y)	Project/Existing Contribution[c]	Receptor Location[b] (UTM X, UTM Y)	Project/Existing Contribution[c]	Receptor Location[b] (UTM X, UTM Y)	Project/Existing Contribution[c]
Scenario 2 – Operations								
Resident								
Total Project	(544020, 4176560)	4.4	(544020, 4176560)	0.297	(544020, 4176560)	4.4	(544020, 4176560)	0.297
Existing	(544020, 4176560)	27.8	(544020, 4176560)	8.21	(544020, 4176560)	27.8	(544020, 4176560)	8.21
Existing + Project		32.2		8.51		32.2		8.51
Pomeroy Center								
Total Project	(543960, 4175940)	2.9	(543960, 4175940)	0.12	(543960, 4175940)	2.9	(543960, 4175940)	0.12
Existing	(543960, 4175940)	51.0	(543960, 4175940)	8.79	(543960, 4175940)	51.0	(543960, 4175940)	8.79
Existing + Project		53.9		8.92		53.9		8.92
School								
Total Project	(544060, 4176700)	0.2	(544060, 4176700)	0.06	(544060, 4176700)	0.2	(544060, 4176700)	0.06
Existing	(544060, 4176700)	20.9	(544060, 4176700)	8.14	(544060, 4176700)	20.9	(544060, 4176700)	8.14
Existing + Project		21.1		8.19		20.9		8.19

ABBREVIATIONS:

UTM = Universal Transverse Mercator
UTM – X = eastward-measured distance
UTM – Y = northward-measured distance
$PM_{2.5}$ = fine particulate matter less than 2.5 micrometers in aerodynamic diameter
$\mu g/m^3$ = micrograms per cubic meters

SOURCE: ESA, 2021.

NOTES:

a Controls include: all off-road construction equipment was modeled with Tier 4 Final engine emission standards for all engines greater than 125 hp.
b Maximally impacted sensitive receptor.
c Total Project risk or Existing + Project risk may not appear to add due to rounding.
d The $PM_{2.5}$ annual concentration represent the worst year of exposure, not a summation. Project construction and operations do not overlap and therefore are not additive.

APPENDIX H
COASTAL PROCESS ANALYSIS TECHNICAL REPORT

Final

OCEAN BEACH CLIMATE CHANGE ADAPTATION PROJECT

Coastal Process Analysis

Prepared for
San Francisco Planning Department
City and County of San Francisco
Case No. 2019-020115ENV

December 2021

Final

OCEAN BEACH CLIMATE CHANGE ADAPTATION PROJECT

Coastal Process Analysis

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December 2021

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SUMMARY

The City and County of San Francisco (city) is currently designing a coastal adaptation and sea-level rise resilience project to improve the portion of Ocean Beach from Sloat Boulevard to Fort Funston known as South Ocean Beach. The Ocean Beach Climate Change Adaptation Project (project) is a multi-objective project that will address shoreline erosion, severe coastal storm and wave hazards, and sea-level rise, which threaten city infrastructure, coastal access and recreational facilities, and public safety. The project would involve substantial changes to the South Ocean Beach shoreline, including construction of a buried, low-profile wall[1] and trigger-based, episodic beach nourishment.

While the project is intended to address shoreline erosion effects on critical infrastructure, such large-scale shore changes can alter existing coastal processes, resulting in unintended effects on adjacent areas along the beach, bluffs, and through the surf zone. This report presents a technical study of the potential effects of the project on coastal processes and is intended to inform the impacts assessment in an environmental impact report (EIR) being prepared pursuant to the California Environmental Quality Act (CEQA) and to support environmental regulatory permitting.

The following summarizes the data analysis and modeling conducted for this study, along with the study's conclusions:

- Fifteen years of field measurements collected by the USGS, ESA, and others, including beach and bluff topographic surveys and surf zone bathymetric surveys, were used to develop relationships characterizing the changes in offshore and nearshore bar conditions as a function of average wave power and average total water level over a 30-day period.
- Fifteen years of bluff surveys collected by the USGS using structure-from-motion techniques were used to develop series of bluff and beach profiles over time, from which bluff toe erosion rates were computed over space and time. The bluff toe erosion data from an area immediately south of the 2010 emergency revetment was used to calibrate a simplified model of long-term shore change (Pelnard-Considère equation), which was used to inform an assessment of how project conditions with a low-profile wall that is set back further landward than the existing bluffs would affect bluff erosion adjacent to the project.
- A numerical model that coupled hydrodynamics, sediment transport and bed change was developed using the U.S. Army Corps of Engineers' Coastal Modeling System (CMS). The model was used to simulate tides, currents, waves, sediment transport, and morphology change of the surf zone for baseline and project conditions. The model's simulated tides,

1 The project proposes to construct a buried, low-profile wall to protect the Lake Merced Transport tunnel (LMT), which would be located landward of the existing bluff face, and maintained with the intent that it is buried most of the time. This technical report includes assessment of the beach in its nourished and eroded state, and refers to the buried, low-profile wall simply as "the wall" or "low-profile wall."

currents and waves appeared reasonable in comparison to available field data and other modeling. However, counter to expectations based upon coastal engineering literature and historic observations, the model's profile response showed relaxing or smoothing of the profile, rather than the offshore migration of sand bars that would become more defined over the simulated winter month. Therefore, we concluded that the numerical model did not accurately predict how the bars would respond to baseline and project conditions.

- Given the model limitations noted above, we relied upon coastal engineering professional judgment and anecdotal observations of the project area to inform our assessment of potential project effects on sand bars. For project conditions with the new, low-profile wall set-back landward of the existing bluff, the coastal processes in the surf zone are expected to form a more natural geomorphic beach condition relative to the existing baseline condition, which is constrained by armor and rubble. For periods when the wall is exposed, there may be temporary increases in wave reflections that could contribute to local scour in front of the wall, and possibly affecting currents and formation of rip currents, but we expect these to be recoverable through natural seasonal fluctuations and the proposed management actions (e.g., monitoring and beach nourishment).
- Modeled end effect erosion indicates that the project conditions would increase the annualized erosion rate over a ten-year period by up to 0.3 feet per year at the south end of the project for conditions where the wall is exposed. However, the exposed wall conditions are expected to have relatively low likelihoods and would be managed by trigger-based beach nourishment to be informed by long-term project monitoring.

1 INTRODUCTION

The City and County of San Francisco (city) is currently designing a coastal adaptation and sea-level rise resilience project to improve the portion of Ocean Beach from Sloat Boulevard to Fort Funston known as South Ocean Beach. The Ocean Beach Climate Change Adaptation Project (project) is a multi-objective project that will address shoreline erosion, severe coastal storm and wave hazards, and sea-level rise, which threaten city infrastructure, coastal access and recreational facilities, and public safety. Major project components include:

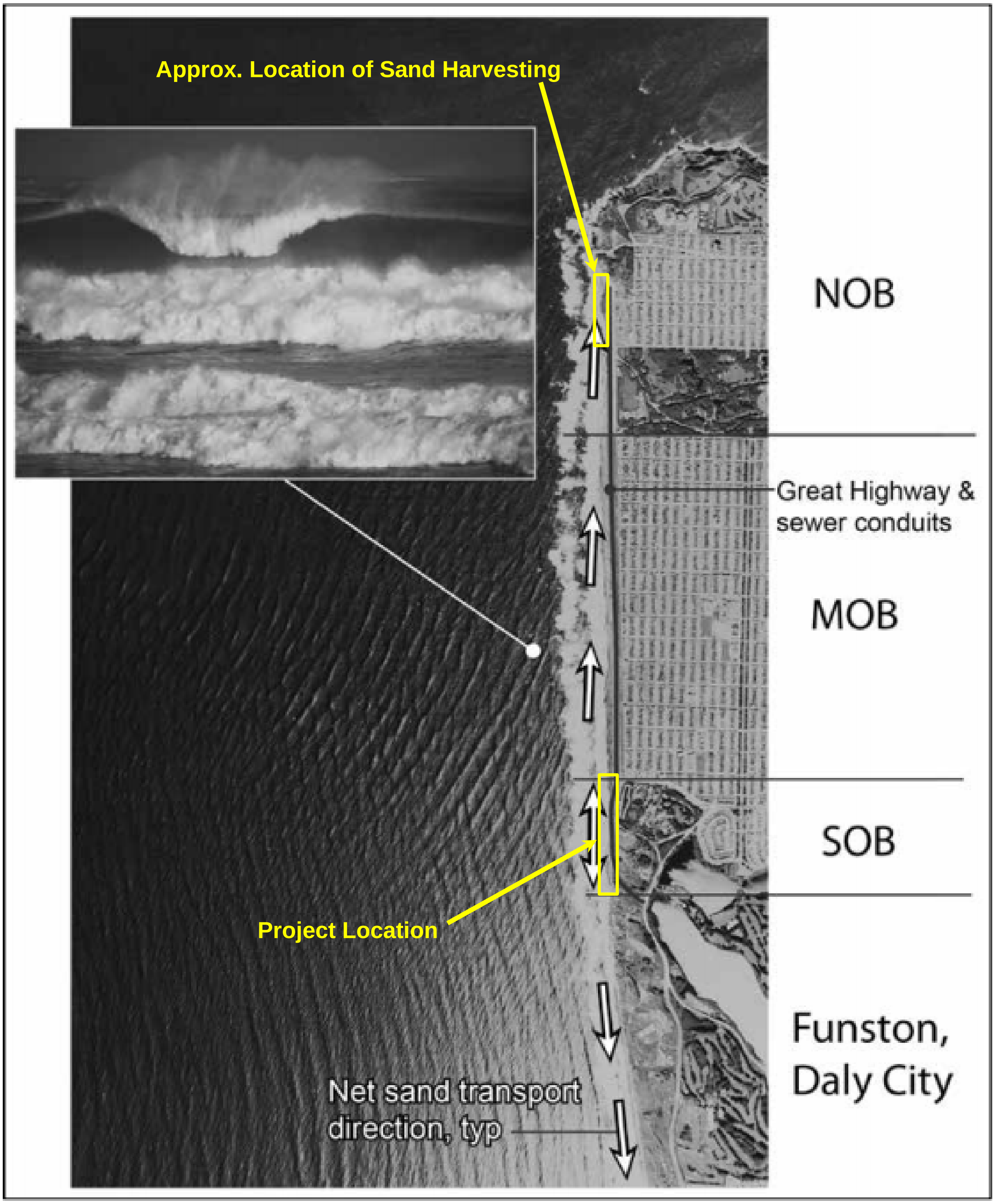
- Constructing a buried, low-profile wall[2] to protect existing sewer infrastructure from shoreline erosion
- Removing rock and sandbag revetments,[3] and rubble and other debris from the beach, re-contouring the bluff, and planting dune vegetation
- Implementing a long-term *beach nourishment*[4] program that will help maintain a sandy beach
- Permanently closing the Great Highway between Sloat and Skyline boulevards to public vehicle traffic, and reconfiguring affected intersections and San Francisco Zoo parking access, and maintaining a service road to San Francisco Public Utilities Commission (SFPUC) facilities
- Constructing a multi-use trail, beach access stairway, coastal access parking, and restrooms

The project area generally encompasses the portion of San Francisco's Ocean Beach extending south from Sloat Boulevard to the northern edge of the Fort Funston bluffs, and a portion of Ocean Beach north of Lincoln Boulevard where sand is harvested for placement south of Sloat Boulevard. The project location is shown in **Figure 1**.

2 The project proposes to construct a buried, low-profile wall to protect the Lake Merced Transport tunnel (LMT), which would be located landward of the existing bluff face, and maintained with the intent that it is buried most of the time. This technical report includes assessment of the beach in its nourished and eroded state, and refers to the buried, low-profile wall simply as "the wall" or "low-profile wall."

3 In coastal engineering, revetments are sloping structures placed on the shoreline to protect the shoreline from erosion or other modification by waves.

4 Beach nourishment is the practice of adding large quantities of sand or sediment to beaches to slow erosion, increase beach width, and provide for continued public beach access and recreation opportunities.



SOURCE: Battalio (2014)
NOTE: Considerable debate and opinions on the direction of net sand transport exists. The direction shown in the figure represents one perspective.

Figure 1
Project Location and Net Sediment Transport Directions

This report represents a supplemental technical study of the effects of the project on coastal processes and is intended to inform the impacts assessment in an environmental impact report (EIR) being prepared pursuant to the California Environmental Quality Act (CEQA) and to support environmental regulatory permitting. The technical analysis presented in this report draws on information provided by the project designer, Moffatt and Nichol Engineers, public agencies, including the United States Geological Survey (USGS) and the United States Army Corps of Engineers (USACE), and developed by ESA's Coastal Zone Engineering and Management team, including Louis White, PE, Bob Battalio, PE, Dane Behrens, PhD, PE, Pablo Quiroga, EIT, Chi-Chun Alicia Juang, EIT, and Yashar Rafati, PhD, EIT.

1.1 Background

Ocean Beach comprises a 3.5-mile stretch of sandy beach that forms the western boundary of San Francisco. It is influenced by complex coastal processes, including intense wave conditions, strong tidal currents, and a large ebb shoal delta consisting of a semi-circular sand bar offshore and to the North of South Ocean Beach. The ebb shoal delta extends from the Marin headlands north of the Golden Gate. to Middle Ocean Beach. Chronic erosion of the beach and bluffs by episodic coastal storms occurs at South Ocean Beach. This erosion has undermined and damaged beach parking lots, stormwater drainage facilities and the Great Highway, threatens existing underground wastewater system infrastructure, and has constrained public shoreline access and recreational opportunities.

The net transport directions shown in Figure 1 are based on a series of studies that include a sand budget analysis in order to characterize ongoing erosion problems at Ocean Beach, and in particular at South Ocean Beach.[5,6] The arrows indicate a conceptual model of net longshore sand transport, showing a diversion zone in the vicinity of South Ocean Beach, northward transport north of the diversion zone (Middle and North Ocean Beach), and southward transport south of the project area (Fort Funston and Daly City). The concept of a zone of diversion in net transport was associated with wave and sand supply gradients[7], and also anecdotal observations indicating dispersal of sand placed at South Ocean Beach.[8] Multiple studies by the USGS indicate southward transport through the study area and a diversion zone farther north in the vicinity of

5 Battalio R.T., and Trivedi, D., 1996, Sediment transport processes at Ocean Beach, San Francisco, CA, *Proc. 25th Int. Conf. Coastal Engineerin*g, Orlando, FL, ASCE, 2691-2704.

6 Battalio, R.T., 2014, Littoral processes along the Pacific and bay shores of San Francisco, California, USA, *Shore & Beach*, 82(1), Winter 2014, 3-21.

7 Battalio R.T., and Trivedi, D., 1996, Sediment transport processes at Ocean Beach, San Francisco, CA, *Proc. 25th Int. Conf. Coastal Engineerin*g, Orlando, FL, ASCE, 2691-2704.

8 Sand has been placed at South Ocean Beach to mitigate erosion of the backshore and provide wider beaches repeatedly since the early 2000s.

Middle Ocean Beach[9,10,11], and northward transport along north Ocean Beach[12]. The wave modeling used by the USGS is an industry standard model that was not able to resolve some potential sand transport pathways thought to exist, such as onshore sand transport from the San Francisco Bar to Ocean Beach and sand transport northward around Point Lobos, and Fort Point and into San Francisco Bay.[13] We note that the model uses average wave directions which can be erroneous in the vicinity of strong refraction-driven wave crossing known to exist at Ocean Beach (see Figure 1 inset). The northward transport computed along Ocean Beach for strong westerly swell[14] is an indication that the average direction was dominated by the refracted southwesterly swell in this case. After a review of these documents we conclude that the net longshore sand transport is potentially southward in the study area, but shore modifications have resulted in bluffs that are farther seaward, resulting in very narrow beaches and essentially net transport away, to the north, south and offshore, from the project area, as indicated in Figure 1.

Since the 1990s, the city has responded to the erosion through implementation of a series of hard shoreline armoring (e.g., construction of rock revetments) and soft shoreline protection measures (e.g., beach nourishment and sandbag revetments). In the intervening period, the city has also undertaken planning initiatives aimed at developing a long-term strategy for managing the South Ocean Beach shoreline, including major initiatives such as the development of the 2012 Ocean Beach Master Plan (master plan).[15,16,17] The terms of a 2014 legal settlement agreement[18] and a 2015 California Coastal Commission permit[19] both establish timelines for developing and implementing a long-term solution to shoreline management at South Ocean Beach. In 2018, the

9 Hansen, J.E., Elias, E.P.L, List, J.H., Erikson, L.H., and Barnard, P.L., 2013, Tidally influenced alongshore circulation at an inlet-adjacent shoreline, *Continental Shelf Research*, 56, 26-38.

10 Hansen J.E., Elias, E., and Barnard, P.L., 2013, Changes in surfzone morphodynamics driven by multi-decadal contraction of a large ebb-tidal delta, *Marine Geology*, 345, 221-234.

11 Elias, E.P.L., and Hansen, J.E., 2013, Understanding processes controlling sediment transports at the mouth of a highly energetic inlet system (San Francisco Bay, CA), *Marine Geology*, 345, 207-220.

12 Barnard, P.L., Foxgrover, A.C., Elias, E.P.L., Erikson, L.H., Hein, J.R., McGann, M., Mizell, K., Rosenbauer, R.J., Swarzenski, P.W., Takesue, R.K., Wong, F.L., and Woodrow, D.L., 2013, Integration of bed characteristics, geochemical tracers, current measurements, and numerical modeling for assessing the provenance of beach sand in the San Francisco Bay Coastal System, *Marine Geology*, 336, 120-145.

13 Hansen J.E., Elias, E., and Barnard, P.L., 2013, Changes in surfzone morphodynamics driven by multi-decadal contraction of a large ebb-tidal delta, *Marine Geology*, 345, 221-234.

14 Elias, E.P.L., and Hansen, J.E., 2013, Understanding processes controlling sediment transports at the mouth of a highly energetic inlet system (San Francisco Bay, CA), *Marine Geology*, 345, 207-220.

15 SPUR, AECOM, ESA PWA, Nelson\Nygaard, Sherwood Design Engineers, Phil D. King, PhD, 2012, Ocean Beach Master Plan, Prepared for State of California Coastal Conservancy, San Francisco Public Utilities Commission, and the National Park Service.

16 SPUR, ESA PWA, Moffatt & Nichol, McMillen Jacobs Associates, and AGS, Inc., 2015, Coastal Protection Measures & Management Strategy for South Ocean Beach, Ocean Beach Master Plan: Coastal Management Framework, Prepared for San Francisco Public Utilities Commission, April 24, 2015.

17 SPUR and AECOM, 2017, Ocean Beach Open Space Landscape Design Summary, Prepared for the California State Coastal Conservancy, the National Parks Service Cosco Busan Settlement Fund, and the San Francisco Public Utilities Commission, February 2017.

18 California Coastal Protection Network and City and County of San Francisco, 2014, Settlement Agreement and Mutual Release in the case California Coastal Protection Network v. City & County of San Francisco, Case No. CGC-11-513176.

19 California Coastal Commission, 2015, Coastal Development Permit, Application Number 2-15-1357, Granted by the CCC to San Francisco Public Utilities Commission on November 5, 2015, Permit dated November 9, 2015.

city amended its local coastal program, the Western Shoreline Area Plan,[20] to adopt policies that advance the Ocean Beach Master Plan's general vision for South Ocean Beach.

1.2 Proposed Shore Modifications

Under current conditions, approximately 1,200 feet of the site is protected by rock and sandbag revetments; the remaining 2,000 feet of beach is mostly backed by substantial amounts of rubble and debris from legacy shoreline development and erosion prevention efforts. Under the project, the city would remove the existing shore protection structures, rubble and debris, and construct a low-profile wall along an alignment that is inland of the toe of the bluff and revetments, and reshape the bluff to provide a more gradual transition between beach and upland areas. To maintain a sandy beach and minimize wall exposure, the city would implement a shore monitoring and trigger-based beach nourishment program.

The proposed wall would extend from Sloat Boulevard to approximately 3,200 feet to the south. The wall would be approximately 3 feet thick, set back as far from the shoreline as feasible, and buried under sand. To stabilize the bluff face above the wall, the city would reshape the bluff face and construct a separate 3-foot-thick, gently sloping (3:1 horizontal to vertical slope) layer of cementitious material, composed of a *soil-cement mix*[21] or *controlled low strength material*[22] (slope stabilization). The slope stabilization would minimize erosion of the material overlying the tunnel and protect against scour behind the wall from wave runup and high surf conditions.

The project design calls for the wall and slope stabilization to be buried a minimum of 4 feet below the ground surface. Under normal conditions, the wall and slope stabilization would remain buried. However, the wall and slope stabilization could be exposed after severe storms and high wave conditions when the beach and bluff can erode away rapidly. To address this issue, the city proposes to implement a shoreline monitoring program and place sand when established triggers are met during monitoring.[23] The first trigger would be reached if the beach width were observed to be less than 50 feet over a contiguous 500-foot length of beach.[24] The second trigger would be reached if the buried wall were observed to be exposed over a contiguous 500-foot length of beach.[25] Sand placements would occur as soon as possible following reporting that the trigger has been reached.

The city has identified two primary sand sources and placement methods. The first is the San Francisco Harbor – Main Ship Channel, which is regularly dredged by the U.S. Army Corps of Engineers (Corps) as part of that agency's ongoing federal navigation channels maintenance

[20] The Western Shoreline Area Plan is the land use plan component of the city's local coastal program. The city obtained California Coastal Commission certification of the amendment in May 2018.

[21] A soil-cement mix is a weak form of concrete formed by mixing in place the existing soils with a cementitious grout.

[22] A controlled low strength material is a weak mixture of cement, aggregate, and water that flows easily.

[23] The areas of measurements for sand placement triggers are those above the mean high water elevation.

[24] Moffatt & Nichol Engineers, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020. Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements. Prepared for San Francisco Public Utilities Commission. July 2020.

[25] Ibid.

program.[26] Under the first option, referred to generally as the "large placement," a Corps dredge would pump up sand in a *slurry*[27] onto the beach, rather than disposing of it offshore. The large sand placements would be between 300,000 and 500,000 cubic yards. This potential option would require an extended/updated agreement with the Corps and federal approval.[28]

The second primary source is North Ocean Beach (i.e., north of Lincoln Way). Under this option, referred to generally as the "small placement," the city would continue its practice of excavating and trucking excess sand from North Ocean Beach to South Ocean (referred to as *sand backpass*).[29,] The small placement option would involve trucks dumping approximately 85,000 cubic yards of sand onto the beach and reshaped bluff. In the event that sand from the Corps and North Ocean Beach is unavailable in a given year, the city would obtain a smaller volume of sand (~25,000 cubic yards) from a commercial vendor. Sand removed along the Great Highway for maintenance north of Sloat Boulevard could also be placed at the South Ocean Beach project site.

The type and frequency of sand placements would depend upon sand availability (i.e., Corps dredge and North Ocean Beach) and observed shoreline conditions (e.g., sea level rise and related erosion rates). In developing the project's sand management plan, the city's design engineer used a model to estimate the performance of the small and large sand placements in terms of wall exposure and maintaining a sandy beach. Based upon this analysis, which includes consideration for sea-level rise of up to 8.1 feet, wall exposure would be infrequent, with full wall exposure occurring approximately four times over the project lifetime (modeled as 80 years). **Table 1** shows the modeled probability of various beach widths[30] under the project for both the small and large sand placements, which represents the range of potential sand placement types and frequencies. The modeling results indicate that, under the project, South Ocean Beach would be wider than 50 feet at least 90 percent of the time over the lifetime of the project.[31]

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[26] To provide deep-draft marine vessel access between the Pacific Ocean and San Francisco Bay, the Corps regularly dredges a sandbar located approximately 2 miles offshore of the Golden Gate. Commonly known as the main ship channel, the passage measures approximately 2,000 feet wide and 26,000 feet long, and is maintained at a depth of approximately 55 feet mean lower low water. Dredged material from the main ship channel generally consist of fine sand (median diameter range from 0.15 to 0.21 millimeters).

[27] A slurry is a mix of sand and ocean water that can be transported via pipeline from an offshore dredge to the beach.

[28] Per the U.S. Army Corps of Engineers' Final Environmental Assessment/Environmental Impact Report for Maintenance Dredging of the Federal Navigation Channels in San Francisco Bay Fiscal Years 2015-2024, the median volume of material dredged from the main ship channel per dredging episode between 2000 and 2014 is 306,000 cubic yards (range of 78,000 to 613,000 cubic yards). Thus, a large sand placement scenario with 300,000 cubic yards per placement event is considered a reasonable case for purposes of the project's coastal process analysis. Moreover, given the shore would be set back and wider relative to current conditions, and that a beach nourishment project of 300,000 cubic yards would persist for multiple years and would support the natural coastal processes, the project with a 500,000 cubic yard large placement would not be expected to have substantially different effects.

[29] Sand backpassing has been performed at Ocean Beach since 2013 and occurred most recently in 2019.

[30] The metric "beach width" is defined in the Moffatt & Nichol (M&N) *Sand Management Plan* (2020) as the distance from the backshore (i.e. wall) to the mean high tide line (i.e., the elevation contour corresponding to the mean high water tidal datum, approximately 5.3 feet NAVD). For the M&N analysis summarized here, the beach width is represented as a spatial-average along the project area.

[31] Moffatt & Nichol Engineers, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020. Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements. Prepared for San Francisco Public Utilities Commission. July 2020.

TABLE 1
PERCENT OCCURRENCE OF MODELED BEACH WIDTH RANGES FOR SMALL AND LARGE SAND PLACEMENTS

	Beach Width[a] Range	Small Sand Placements (85,000 cubic yards)	Large Sand Placements (300,000 cubic yards)
Average Percent of Time Beach Width Distribution (%)	Width < 25 feet	3 %	2 %
	25 feet < Width < 50 feet	6 %	4 %
	50 feet < Width < 80 feet	17 %	13 %
	80 feet < Width < 160 feet	68 %	63 %
	160 feet < Width < 230 feet	6 %	18 %
	Width > 230 feet	0 %	0 %

NOTES:

a Distance from the backshore (i.e., wall) to the mean high tide line (i.e., the elevation contour corresponding to the mean high water tidal datum, approximately 5.3 feet NAVD.

SOURCE: Moffat & Nichol Engineers (2020a) Sand Management Plan

1.3 Purpose of Study

The purpose of this study is to provide the technical information necessary to assess whether the proposed project (construction of a new wall and beach nourishment) would result in substantial adverse effects on coastal processes, focusing specifically on beach and bluff erosion, or *end effects*, adjacent to the project, and offshore sand bars. Human manipulation of shorelines can disrupt natural coastal processes, resulting in unintended effects on adjacent coastal areas. Shore protection structures (e.g., seawalls, revetments) are designed to prevent erosion of the land behind the structures. Such features can change wave energy dissipation and the rate of sand transport locally.[32] During elevated wave events, scour can occur in front of and adjacent to an exposed shoreline protection structure, lowering the beach, increasing wave reflection and increasing offshore and alongshore sand movement. The offshore sand movement and reflected waves can change the shape of the nearshore sand bars and associated breaking wave patterns.[33] Beach nourishment projects can help to dissipate wave energy by increasing sand supply to the surf zone and adjacent shores and buffering the shore from erosion.[34] However, sand placement can also alter offshore sand bar geometry by changing sand transport rates and patterns through the surf zone.[35] These changes can, in turn, affect wave breaks and patterns.[36,37,38]

32 Griggs, Gary; Kiki Patsch and Lauret Savoy. *Living with the Changing California Coast*, University of California Press, Berkeley and Los Angeles California, USA. 2005.

33 U.S. Army Corps of Engineers (USACE), 2003. Coastal Engineering Manual 1110-2-1100, Chapter 3, Cross-shore Sediment Transport Processes, Figure III.3.2.

34 Ibid.

35 Stauble, Donald K. PhD, PG, 2005. A Review of the Role of Grain Size in Beach Nourishment Projects. U.S. Army Engineer Research and Development Center Coastal and Hydraulics Laboratory 3909 Halls Ferry Road Vicksburg, MS 39180-6199.

36 Dean, R.G., 2002, *Beach Nourishment Theory and Practice*, Advanced Series on Ocean Engineering – Volume 18, World Scientific, River Edge, NJ, 399 pp.

37 Dally, W.R., and Osiecki, D.A., 2018, Evaluating the Impact of Beach Nourishment on Surfing, *Journal of Coastal Research*, **34**(4), pp. 793-805.

38 Usher, L.E., 2021, Virginia and North Carolina surfers' perceptions of beach nourishment, *Ocean & Coastal Management*, 203,

1.4 Scope of Study

The study focuses on project elements proposed for the southern portion of Ocean Beach, extending south from Sloat Boulevard approximately 3,200 feet to the Fort Funston bluffs, commonly referred to as South Ocean Beach. Since this technical report addresses the potential for project-related impacts in the coastal zone, and since coastal processes are complex and interconnected with areas of Ocean Beach to the immediate north and south, the study area extends several thousand feet to the north and south of the South Ocean Beach project site boundaries.

The scope of this study includes data review and analysis, and modeling of the nearshore system at South Ocean Beach. As part of the study, ESA acquired data from the USGS including beach, bluff, and nearshore surveys conducted over the last approximately 15 years. ESA developed a hydrodynamic[39] and morphodynamic[40] model of the system using the USACE Coastal Modeling System (CMS) platform, which is a numerical model that is used to simulate waves, currents, and sediment transport in complex, coastal systems. ESA used the data analysis and modeling to assess how the project could affect the nearshore processes, including potential changes to the sandbars offshore of the project site and potential for accelerated erosion adjacent to the south end of the project. The scope of this study does not include assessing the performance of the project, the sand management plan, or the potential project effects with sea-level rise.

Middle Ocean Beach extends approximately 10,500 feet south from Lincoln Way to Sloat Boulevard. This reach is characterized by a moderately wide sandy beach (approximately 180 feet to 210 feet in width),[41] backed by vegetated sand dunes or a seawall (north from Taraval Avenue). Inter-annual variations in shoreline position are substantial, due to the high wave power dissipated on this segment of shoreline. However, the long-term average Middle Ocean Beach shore position is relatively stable (i.e., not eroding), due in part to alongshore sand transport and erosion of the sand dune barrier constructed as part of the Clean Water Program in the 1980s and 1990s.[42] Annual shoreline data collected by the USGS between 2004 and 2020 indicates Middle Ocean Beach is widening, with an average annual accretion rate of about 4.3 feet per year (beach accretion and erosion is measured as the horizontal movement of the mean high water line over time). Closer to the project site (i.e., within 1,000 feet upcoast of Sloat Boulevard), the average annual accretion rate is around 0.7 feet per year.[43] Thus, while up to 150 feet of beach erosion has been documented at a single location during a single storm season, Middle Ocean Beach is generally widening.[44]

39 Hydrodynamic applies to moving water, in this case waves and currents.

40 Morphodynamic model refers to prediction of the change in shore and nearshore surface elevations (aka bed change) resulting from hydrodynamics.

41 Hansen, J. E., and Barnard, P. L., 2010. Sub-weekly to interannual variability of a high energy shoreline. Coastal Engineering, 51, 959-972

42 Battalio, R.T., 2014, Littoral processes along the Pacific and bay shores of San Francisco, California, USA, Shore & Beach, 82(1), Winter 2014, 3-21.

43 USGS (2020). Ocean Beach LMT Seawall Project Area Erosion Rates. Processed and Provided by Dan Hoover, PhD. Unpublished Data. February 5, 2020.

44 Moffatt & Nichol Engineers, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020. Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements. Prepared for San Francisco Public Utilities Commission. July 2020. Figure 2-1.

The analysis of project end effects in this study is focused on the transitions from South Ocean Beach to Middle Ocean Beach to the north and to Fort Funston to the south. As noted above, Middle Ocean Beach is accreting, and end effects associated with present-day South Ocean Beach structures or management have not been observed at Middle Ocean Beach. For these reasons, and because the project would remove existing shoreline protection and widen South Ocean Beach, the project would not result in accelerated erosion along Middle Ocean Beach. Therefore, the discussion of end effects in this study focuses on the south end of the project toward the Fort Funston shoreline.

1.5 Structure of Report

The remainder of this document is organized as follows:

- Section 2 presents an overview of the technical approach, including both the data analysis and setup of the numerical model
- Section 3 summarizes the results of the analysis of the field observations and the numerical modeling, and the project effects relative to baseline conditions, including a discussion of the numerical model output relative to anecdotal and theoretical expectations
- Section 4 presents conclusions of the study

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2 TECHNICAL APPROACH

This section describes the technical approach and methods that were used to address the potential changes to the sand bars and to the adjacent backshore erosion due to the project. The following includes an overview of the approach, description of the data collection and analysis, the model setup and application, and key assumptions.

2.1 Overview of Approach

The technical approach used for this study relied on a combination of analysis of data collected at the site and modeling of the system using a numerical model to develop an understanding of the nearshore coastal processes. Overall, we assessed the natural variability of the system, based on the findings of existing studies (see Section 5, References) and the analysis of over 15 years of beach topography and surf-zone profiles collected by the USGS (observations).[45] We used a detailed numerical model to simulate the coastal processes, including the hydraulics and sediment transport, over a month-long event, for which we compared the results to the observations.

We focused the assessment on two primary physical process questions:

- What are the effects of the project on the sand bars, which influence wave breaking and affect surfing conditions?
- What are the effects of the project on coastal erosion immediately north and south of the project?

The data analysis and results are described in terms of *bar effects* and *end effects*, referring to the effects of the project on the sand bars and the backshore erosion, respectively. **Figure 2** presents photographs taken on February 21, 2019 at the South Ocean Beach site looking south toward the Fort Funston bluffs and downward and to the north, as an example of the end effects or flanking erosion occurring immediately south of the emergency revetment constructed in 2010.

Throughout the analysis, we coordinated with others to provide input on the technical approach, characterization of the proposed project, and for the modeling. At interim study milestones, we met with staff from the USGS who reviewed the overall technical approach, preliminary data analysis methods and findings, and provided additional insights into interpretation of the data. Similarly, the analysis relied on information and analysis developed in support of the project design, and thus we coordinated with the project designers, Moffatt and Nichol Engineers.

45 USGS, 2021, Provisional monitoring data provided by USGS researchers Dan Hoover and Jonathan Warrick, consisting of repeated surveys of ocean floor and beach elevations, photographs and digital elevation models.

SOURCE: Louis White 2/21/2019

Figure 2
Photographs of South Ocean Beach looking toward Fort Funston Bluffs (left) and area of acute erosion adjacent to 2010 revetment (right)

We developed a series of metrics with the technical team to test the confidence of model predictions for project effects (relative to uncertainty), including the following indicator metrics for bar effects and end effects:

- Bar Effects
  - The location of the crest of the offshore and nearshore sand bars[46]
  - The elevation of the crest of the offshore and nearshore sand bars
  - The relief[47] of the offshore and nearshore sand bars relative to the trough (located immediately shoreward of the sand bar)
- End Effects
  - Intensity and frequency of incident waves[48]
  - Elevated water levels
  - Local scour

The parameters listed above were tabulated for data observations as well as from the model results, and used to evaluate the potential end erosion and bar effects of the project relative to baseline conditions. This analysis relied on developing an understanding of the natural variability of the above parameters from the observed data, and an understanding of the baseline condition using the numerical model. Several project conditions were analyzed using the numerical model, and the project effects were evaluated by comparing the project conditions results to the natural variability

46 The beach profile at Ocean Beach typically includes a nearshore and offshore sand bar, which are areas of locally raised sand platforms upon which waves break. The largest waves at Ocean Beach will break on the offshore bar, which forms and degrades annually and is used for surfing during large swells, while relatively smaller waves break on the nearshore bar, which is more persistent and is used for surfing more frequently throughout the year.

47 Bar relief is defined as the height of the bar crest relative to the trough located immediately shoreward of the bar.

48 In this context, the term *incident waves* refer to waves that are arriving at or approaching the beach or a specific section of shore.

of the observed data and the baseline conditions results. The technical methods for the data analysis and the modeling are described in more detail in the following sections.

2.2 Data Collection and Analysis

Data collection and analysis was grouped into two categories concerning the bar effects and end effects, as described below. This effort leveraged several long-term monitoring datasets that provided hydrologic and morphologic information within the project area. Understanding the long-term trends in these data is a necessity, as it (1) provides a basis for understanding natural sandbar dynamics and erosion along the backshore, for use in developing metrics for testing project effects, (2) helps with identifying prior bar and backshore responses to management actions, (3) can be used to establish a level of confidence in the predictions of the numerical model, and (4) can be used to quantify levels of uncertainty in the data. Understanding uncertainty is important to assess if the model results under simulated project conditions truly represent a substantial change relative to the baseline. If the historic observation data on bar conditions or end effects show a high level of variability, it is more difficult to establish project effects with certainty.

Table 2 summarizes the sources of data used in this study. All sources were either publicly available, collected previously by ESA, or provided by the USGS.

Figure 3 presents a strip chart that shows the availability of beach topography and surf zone survey data sets over time (top row), as well as the corresponding incident wave height, non-tidal residuals, and the volume of sand backpass projects[49,50] that occurred over the timeframe. The data availability includes USGS-collected beach topography data sets, USGS-collected bluff structure-from-motion (SfM) data sets, USGS-collected surf zone bathymetry surveys (both regular and hi-resolution coverage), and ESA-collected surveys of the bluffs and beach. These data sets are described below. Also shown on the chart are the wave conditions and the non-tidal residuals (NTR), which are defined as the difference of the observed tide and predicted tide. This information was used to establish the modeling period, which we selected as January 2017 because of its relatively high waves, water levels, and dense availability of data sets.

USGS offshore bed elevation (i.e., bathymetry) data were particularly important for studying bar conditions. Offshore bathymetry was collected by jet ski one to five times per year, and generally covers offshore areas with bed elevations from the mean lower low water (MLLW) contour to approximately -50 feet NAVD.[51] While these surveys sometimes cover areas farther inland, wave breaking on the nearshore bar can prevent safe boat operation landward of the MLLW contour, and air and sediment in the water column often degrade sonar data quality, limiting data acquisition in that region.

[49] Environmental Science Associates (ESA), 2020, 2019-2020 Monitoring Report, Ocean Beach Short-Term Erosion Protection Measures Project, Prepared for San Francisco Public Utilities Commission, June 2020.

[50] SFPUC, *Alternatives Analysis Report for Coastal Adaptation Strategies for South Ocean Beach Wastewater Systems*, February 2018.

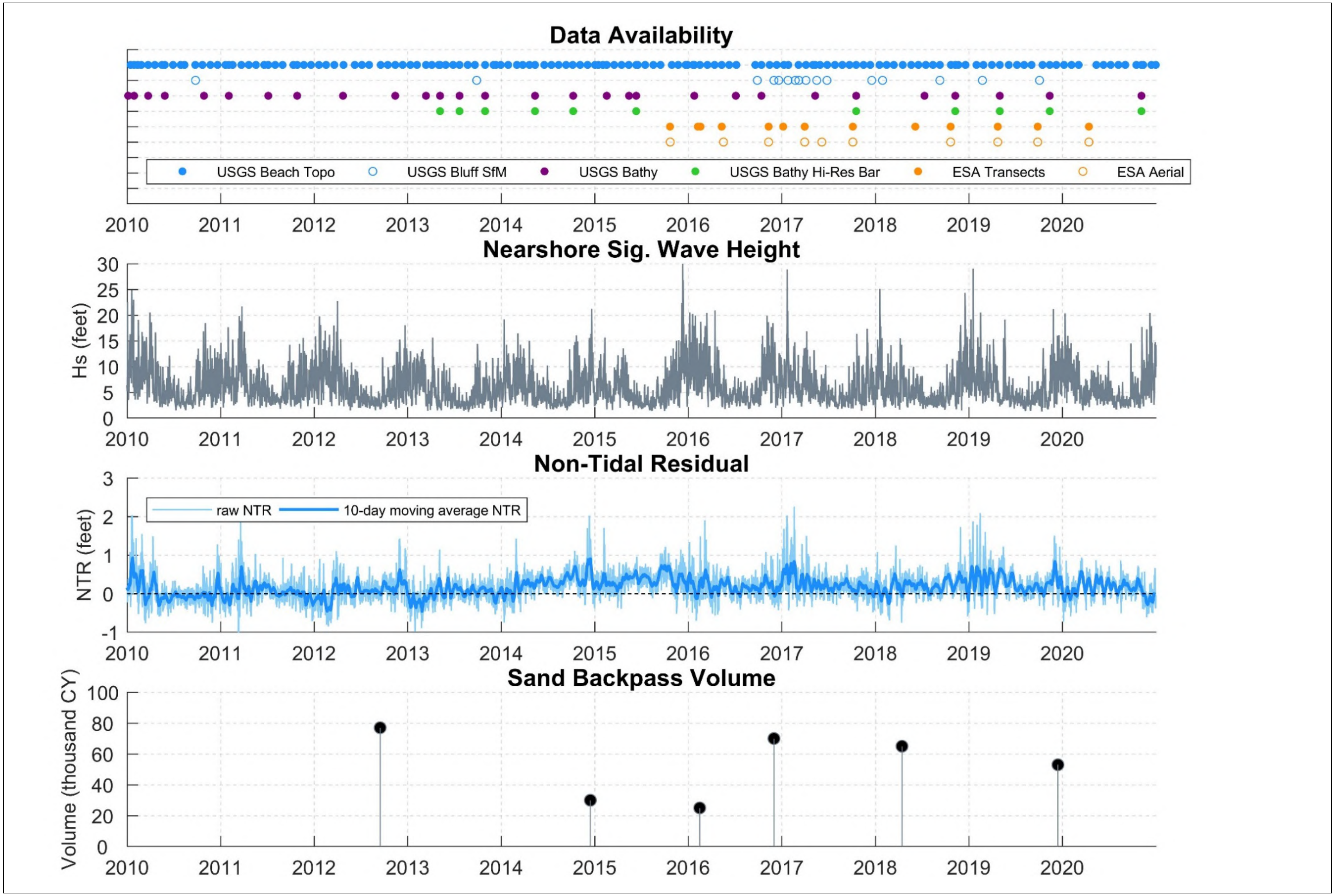
[51] NAVD refers to the North American Vertical Datum of 1988, a fixed reference for elevations determined by geodetic leveling. The datum was derived from a general adjustment of the first-order terrestrial leveling nets of the United States, Canada, and Mexico, and is generally close to the mean lower low water tidal datum.

TABLE 2
DATA SOURCES

Data Source	Location	Source	Notes
Coastal Hydrology			
Waves: Offshore	18 miles west of Project Site	NDBC[a] 46026	Offshore buoy (deepwater waves)
Waves: Offshore	8 miles NW of Project Site	NDBC 46237	San Francisco Bar buoy
Waves: Nearshore	Adjacent to Project Site	CDIP[b] SF014	CDIP Predictions at 10m depth contour[c]
Ocean Tides	Point Reyes (34 miles NW of Project Site)	NOAA[d] 9415020	Offshore tides, unaffected by SF Bay currents
Morphology			
Nearshore Bathymetry	Ocean Beach (including Project Site)	USGS[e]	Soundings collected across the surf zone during jet ski surveys every 6 months ±
Beach Topography	Ocean Beach (including Project Site)	USGS	Ground-based RTK-GPS surveys of beach topography collected every 2-4 weeks
Beach Topography	Project Site	ESA[f], SOA[g]	Ground-based RTK GPS surveys and aerial photogrammetry in fall and spring
Beach and Upland Topography	Ocean Beach and Upland, Bluffs	USGS	2016 Coastal LiDAR collected prior to El Niño Winter conditions
Upland Topography	Fort Funston Bluffs, Project Area	USGS, CCRP[h]	Bluff Topography from photogrammetry
Site Photographs	Project Area	ESA	Monitoring photographs collected to document site conditions

NOTES:

a. NDBC = National Data Buoy Center
b. CDIP = Coastal Data Information Program
c. The CDIP wave estimates do not account for wave breaking shoreward of the sand bars at the site.
d. NOAA = National Oceanic and Atmospheric Administration
e. USGS = United States Geological Survey
f. ESA = Environmental Science Associates
g. SOA = Sierra Overhead Analytics
h. CCRP = California Coastal Records Project



SOURCE: nearshore significant wave heights estimated by CDIP at MOP station SF014. Non-tidal residuals based on NOAA Pt Reyes tide station.

Figure 3
Data availability (top) compared with hourly nearshore significant wave height (second panel), hourly and running average non-tide residual water levels (third panel), and sand backpass volumes (fourth panel)

Beach topography is also important since it has a close interrelationship with the nearshore bar (through seasonal bar welding and erosion processes), and it is also closely tied to erosive conditions on the backshore bluff areas.[52,53] The USGS typically collects beach topography every 4 weeks using either ATV-mounted RTK-GPS[54], or by using RTK-GPS on foot where the beach is too narrow to pass by vehicle. Since 2015, ESA has also collected ground-based RTK-GPS surveys at a number of cross sections along the project site and aerial topographic mapping, as part of a South Ocean Beach monitoring program.[55] The monitoring includes aerial (drone-based) photogrammetry surveys that yield high density measurements of the beach and bluff elevations, and ground-based photographs that are used to document localized erosion.

The USGS has conducted several SfM surveys to assess detailed changes in bluff morphology over the last 15 years.[56] The SfM data includes processing of imagery collected by the USGS as well as from imagery obtained from the California Coastal Records Project.[57] The USGS provided this data to ESA, from which bluff transects were extracted and erosion patterns were assessed. The SfM data is relatively sparse over time, but several data sets were collected in the 2016-2017 winter.

2.2.1 End Effects

End effects refers to the change in erosion pattern adjacent to shore armoring (hereafter also referred to as a wall or low-profile wall) and can be thought of as the localized transition between the two conditions (armored and unarmored). Of relevance is whether the anticipated occasional exposure of the proposed wall would substantially increase the extent and/or rate of erosion on the adjacent Fort Funston shoreline (to the south).

Background

Effects of Exposed Coastal Armoring on Adjacent Shores

Coastal engineering literature identifies several mechanisms which may cause increased erosion adjacent to a coastal structure, and the most pertinent for south Ocean Beach are:

- Reduced sand supply caused by the wall blocking or reducing longshore sand transport;
- Wave reflection from the wall that changes the sand transport patterns;

52 Collins, B.D., and Sitar, N., 2008, Processes of coastal bluff erosion in weakly lithified sands, Pacifica, California, USA, *Geomorphology*, 97(3), 483-501.

53 Young, A.P., Guza, R.T., Matsumoto, H., Merrifield, M.A., O'Reilly, W.C., and Swirad, Z.M., 2021, Three years of weekly observations of coastal cliff erosion by waves and rainfall, *Geomorphology*, 375, Article 107545.

54 RTK-GPS: Realtime Kinetic Global Positioning System; a topographic surveying method relying on communication between satellites and ground-based equipment.

55 Environmental Science Associates (ESA), 2016, 2016-2021 Short-Term Monitoring Program, Ocean Beach Short-Term Erosion Protection Measures Project, Prepared for San Francisco Public Utilities Commission, January 27, 2016.

56 Warrick, J.A., Ritchie, A.C., Adelman, G., Adelman, K., and Limber, P.W., 2017, New techniques to measure cliff change from historical oblique aerial photographs and Structure-from-Motion photogrammetry, *Journal of Coastal Research*, 33(1), 39–55.

57 Ibid.

- Accelerated longshore current owing to wave reflection and or scour at the wall; and,
- Rip current formation that carries sand offshore.

These end effects are limited in alongshore extent, generally on the order of a thousand feet from each end of the wall. This distance is related to the wavelength of the typical winter waves[58] which, for the project area, have peak periods of approximately 16 to 20 seconds. This approximate alongshore extent was used to guide the analysis of assessing the potential accelerated erosion for the study.

The shore modeling performed by Moffatt & Nichol Engineers indicates that the sand placement would maintain a beach in front of the wall most of the time, largely preventing wave-wall interactions that might lead to end effects. Therefore, the analysis considers limited-duration events that represent occasional wall exposure; for example, one “extensive” and one “moderate” exposure event, characterized by the spatial extent and time duration of exposure, based on the prior modeling. Each of these “events” are expected to be recoverable and relatively short term (months), in the sense that sand will move back onshore naturally, and if necessary would also be placed mechanically, building up and widening the beach, and re-covering the wall.

Data Analysis Approach

We coordinated with the USGS, owing to their prior work in the area studying bluff erosion at Fort Funston, to request and receive specific data sets on shore topography and bathymetry, and bluff erosion. The data was used to identify historic erosion rates and locations, and to select observed events that could be used to verify the proposed modeling and interpret results. We used observed erosion events to verify the hydrodynamic model and develop a relationship of bluff or dune response to the approximate modeled wave and water level conditions using an analytical model of shore erosion, which was then used to determine erosion potential under project conditions.

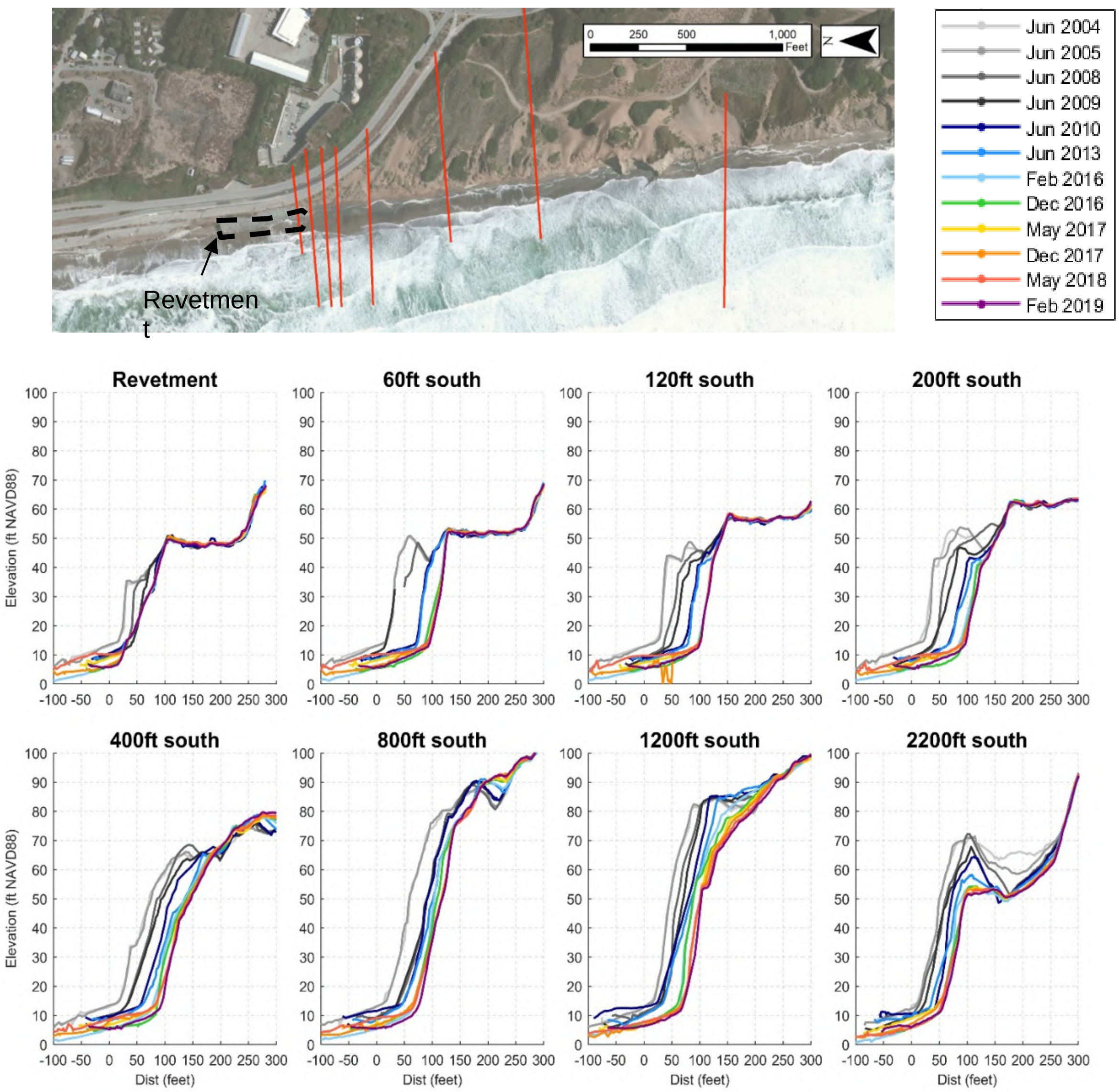
Topography of the Fort Funston bluffs and portions of the backshore areas of the project site were provided by the USGS. These data are based on a photogrammetry technique developed for extracting topography from multiple overlapping photographs of the backshore area. These photographs consisted of oblique aerial images taken from aircraft (Warrick et al. 2017).

The USGS provided digital data files for the series of dates shown in Figure 3. The high density of data collection in 2016 and 2017 made it possible to assess the bluff erosion response to the 2015/2016 El Niño and 2016/2017 La Niña winter conditions. We also utilized drone-based topographic data of the project area, collected as part of SFPUC’s annual shoreline monitoring over the same time period, so the area of coverage includes both the project site and the Fort Funston bluffs to the south.

ESA used the following procedure to measure bluff erosion rates:

[58] Larson, M., Hanson, H., and Kraus, N.C., 1987, Analytical solutions of the one-line model of shoreline change, Coastal Engineering Research Center, Vicksburg, MS, October 1987.

- USGS raw photogrammetry point clouds were processed using LASzip software to convert them to a format that could be processed in ESRI ArcMap GIS software.
- A series of shore-perpendicular transects were selected through the project site and extending several thousand feet south. Transect intervals varied, having a high concentration in places of interest such as the 2010 revetment (about 60-200 feet apart), and increasing in distance to the south (~400+ feet apart).
- Topography transects were cut from the SfM data processed by the USGS for each time period that data were collected. **Figure 4** presents the bluff profiles over time at several locations south of the existing revetment.



SOURCE: USGS (2021) Provisional Data

Figure 4
Series of bluff profiles over time at locations extending south from the existing 2010 revetment and the southern terminus of the project site

- ESA developed a software routine in Matlab© to identify points of interest on each transect, such as bluff toe or bluff crest elevations.

- Rates of erosion were estimated based on the relative change of the bluff toe at each transect, using 2004 as a starting point.

- We fit an analytical model of erosion adjacent to a seawall, based on the Pelnard-Considère equation (analytical model),[59,60,61] to approximated bluff toe locations derived from the USGS bluff topography surveys. The Pelnard-Considère equation is fundamental to the study of shore evolution in the field of coastal engineering, and represents the first analytical solutions to describe shoreline change. Although the Pelnard-Considère equation uses simplifying assumptions regarding cross-shore sediment flux, it is widely used to estimate shoreline change. The analytical model used a longshore diffusivity of 0.02 ft^2 per second, based on the value reported in the project's *Sand Management Plan*,[62] and was calibrated by changing the relative wave direction. We note that while the Pelnard-Considère equation was developed for sandy shores, we are using this approach to infer the change in the beach backshore. Long-term shoreline change and backshore (i.e., bluff) change are both related to the wave-induced transport of sand.[63] The application of this conceptual model relies on the implicit assumption that bluff and shoreline long-term changes should correlate on a strongly eroding shore.[64,65,66]

- We used the analytical model of bluff toe erosion to estimate the erosion occurring under baseline and project conditions. Monthly average surf zone wave heights simulated by the numerical model and the likely beach berm elevation [67] were input into the analytical model used for describing shoreline changes based upon wave and sediment characteristics. The model translates annual average wave and beach conditions to annual average amounts of erosion as a function of distance along the beach over time. To assess the baseline and project conditions, we applied the case of erosion at the end of a semi-infinite seawall. The results

[59] Pelnard-Considère, R., 1956, Essai de Theorie de L'evolution des Formes de Rivage en Plages de Sable et de Galets, Les Energies de la Mer: Compte Rendu Des Quatriemes Journees de L'hydraulique, Paris 13, 14 and 15 Juin 1956; Question III, rapport 1, 74-1-10.

[60] Larson, M., Hanson, H., and Kraus, N.C., 1987, Analytical solutions of the one-line model of shoreline change, Coastal Engineering Research Center, Vicksburg, MS, October 1987.

[61] Dean, R.G., 2002, *Beach Nourishment Theory and Practice*, Advanced Series on Ocean Engineering – Volume 18, World Scientific, River Edge, NJ, 399 pp.

[62] Moffatt & Nichol Engineers, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020a, Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements, Prepared for San Francisco Public Utilities Commission. July 2020.

[63] Vitousek, S., Barnard, P.L., Limber, P., Erikson, L., and Cole, B., 2017, A model integrating longshore and cross-shore processes for predicting long-term shoreline response to climate change, *Journal of Geophysical Research: Earth Surface*, 122, 782-806.

[64] Ashton, A.D., Walkden, M.J.A., and Dickson, M.E., 2011, Equilibrium responses of cliffed coasts to changes in the rate of sea level rise, *Marine Geology*, 284, 217-229.

[65] Young, A.P., Flick, R.E., O'Reilly, W.C., Chadwick, D.B., Crampton, W.C., and Helly, J.J., 2014, Estimating cliff retreat in southern California considering sea level rise using a sand balance approach, *Marine Geology*, 348, 15-26.

[66] Earlie, C., Masselink, G., and Russell, P., 2018, The role of beach morphology on coastal cliff erosion under extreme waves, *Earth Surface Process and Landforms*, 43, 1213-1228.

[67] The beach berm is the nearly horizontal portion of beach extending landward from the top of the beach face (swash zone) to the back-beach. The likely beach berm elevation was determined using applied geomorphology and reference data, as well as interpretation of the proposed project design. We selected a likely beach berm elevation for each modeled scenario that would be expected under the corresponding conditions (i.e., recently nourished with dry back-beach, eroded, etc.).

were "annualized" erosion rates, which were calculated as the annual average erosion rate over a 10-year period.

2.2.2 Bar Dynamics

Analysis of potential effects on offshore sand bars from the project wall and sand placement and, in turn, potential effects on wave characteristics in the surf zone, is presented below. Specifically, the existing offshore sand bar geometry allows for wave breaking patterns that support surfing activities. Thus, the analysis considers the project's potential to substantially alter the offshore sand bar geometry.

Background

Effects of Shore Armoring on Sand Bars

In general, shore armoring (seawall) is designed to protect the backshore from incident waves in order to prevent erosion of the land behind the seawall. Therefore, seawalls change the rate of wave dissipation and can change sediment transport locally. During elevated wave events, scour can occur in front of a seawall, lowering the beach, increasing wave reflection and increasing offshore and alongshore sand movement. The offshore sand movement and reflected waves can change the shape of the nearshore sand bars and associated breaking wave patterns.

As described above for end effects, we looked at two wall exposure events based on the beach width modeling already completed, and evaluated how the project would affect the offshore sand bars and wave fields. Specifically, we used the CMS model to evaluate whether anticipated exposures of the wall would increase the wave reflections through the surf zone in areas typically used for surfing, and if the armoring would affect the locations, elevations, and persistence of sand bars, as well as the potential formation of persistent rip current channels across the surf zone.

Effects of Sand Placement on Sand Bars

Sand placement can alter offshore sand bar geometry by changing sand transport rates and patterns through the surf zone. The sacrificial sand berms placed recently (also known as the "backpass" of sand from North Ocean Beach) provide sand to the beach that buffers the backshore from erosion. The sand then moves offshore and to the north and south away from the placement area, increasing sand supply to the surf zone and adjacent shores. Hence we anticipate, and anecdotally observe[68], wider beaches and shallower nearshore sand bars both at the south Ocean Beach sand placement area, and to the north and south. Independent parameters affecting these changes are mostly the wave and water level conditions, the existing (pre-placement) geometry, the volume of sand, the placement geometry and the sand grain sizes.

We reviewed available information regarding the backpassing, apparent effects, and anecdotal evidence of surfing conditions by beach users (see "Discussion of Model Output Relative to Anecdotal and Theoretical Expectations" in Section 3.3.1). We also applied the numerical model

[68] These opinions are based on anecdotal observations of sand bar and breaker locations by ESA staff.

(i.e., CMS) to better understand the effect of sand placement on offshore sand bar geometry as a surrogate for impacts to surfing. The model was applied to a range of nourishment volumes to characterize project conditions relative to no-project conditions, and natural variability and model uncertainty.

Data Analysis Approach

ESA processed USGS offshore bathymetry and beach topography from 2004 to 2019 to provide an understanding of sandbar morphology. Five of the USGS' long-term monitoring transects are located within the project area – one 500 feet south of Sloat Boulevard (USGS line 12), another near the Emergency Quarry Revetment (EQR) constructed in 1997-1999 (USGS line 13), and a third north of the emergency revetment constructed in 2010 (USGS line 14), and two more that are located just north (USGS line 11) and south (USGS line 15) of the project area.

Despite the availability of many years of bed elevation data along these transects, there were several steps that were required to convert this into a complete dataset for looking at changes in bar conditions. For example, direct measurement of the interior bar was sometimes prevented by the gap in the surf zone between the USGS bathymetry and the beach topography. Also, the non-uniform and spatially varied nature of the surf zone at Ocean Beach leads to conditions where offshore bars do not always maintain the same position or shape in the alongshore direction, so observations of bar conditions at one transect were often different than observations at the next. Lastly, given the challenges with measuring conditions in the coastal zone (e.g., beach erosion in winter may prevent a beach survey from happening, or stormy conditions may limit scheduling for boat-based surveys), it was not always the case that bathymetry surveys occurred within several weeks of surveys on the beach.

To address these challenges and arrive at a complete dataset of bar conditions, ESA applied the following steps:

- The timing of USGS transects from 2004 to 2019 was compared to the timing of USGS and ESA beach topography surveys. Approximately 220 transects[69] were chosen within these 16 years, when offshore bathymetry and beach topography were collected within several weeks of each other.

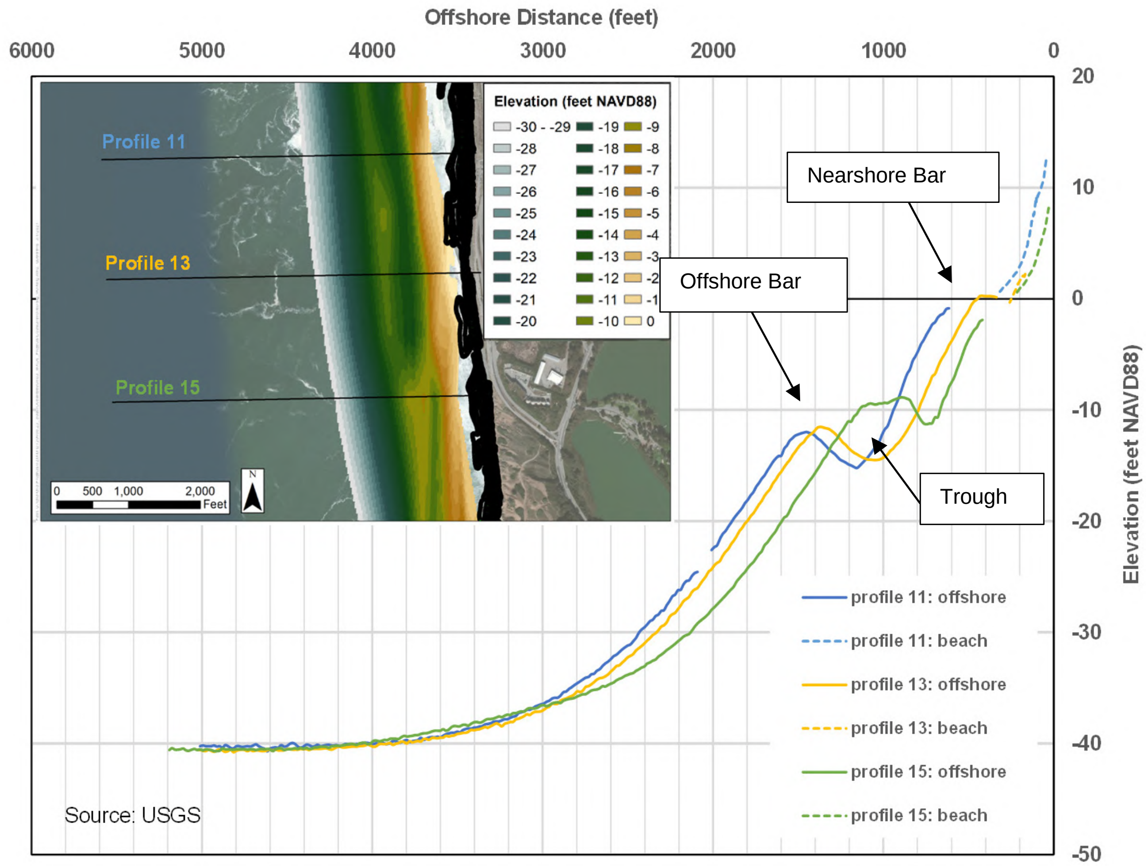
- Beach topography points were fit to the same transects that USGS uses when collecting offshore bathymetry. This created complete transects that include data points showing offshore bar conditions, and a landward portion with data showing intertidal and backshore beach conditions. **Figure 5** shows three beach profiles at the project site from the USGS May 2017 survey.

- For some of the 220 surveyed transects, the offshore and landward data sets overlapped, so there was no gap in the surf zone. However, it was more common for there to be a gap of several hundred feet between the two sets of points. To fill this gap, a smooth polyline (i.e., spline) curve-fit was applied using data from the offshore and landward surveys. **Figure 6** presents several "completed" profiles at Transect 13, located offshore of the EQR.

[69] The number of transects analyzed total 220, composed of 5 transect locations over 44 surveys.

- Bar metrics (e.g., distance offshore, crest elevation, crest-trough relief) were manually picked from each transect, for both the offshore bar and the nearshore bar, as well as MHW (see Figure 6). We note that the nearshore trough is not well-defined or apparent for several transects, but we selected an approximate location and characterized its relief as negative to provide sufficient data for the analysis. Overall, the changes in the nearshore trough remain highly variable and not well understood.

- For each bar metric, we computed a spatially averaged value over transects 11 through 15, which was based on an approach that averaged shoreline variations over 500-meter-long reaches to analyze the response of the MHW shoreline at Ocean Beach to wave conditions.[70]

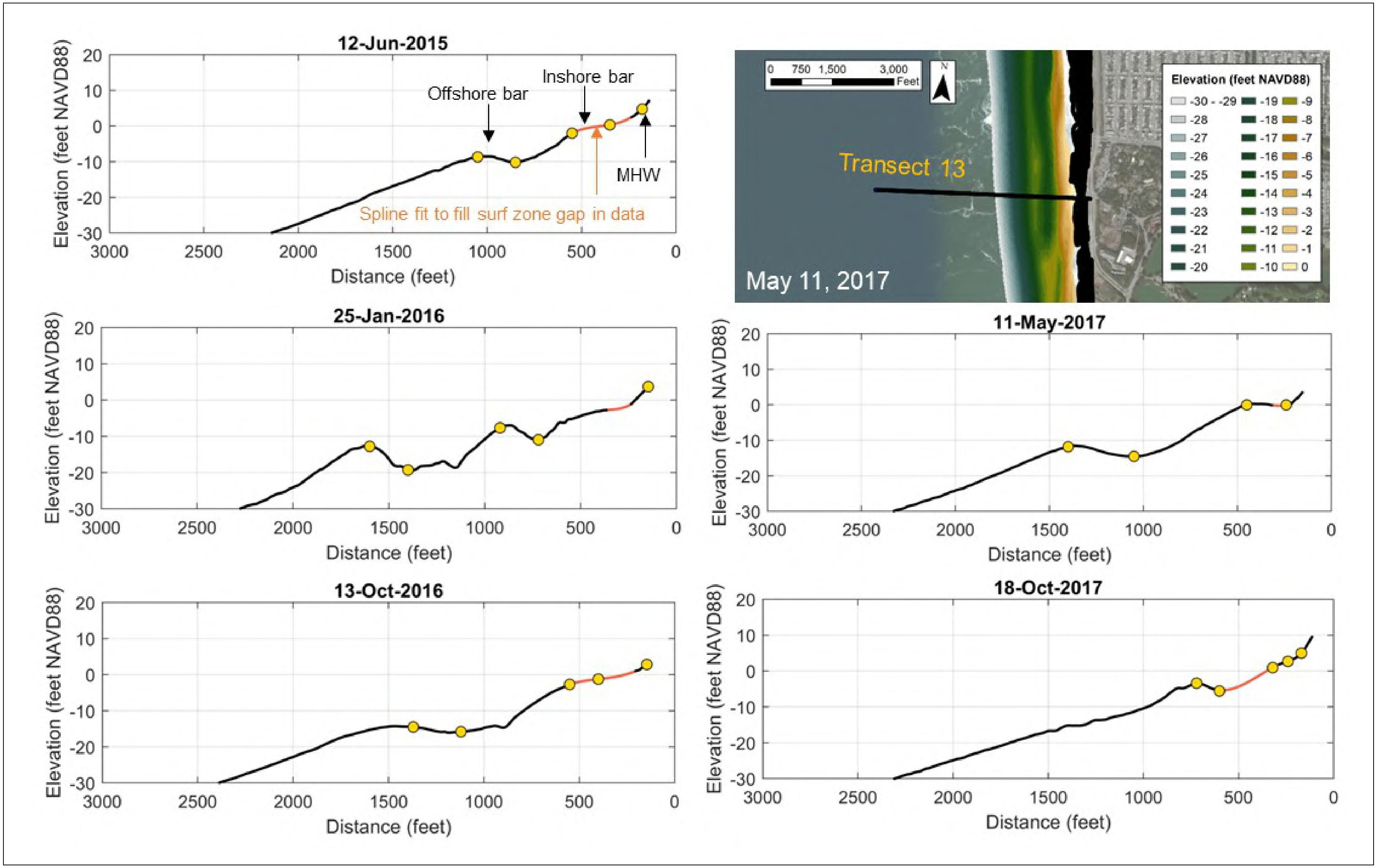


SOURCE: USGS (2021) Provisional Data

Figure 5

May 2017 offshore bathymetry and nearshore topography at three profilesin the project site showing the nearshore and offshore bars and troughs. Bathymetric surface shows depths from -40 to 0 feet NAVD based on Profiles 11, 12, 13, 14, and 15. Black dots on beach show beach topo point coverage.

70 Hansen, J.E., and Barnard, P.L, 2009, The observed relationship between wave conditions and beach response, Ocean Beach, San Francisco, CA, Proceedings of the 10th International Coastal Symposium, Lisbon, Portugal, *J. Coast. Res.*, SI 56, 1771-1775.



SOURCE: USGS (2021) Provisional Data

Figure 6
Series of “completed” transects combining USGS offshore and nearshore topography, with gap filled by spine fit in the surf zone

2.3 Model Setup and Application

To simulate the nearshore coastal processes at the project site, we used the CMS, to simulate the physical processes of the nearshore coastal environment. The CMS includes hydrodynamic[71] and morphological[72] change.[73,74] The CMS relies on two primary modules: CMS-Flow and CMS-Wave. The CMS-Flow module is a coupled[75] hydrodynamic and sediment transport model that can be driven by the Wave module. The CMS-Wave module is a phase-averaged spectral wave model that computes wave refraction shoaling, reflection, diffraction, and breaking as well as the effects of wind. Run together, the combined model can be used to simulate the morphologic changes in the nearshore zone due to sand placement including the change to offshore sand bars and waves.

The CMS model was previously applied by the USACE in 2010 at south Ocean Beach to model sand movement from theoretical sand placements similar to the backpassing and to the proposed beach placements.[76] Throughout the development of the model for the project, we communicated with the USACE model developers who answered questions and provided feedback on our model setup.

2.3.1 Model Domain and Bathymetry

Figures 7 and 8 present the model domain for the CMS-Wave module and the CMS-Flow module, respectively. The CMS-Wave model domain is a non-uniform rectilinear grid with grid sizes of approximately 400 meters on the seaward boundary in deep water and 20 meters in the vicinity of the shore and the project. The CMS-Wave model domain extends over 30 miles offshore of the project site to the Point Reyes buoy, and south from Point Reyes to Pacifica. The CMS-Flow model domain is a quadtree grid with cell sizes of 320 meters in the offshore locations and reducing to 5 meters in the vicinity of the project site. Two CMS-Flow model domains were produced: one that included all of San Francisco Bay, which was used to generate a tidal flux boundary condition at the Golden Gate, and another model domain that cut off the Bay and applied the boundary condition for project runs.

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71 Hydrodynamic applies to moving water, in this case waves and currents.

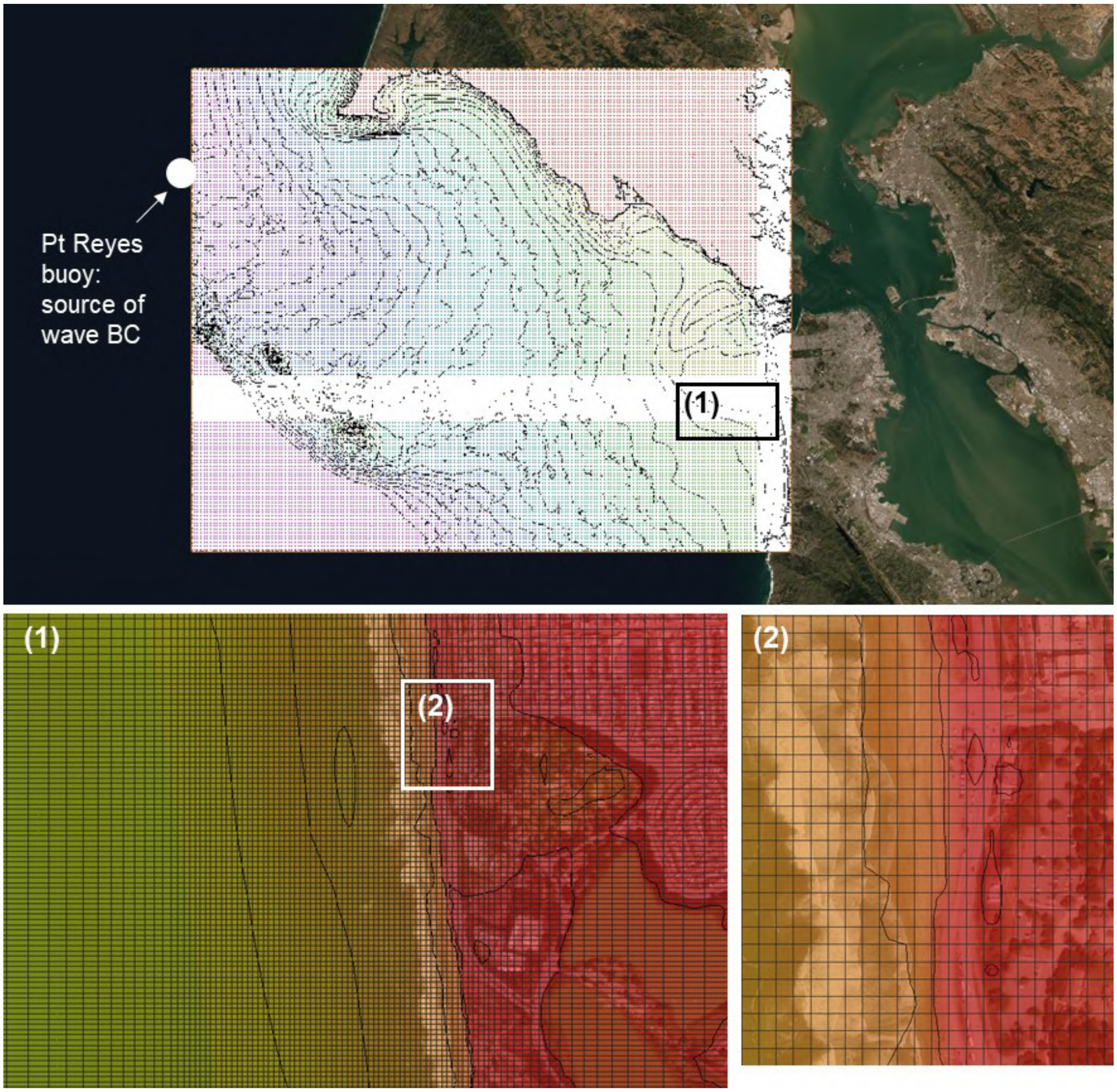
72 Morphology refers to the shape of landforms, in this case the beach and surf zone shaped by waves and currents. Morphological change refers to the fluctuations and cumulative changes, in particular changes in equilibrium conditions. Morphodynamic model refers to prediction of the change in shore and nearshore surface elevations (aka bed change) resulting from hydrodynamics.

73 Buttolph, A.M., Reek, C.W., Kraus, N.C., Ono, N., Larson, M., Camenen, B., Hanson, H., Wamsley, T., and Zundel, A.K., 2006, Two-dimensional depth-averaged circulation model CMS-M2D: Version 3.0, Report 2 Sediment Transport and Morphology Change, Coastal and Hydraulics Laboratory Technical Report ERDC/CHL-TR-06-7, Vicksburg, MS, U.S. Army Research and Development Center, August 2006.

74 Lin, L., Demirbilek, Z., Mase, H., Zheng, J., and Yamada, F., 2008, CMS-Wave: A near-shore spectral wave processes model for coastal inlets and navigation projects, Coastal and Hydraulics Laboratory Technical Report ERCD/CHL-TR-08-13, Vicksburg, MS, U.S. Army Research and Development Center, August 2008.

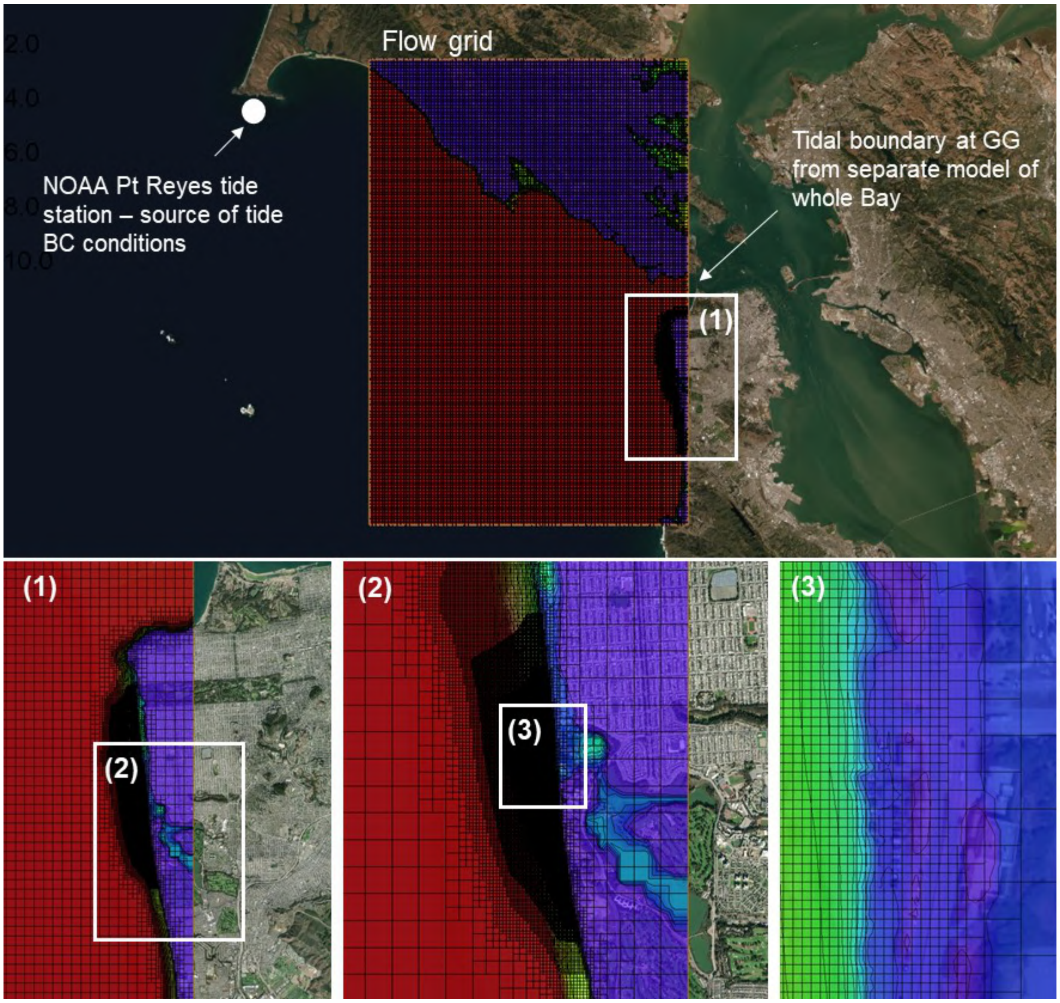
75 Coupled refers to the interaction of model routines, in this case, the wave hydrodynamics affect sediment transport, which results in sand bed change which feeds-back to influence the wave hydrodynamics and sediment transport. In this way, coupling provides a more realistic prediction of shore and surf zone changes. Coupling is not always done owing to the increased computational demand and increased method uncertainty.

76 Lin, L. Li, H., Wu, F. and Andes, L.C., 2012, Littoral Transport Modeling for Ocean Beach and San Francisco Bight, California, Proceedings of 33rd Conference on Coastal Engineering, Santander, Spain, 2012.



SOURCE: ESA CMS Model

Figure 7
Model domain for CMS-Wave uses a non-uniform rectangular grid



SOURCE: ESA CMS Model

Figure 8
Model domain for CMS-Flow uses a quadtree grid

The bathymetry for the model domain was compiled using data from NOAA, USGS, and ESA surveys:

- Offshore and San Francisco Bay bathymetry was based on the NOAA (2010) topobathy data
- Upland areas landward of the beach and dunes were based on USGS 2016 LiDAR for the West Coast (NOAA Office for Coastal Management 2021)
- Nearshore bathymetry data is based on the USGS bathymetric survey on October 13, 2016
- Beach topography north and south of the project site was based on the USGS beach topographic survey on November 14, 2016
- Beach and backshore topography from ESA and Sierra Overhead Analytics survey on November 10, 2016

The data sets listed above were stitched together to form a seamless topobathy data set for the entire domain to represent the existing site grades that were assumed to be representative of initial conditions for modeling. Review of the data were conducted, and smoothing of artifacts associated with reduction of data to the model grid discretization was completed manually. The selected elevation datum for the modeling was NAVD. The CMS model uses metric units only, and so a depth grid was compiled that represented the depth of the bed relative to the NAVD datum in meters.

2.3.2 Simulation Period and Model Forcing

Two CMS simulations were set up for one-month periods: a verification period that simulated January 2010, which was investigated by the USACE,[77] and a verification/baseline/project run period in January 2017. For each of these periods we developed boundary conditions using wind, water level and wave data. We applied hourly wind data from the San Francisco buoy (NOAA NDBC 46026), water level data from the Point Reyes tide gauge (NOAA NOS Sta. 9415020) relative to NAVD in meters, and spectral wave data from the Point Reyes buoy (CDIP 029, NOAA NDBC 46214).

2.3.3 Application

The baseline and with-project model scenarios were developed in coordination with the SFPUC's design team, including Moffatt & Nichol Engineers, in order to accurately reflect the design conditions for buried and exposed wall scenarios. An initial verification run using the January 2010 period was conducted, and found that the wave, water level and current results were similar to those found by the USACE modeling for the same period. **Table 3** presents a summary of the verification, baseline, and project conditions runs that were conducted.

TABLE 3
MODEL SCENARIOS

Model Scenario	Time Period	Project	Site Condition
Verification[a]	January 1-31, 2010	Existing (No Project)	Partially Eroded
Verification/Baseline	Dec 30, 2016 – Jan 29, 2017	Existing (No Project)	Partially Eroded
Verification/Baseline w/ Backpass	Dec 30, 2016 – Jan 29, 2017	Existing (No Project)	Partially Eroded + 70,000 CY Backpass
Project w/ Small Placement	Dec 30, 2016 – Jan 29, 2017	With Project	85,000 CY placement
Project w/ Large Placement	Dec 30, 2016 – Jan 29, 2017	With Project	300,000 CY placement
Project w/ Partially Exposed Wall	Dec 30, 2016 – Jan 29, 2017	With Project	Beach eroded to MSL at several 500-foot segments along the wall. Adjacent bluffs not eroded
Project w/ Fully Exposed Wall	Dec 30, 2016 – Jan 29, 2017	With Project	Entire beach eroded to MSL in front of the wall. Bluff erosion adjacent to northern and southern boundaries of the site.

NOTES:

a. Results for the 2010 verification run are not included in this report for brevity. This was an attempt to "check" that the model produced results similar to prior USACE modeling.

[77] Lin, L. Li, H., Wu, F. and Andes, L.C., 2012, Littoral Transport Modeling for Ocean Beach and San Francisco Bight, California, Proceedings of 33rd Conference on Coastal Engineering, Santander, Spain, 2012.

The CMS-FLOW and WAVE modules required several settings and parameterizations. One of the key settings was the selection of the transport grain size – the sediment grain size that is used to compute sediment transport. Based on review of sediment data at the project site and testing different values in the model, we selected a transport grain size of 0.3 mm, which is a reasonable grain size found in the swash zone of South Ocean Beach, and which was found to be most numerically stable. The USACE model developers reviewed and recommended values for the settings. We have not included the values of most of the settings in this report for brevity except for key parameters.

Baseline Conditions

Two baseline conditions model runs were conducted to simulate the no project condition: the first baseline conditions run assumed eroded site conditions observed in November 2016, and the second baseline conditions run assumed the November 2016 conditions with the 70,000 cubic yard (CY) backpass project in place. These baseline conditions runs also served as a model verification, for which the results were compared to observations qualitatively (see Section 3).

Project Conditions

Four project conditions model runs were completed to assess the effects of the project for nourished and eroded conditions.

As noted above, two nourished conditions included the project plus a small sand placement of 85,000 cubic yards, which is based on the project design conditions presented in the 35% design construction plans,[78] and a large sand placement of approximately 300,000 cubic yards. Based on coordination with the project designers, we understand that the small sand placement would restore the design grades. The large placement geometry assumed a nourishment similar to the USACE-designed pilot pump-ashore project,[79] which proposes construction of a sand berm to elevation 30 feet NAVD with an approximately 100-foot wide crest, and sloping down to existing beach grades at a 4:1 (horizontal to vertical) slope. For the project plus large placement model run, we assumed that the berm had adjusted after approximately three months, and the berm crest had eroded to about 60 feet wide and the berm face was adjusted from being reworked naturally by waves.

The two eroded conditions included partially and fully exposed wall conditions, which are based on the potential wall exposures described in the project's *Sand Management Plan*.[80] The partially exposed wall condition includes three 500-foot-long segments of exposed wall where the beach has eroded to mean sea-level (approximately elevation 3 feet NAVD). The exposed segments were located at the north and south ends of the proposed low-profile wall, and at a location where

[78] Moffatt & Nichol Engineers, and AGS, 2020b, 35%-Complete Construction Plans, Ocean Beach Climate Change Adaptation Project – Long-Term Improvements, Prepared for San Francisco Public Utilities Commission, October 2020.

[79] USACE, 2020, 95%-Complete Construction Plans, Ocean Beach Pump-Ashore Project, Prepared by the U.S. Army Corps of Engineers, November 23, 2020.

[80] Moffatt & Nichol Engineers, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020a, Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements, Prepared for San Francisco Public Utilities Commission. July 2020.

the wall alignment is most seaward on the shore (located at the existing EQR). The fully exposed wall condition is an extreme case that assumes all of the beach erodes in front of the proposed low-profile wall to mean sea-level (approximately elevation 3 feet NAVD), and the bluffs and dunes to the south and north of the site, respectively, are eroded to be in-line with the proposed wall. This condition has a low probability of occurrence, and its occurrence was estimated as three to four times over a period of 80 years.[81] Input from the USGS upon review of the project conditions stated that it appeared to be a possible but extreme future event.

2.4 Key Study Assumptions and Uncertainties

The analysis and modeling methods used in the study required making several assumptions to simplify the physical processes and highly complex nearshore environment. We made key assumptions as part of the data analysis and processing, modeling the system using the CMS platform, and for selection of the simulation period and its application to the project analysis. These key assumptions include the following:

- Spatial resolution of the surf zone surveys can adequately capture the primary scale and variation of nearshore bed morphology.

- Measured changes in sand bar morphology between two subsequent surveys can be related to maximum average wave power and average total water level over a 30-day period. This approach assumes that the waves were large enough to induce a seaward migration in the bars. Because gaps in surveys typically exceeded 30 days, the changes were scaled to 30-day equivalents. We normalized the changes in the sand bar metrics to a 30-day period using a linear scaling over the duration between each successive survey. We note that the linear scaling approach might work for durations that span purely a winter or summer period, but which could break down if the duration includes both winter and summer periods when the direction of bar change is expected to reverse.

- CMS model can reasonably simulate the complex physical processes of the Ocean Beach nearshore and beach system, so that the hydrodynamic and morphodynamic output can be used to assess potential changes due to the project.

- The CMS model computes the sand transport for a single grain size, referred to as the transport grain size, when in reality a range of sediment sizes are transported by waves and currents. This limitation exists for most commercially available coastal models, while results are still potentially useful for understanding transport in these complex systems.

- The selected simulation period of January 2017, used to assess baseline and project conditions, can be used to assess the project's effects during a typical winter month that included higher-than-average water levels, multiple large, long-period swell events, and a significant storm event with relatively strong winds that produced significant storm seas from the southwest.

81 Moffatt & Nichol Engineers, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020a, Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements, Prepared for San Francisco Public Utilities Commission. July 2020.

Natural sources of uncertainty are inherent to environmental systems due to fluctuating and chaotic processes, but the acts of field data collection and modeling using numerical algorithms and their required assumptions also introduce *method uncertainty* in addition to the *natural variability*. Natural variability influences trends in the data analysis, which may affect the results (i.e., by influencing the level of uncertainty in trends, and thus, the ability of model predictions to identify impacts above and beyond this uncertainty level). Because the primary source of data was an approximately 15-year period from 2004 to 2019, the data may or may not include the most extreme events, and thereby may bias the results. Based on our professional judgment, the 15-year duration is sufficient to capture the likely range in natural variability of the nearshore system, which included a wide range of calm and relatively stormy seasons.

Method uncertainty is introduced from differences in techniques, algorithms, and how physical processes are considered in the data collection and numerical modeling. Method uncertainty associated with data collection can be introduced by different techniques or approaches to how the data is collected, as well as the environmental conditions in which the data is collected (i.e., performing a surf zone survey during calm conditions may yield different results than if it were conducted during relatively stormier or turbulent conditions). Method uncertainty associated with the modeling is largely due to the inherent assumptions and formulation of algorithms in the numerical model, and how the model is set up to simulate complex physical phenomena. Although the models produce a highly precise result, the accuracy may be affected by the use of a parameterized approach to resolving highly complex physical phenomena (e.g., the actual shoaling and breaking of waves in the surf zone is simulated by simplified equations using selected parameters, and not by solving the fundamental non-linear partial differential equations that govern the phenomena, so as to save computational time and effort). The consequence of this is that the modeling may produce results that would not actually be observed, or results that may vary significantly from the actual physical response of the beach that would be expected under conditions similar to those modeled.

Despite these constraints of applying numerical models, the method uncertainty is nevertheless controlled by comparing model results of baseline conditions to observations, which provides an understanding of how accurately the model is representing reality. In light of these assumptions and uncertainties, our judgment is that the model analysis, in combination with anecdotal evidence and consideration of available data and professional engineering literature, represents a reasonable and sufficient level of analysis needed to assess the potential effects of the project for purposes of environmental review for CEQA and would inform other permitting and agency reviews.

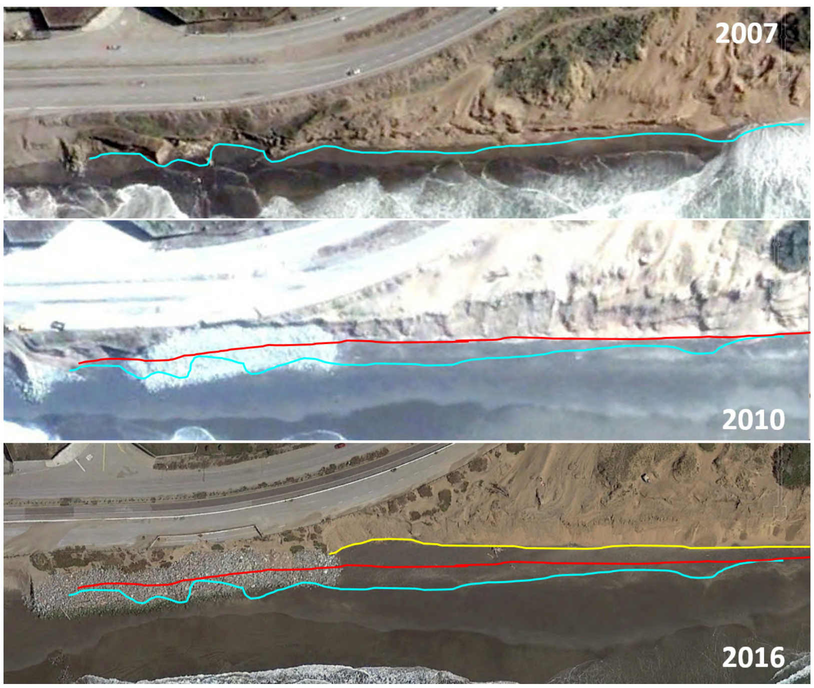
3 RESULTS

This section presents results of the analysis described above. First, a summary of the results of the data analysis is presented for the end effects and bar dynamics. Second, the results of the numerical modeling are presented for baseline and project conditions. Finally, an assessment of the project effects relative to baseline conditions are presented.

3.1 Data Analysis of End Effects and Bar Dynamics

3.1.1 End Effects

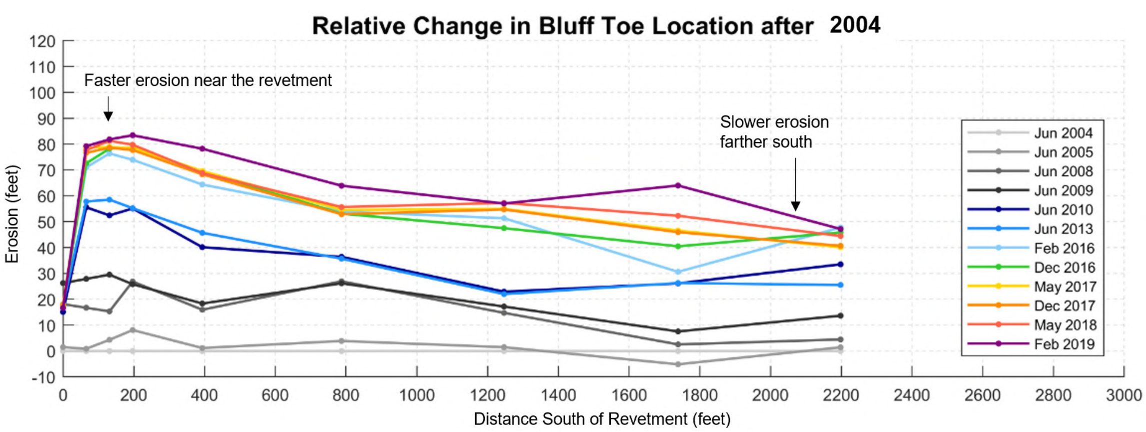
Applying the steps described in Section 2.2.1, we extracted bluff toe erosion amounts over time, which were used to compute erosion rates. **Figure 9** presents a schematic of three aerial images from 2007, 2010, and 2016 located at the section of shore immediately south of the 2010 emergency revetment at the transition to the Fort Funston bluffs. The colored lines shown in Figure 9 represent approximate bluff toe locations for the three time periods, and illustrate the landward shift of the bluffs over time, and a localized erosion perturbation on the south side of the revetment that appears between 2010 and 2016.



SOURCE: Google Earth

Figure 9
Approximate bluff erosion at South Ocean Beach from 2007 to 2016 based on aerials

Figure 10 presents plan-view measurements of the Fort Funston bluff toe for several surveys conducted between 2005 and 2019. These bluff toe measurements were extracted from the bluff profiles presented in Figure 4. The vertical axis is the distance of bluff toe erosion relative to its location in 2004. The horizontal axis is the distance of the measurement from the south end of the 2010 revetment. The gray-scale lines show results from surveys conducted prior to construction of the 2010 revetment, and the color-scale lines are from surveys after it was constructed. Construction of the revetment occurred over the period from February through April 2010, immediately following the declaration of a "state of emergency" by the city in January 2010.[82,83] A series of storms with large waves and high water levels over the period from December 2009 through January 2010 caused erosion at areas south of the Southwest Ocean Outfall (SWOO), which in some areas were reported to be approximately 25 to 30 feet, prompting the emergency declaration.[84] The erosion data for June 2010 in Figure 10 lumps the erosion occurring before and after revetment construction together, and so the data shows a conservatively high amount of erosion post-construction. However, the engineering design and pre-construction survey of the emergency 2010 revetment location indicate that the majority of this erosion occurred within the constructed limits of the 2010 revetment, and that the bluff top to the south of the revetment location in January 2010 had retreated less than ten feet relative to January 2007.[85]



SOURCE: USGS (2021) Provisional Data

Figure 10
Location of bluff toe as a function of distance south of the 2010 revetment over time

The general trend of the lines in Figure 10 indicates an overall erosion of the shore over time, but with a greater amount of erosion occurring within 100 to 400 feet south of the 2010 revetment. The plot also suggests that the erosion accelerated after construction of the 2010 revetment until approximately 2016, and then slowed down. In general, the overall shore changes observed since 2009 resemble the theoretical predictions of the Pelnard-Considère equation, where the amount of

82 ARUP, 2010, Design Report, The Great Highway Emergency Toe Stabilization, Report Prepared for San Francisco Department of Public Works, February 2010.

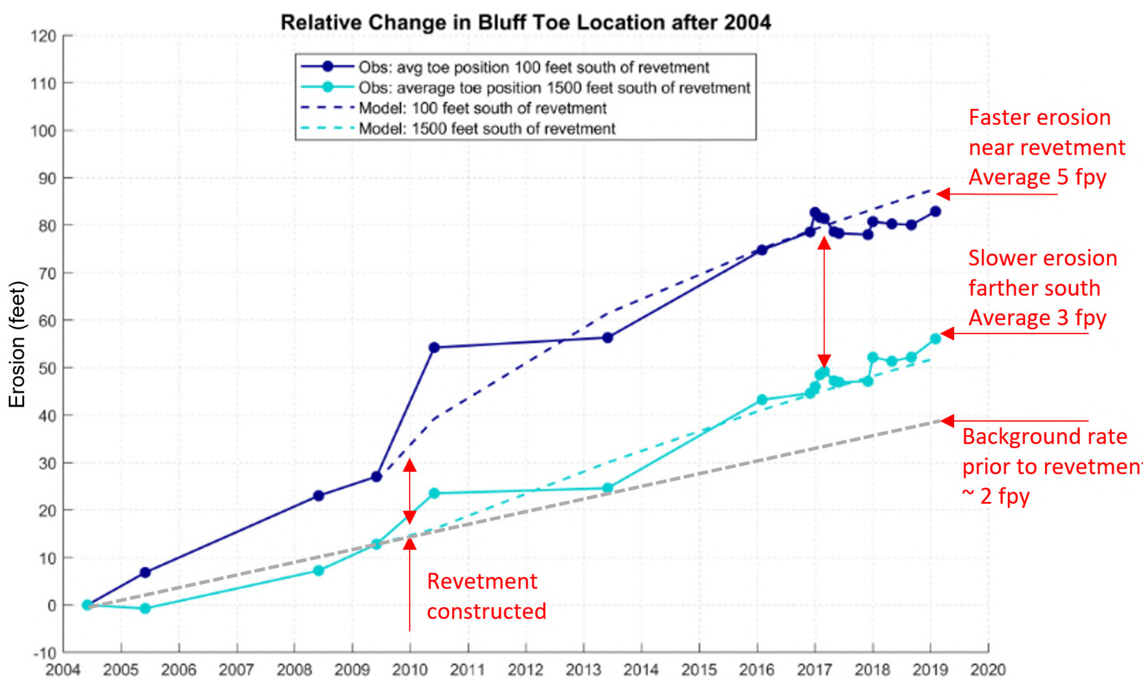
83 Moffatt & Nichol Engineers, 2010, Response to 2009/2010 Storm Wave Erosion, Great Highway Emergency Repairs, Draft Report prepared for Department of Public Works, City and County of San Francisco, August 2010.

84 Moffatt & Nichol Engineers, 2010, Emergency Repair Alternative Assessment on Project Methodology, Great Highway Bluff Stabilization, Report Prepared for City and County of San Francisco, June 15, 2010.

85 ARUP, 2010, Design Report, The Great Highway Emergency Toe Stabilization, Report Prepared for San Francisco Department of Public Works, February 2010.

erosion over a period of time decreases with distance from the structure, and the erosion rate decreases over time or reaches a maximum.[86]

Figure 11 presents a plot of the relative change in bluff toe position over time at two locations south of the 2010 revetment. The dots and solid lines represent the measurements from the USGS data and the colored dashed lines are the predictions of the Pelnard-Considère equation at the two locations. The 100 feet and 1500 feet "locations" represent block averages of the measured erosion over 0 to 200 feet and 1,250 to 2,200 feet south of the revetment, respectively. The averaging is a standard and practical method to manage variability over relatively short distances. The dashed gray line is an approximate background erosion rate of approximately two feet per year for conditions prior to construction of the 2010 revetment. For this analysis, we used Pelnard-Considère's analytical solution to the diffusion equation[87] for shore change downdrift of a seawall. We also note that a talus is often present along portions of the Fort Funston bluffs, which can complicate selection of a bluff toe, resulting in apparent seaward movement of the bluff toe. The talus also provides interim bluff protection, and therefore may influence the estimate of a short-term erosion rate but is unlikely to bias estimates of a long-term erosion rate.



SOURCE: USGS (2021) Provisional Data

Figure 11
Long-term erosion at two locations south of the 2010 revetment compared to the Pelnard-Considère analytical erosion model

[86] Larson, M., Hanson, H., and Kraus, N.C., 1987, Analytical solutions of the one-line model of shoreline change, Coastal Engineering Research Center, Vicksburg, MS, October 1987.

[87] The diffusion equation is a parabolic differential equation that describes many physical phenomena, including conduction of heat in solids, and is used in coastal engineering to describe shoreline evolution and change.

Although the Pelnard-Considère method was developed for sandy beach response to coastal conditions, we have applied the equation to represent changes in bluff toe position over space and time using a longshore diffusivity of 0.02 square feet per second and calibrated by adjusting the average wave direction relative to the shore.[88] As noted in Section 2.21., this application is warranted because the long-term shoreline change and backshore (i.e., bluff) change are both related to the wave-induced transport of sand.[89] The application of this conceptual model relies on the implicit assumption that bluff and shoreline long-term changes should correlate on a strongly eroding shore.[90,91,92]

The analytical model of bluff toe response to the coastal conditions and construction of the 2010 revetment helps distinguish the difference in erosion rates close to the revetment and further south. For this analysis, we selected a start date of June 2009, the most recent date for which pre-revetment shore data were available, which allows for detection of shore adjustments that may have occurred immediately after revetment construction, but prior to the next available bluff survey. Based on the amount of erosion observed at locations 100 and 1,500 south of the revetment from 2009 to 2019, we computed average erosion rates of approximately five feet per year (fpy) and three feet per year, respectively, asymptotically approaching the background erosion rate of about two feet per year. The curves also illustrate how the erosion initially accelerates after construction of the revetment, and then slows down. Note that the observed erosion varies and there is some scatter around the predicted erosion distance, but generally the trends are consistent.

The Pelnard-Considère equation is based on the theory that after initiation of erosion at a structure, the erosion rate slows over time. Furthermore, there is a lot of uncertainty implicit in the prediction. The equation is insensitive to storm sequencing, and is intended for long-term averages, and so the variability of observed changes relative to the Pelnard-Considère predictions it is not surprising.[93] Although little erosion was observed over the period between June 2010 to June 2013, rapid erosion after construction of the revetment in January 2010 exceeded the prediction, and then returned back to the predicted curve circa 2013. This indicates application of the method to the long-term changes with the expectation for variability of observations at a single point.

Review of the bluff toe positions mapped in Figure 11 indicates that the computed average rate depends on the start and end date selected. The above analysis was based on a start date of mid-2009, before revetment construction and prior to January 2010 erosion events that immediately

88 Moffatt & Nichol Engineers, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020a, Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements, Prepared for San Francisco Public Utilities Commission. July 2020.

89 Vitousek, S., Barnard, P.L., Limber, P., Erikson, L., and Cole, B., 2017, A model integrating longshore and cross-shore processes for predicting long-term shoreline response to climate change, *Journal of Geophysical Research: Earth Surface*, 122, 782-806.

90 Ashton, A.D., Walkden, M.J.A., and Dickson, M.E., 2011, Equilibrium responses of cliffed coasts to changes in the rate of sea level rise, *Marine Geology*, 284, 217-229.

91 Young, A.P., Flick, R.E., O'Reilly, W.C., Chadwick, D.B., Crampton, W.C., and Helly, J.J., 2014, Estimating cliff retreat in southern California considering sea level rise using a sand balance approach, *Marine Geology*, 348, 15-26.

92 Earlie, C., Masselink, G., and Russell, P., 2018, The role of beach morphology on coastal cliff erosion under extreme waves, *Earth Surface Process and Landforms*, 43, 1213-1228.

93 Dean, R.G., 2002, *Beach Nourishment Theory and Practice*, Advanced Series on Ocean Engineering – Volume 18, World Scientific, River Edge, NJ, 399 pp.

preceded construction. Alternatively, taking the next available start date of June 2010 results in lower average erosion rates, and rates that are about equal at the 100 feet and 1500 feet locations. While the differences result from selecting different start dates, the data indicate initial adjustments following the erosion in December 2009 and January 2010 and the construction of the 2010 revetment, as follows:

- Initial Erosion Event: Between mid-2009 and mid-2010 the bluff toes eroded about 26 feet at the north transect and 9 feet in the south transect. Some or most of this erosion likely happened in the winter before revetment construction in mid-2010.

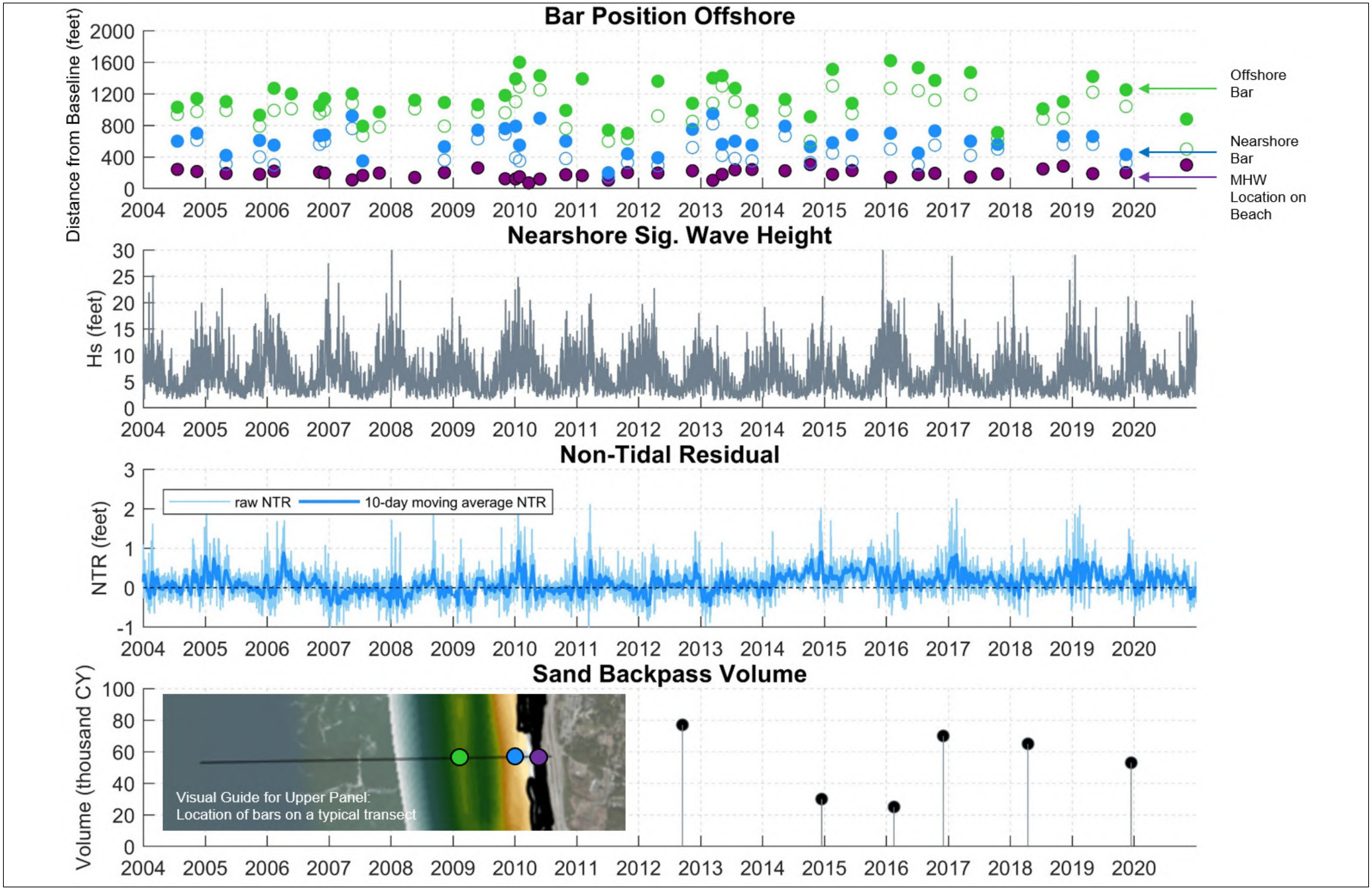
- Talus: In 2010, the erosion at the bluff toe over-steepened the bluffs and the loose soil (mostly sand dunes) sloughed and formed loose deposits of sand at the bluff toe at Fort Funston. This caused the toe to move seaward and may be the reason for the seaward movement of the bluff toe indicated by the mid-2013 data point shown on Figure 11.

Using the erosion data shown in Figure 11 for the northern and southern locations, we computed approximate erosion rates based on different start dates. These computations suggest that the northern location has eroded at a higher rate than the southern location since construction of the revetment in 2010, and this trend appears to have occurred over a longer period dating back to at least 2004.[94] Since 2004, the computed erosion rate at the northern location is approximately 60% greater than at the southern reach, which indicates that there has been a greater amount of erosion in that location overall, and that the erosion may have been amplified at the north location due to the EQR revetment and the exposed SWOO, which precede the 2010 revetment. A start date of mid-2009 yields erosion rates at the northern location on the order of 40-50% greater than the southern location. However, selecting a start date of mid-2010 – approximately a few months after the completion of revetment construction – the erosion rate at the north location is only 0-4% greater than the southern location. Also, most bluff toe recession (i.e., erosion) appears to result from a few severe events, after which upper bluff material deposits as a talus, which must be removed by waves prior to further bluff toe erosion. These and other factors, such as sand supply from the bluffs, placed sand at South Ocean Beach, and sand transport reversals, may deviate from the simplified conditions used in the application of the analytical model. Based on our review of information related to the declaration of the state of emergency, the 2010 revetment design documents, and the available bluff survey data, we conclude that the erosion rate at the northern location is between 5% and 40% greater than the erosion rate at the southern location assuming a start date immediately prior to the construction of the 2010 revetment.

3.1.2 Bar Dynamics

Applying the steps outlined in Section 2.2.2 resulted in a series of bar conditions that were compared to coastal conditions and management actions over time. **Figure 12** compares the time series of nearshore and offshore bar positions against nearshore wave conditions and non-tidal

94 Note that a start date of 2004 is selected because that is the first year of bluff survey data – see Section 2.2.1.



SOURCE: nearshore significant wave heights estimated by CDIP at MOP station SF014. Non-tidal residuals based on NOAA Pt Reyes tide station.

Figure 12
Location of MHW position on beach and offshore crests (solid circles) and troughs (empty circles) at USGS Transect 11 near Sloat Blvd (Top panel), nearshore wave heights (second panel), non-tidal residual water levels (third panel), and sand backpass volumes (bottom panel)

residuals at Transect 11.[95] Appendix A includes similar time series plots for Transects 11 through 15. The top panel of Figure 12 shows the extracted metrics for the mean high water, nearshore trough, nearshore bar crest, offshore bar trough, and offshore bar crest. Also shown on Figure 12 are the coincident time series of wave height at a CDIP MOP station[96] SF014 located offshore of the site, non-tidal residual, which was computed as the difference of the observed and predicted tides at the Point Reyes tide gauge,[97] and sand backpass volumes that indicate the timing and volumes of recent sand placement events at South Ocean Beach.

While Figure 12 shows the relative positions of the offshore bar, nearshore bar, and MHW over time, a more direct link between coastal conditions and bar responses is needed to compare to the modeling analysis. ESA developed relationships between changes in bar conditions and the concurrent oceanic forcing conditions between successive surveys from 2004 to 2019. Several studies have related the changes in the beach and nearshore morphology to the average amount of wave energy over a period of time, generally one to four months, although some studies have related changes in beach morphology to average wave forcing over periods as short as five days.[98,99,100]

Appendix A summarizes how we extracted the bar metrics from the five profile locations and describes the subsequent data analysis used to develop relationships of the changes in bar metrics to the coastal conditions. The figures in the appendix show the absolute change measured between surveys over an approximately six-month period, as well as the amount of change normalized for a 30-day period. The normalized change was computed using a linear scaling over the duration between each successive survey. Other scaling approaches were tested, but which did not yield improved results and so the simple linear approach was selected. Data plots for change in the bar metrics at each profile are presented, as well as spatially averaged change metrics.

The changes in bar metrics are presented for two different indicators of coastal conditions: average wave power and average total water level (TWL). The wave power is also referred to as the wave energy flux, or the rate of wave energy that is transmitted per unit of wave crest length. The use of the wave power as the independent variable in the bar metric plots is similar to approaches by others who have assessed beach changes as a function of wave energy.[101]

The TWL was computed as the sum of the observed tide at the Point Reyes tide gauge and the coincident wave runup, computed using the Stockdon equation, which is a parameterized equation

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95 Non-tidal residuals are the difference of the observed and the predicted tides, and are indicative of how much ocean tides are elevated by short-term surge associated with storms and large-scale oceanic processes like El Niño.

96 CDIP MOP station refers to the Coastal Data Information Program Monitoring and Prediction System, which hosts a network of virtual buoys along the coast of California based on numerical modeling. For this analysis we used data from CDIP MOP station SF014.

97 NOAA NOS Station 9415020 Point Reyes

98 Hansen, J.E., and Barnard, P.L, 2009, The observed relationship between wave conditions and beach response, Ocean Beach, San Francisco, CA, Proceedings of the 10th International Coastal Symposium, Lisbon, Portugal, *J. Coast. Res.*, SI 56, 1771-1775.

99 Hansen, J.E., and Barnard, P.L, 2010, Sub-weekly to interannual variability of a high-energy shoreline, *Coastal Engineering*, Volume 57, Issues 11–12, 2010, 959-972.

100 Yates, M.L., Guza, R.T., O'Reilly, W.C., Hansen, J.E., and Barnard, P.L., 2011, Equilibrium shoreline response of a high wave energy beach, *Journal of Geophysical Research*, Vol. 116, C04014.

101 Hansen, J.E., and Barnard, P.L, 2009, The observed relationship between wave conditions and beach response, Ocean Beach, San Francisco, CA, Proceedings of the 10th International Coastal Symposium, Lisbon, Portugal, *J. Coast. Res.*, SI 56, 1771-1775.

that predicts the 2%-exceedance runup for natural beaches.[102] Because of the steep and armored backshore, the runup computed using the Stockdon equation is not expected to be an accurate calculation of the TWL on the shore, but it is a useful indicator of the wave and water level conditions at a given time. The TWL was selected as a potential independent variable because its value includes both the effects of incident swash and the low-frequency wave setup, which can be a significant contribution to coastal water levels, as well as the tide and any non-tidal residuals associated with low pressure storm systems and other North Pacific pressure anomalies.

We applied three different averaging periods to the wave power and TWL: average between successive surveys, max 30-day average, and max 5-day average between surveys. Note that the interval between successive surveys is approximately 4.5 months on average but ranges between 23 and 358 days. The maximum 30- and 5-day averages were computed as the maximum value from a running mean with 30- and 5-day windows between successive surveys. This yields an average value for the actual interval between surveys, as well as the highest 30-day and 5-day average, each of which is successively higher than the average over the whole period (except for the case of a survey interval less than 30 days). Each figure includes a plot with data from each transect and the spatially averaged data. For purposes of comparing to our numerical model output, we selected a period of 30 days, although, from other studies, we would expect the “tightness” of the fit, or the R^2 value, to improve as the averaging period increases to 60 and up to 120 days.[103] Sand bar metrics are highly variable, both spatially and temporally, and therefore it is difficult to detect changes between location or with time, as well as correlating with wave forcing.[104]

Figure 13 presents the spatially averaged changes in the offshore bar conditions, including the change in the horizontal location of the bar crests (top panel), the change in the elevation of the bar crests (middle panel), and the change in the bar relief (bottom panel), as a function of the max 30- and 5-day average TWL between surveys. The changes in the bar condition parameters (e.g., horizontal location, elevation, relief) were computed as the change measured between two subsequent surveys. Because the survey data was spaced on the order of approximately six months, we applied a linear scale to compute the change in the bar metrics per 30 days. As shown by the three plots, the change in bar morphology is weakly correlated to the average TWL. Although the scatter of the data indicates the natural variability, or uncertainty, of the system, as the average wave power over a given duration increases, the offshore bar tends to move offshore, deepen, and have a better-defined trough or relief. For relatively calmer periods, the offshore bar tends to have little horizontal movement, or a slight onshore movement, a slight increase in elevation, and loss in definition of the crest-trough relief. Based on these data, it is not clear whether the historical sand backpass events have had a noticeable effect on the offshore bar, but we note that the environmental conditions, the volume of the sand placement, and the antecedent conditions would likely influence the effects of sand placements on bar movement and morphology. Appendix A presents plots of changes with wave power and TWL.

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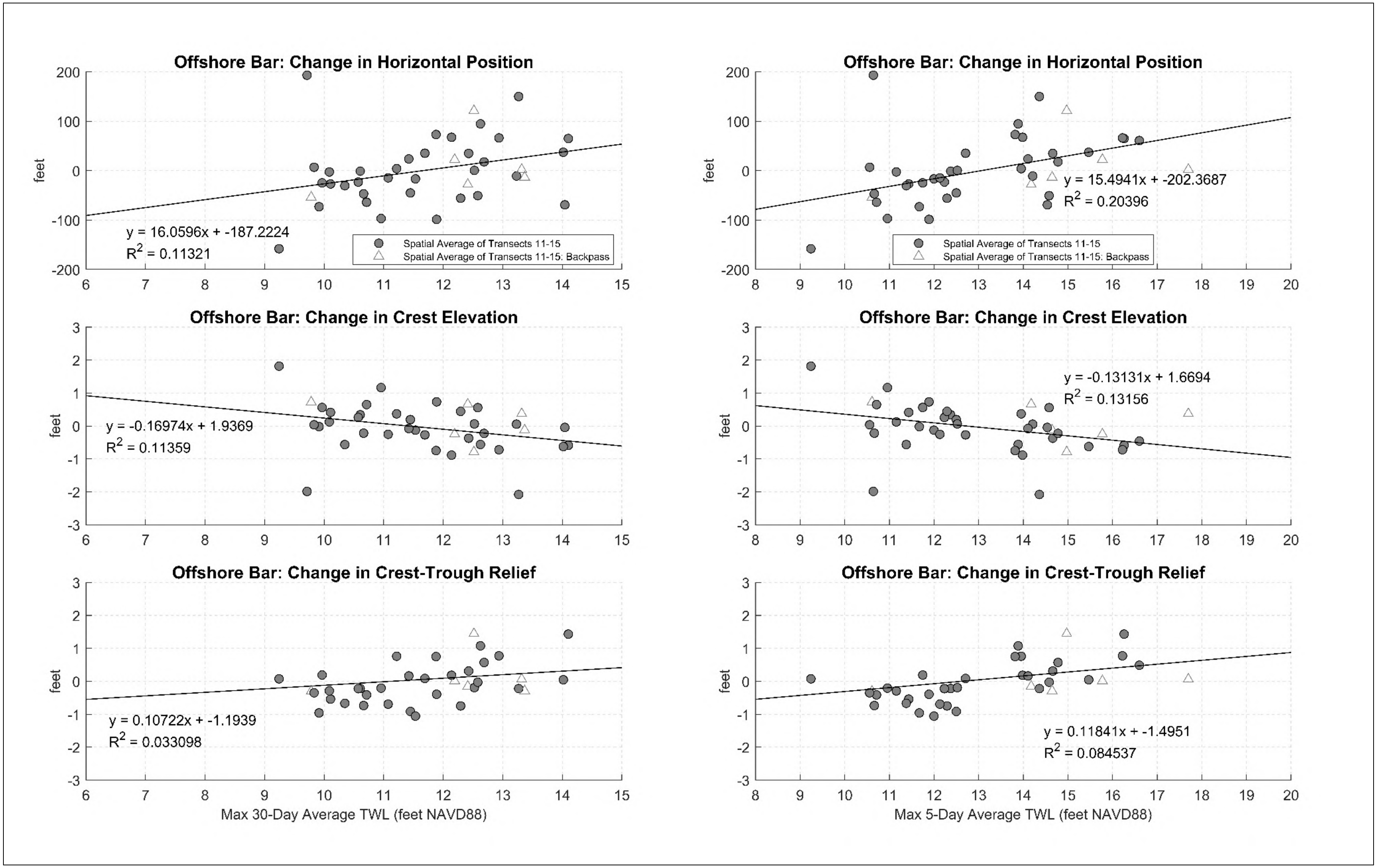
[102] Stockdon, H.F., Holman, R.A., Howd, P.A., and Sallenger, Jr., A.H., 2006, Empirical parameterization of setup, swash, and runup, *Coastal Engineering*, 53, pp. 573-588.

[103] Hansen, J.E., and Barnard, P.L, 2010, Sub-weekly to interannual variability of a high-energy shoreline, *Coastal Engineering*, Volume 57, Issues 11–12, 2010, 959-972.

[104] Bryan, K.R., Davies-Campbell, J. Hume, T.M., and Gallop, S.L., 2019, The influence of sand bar morphology on surfing amenity at New Zealand beach breaks, *In:* Bryan, K.R. and Atkin, E.A. (eds.), Surf Break Management in Aotearoa New Zealand, *Journal of Coastal Research*, Special Issue No. 87, pp. 44-54.

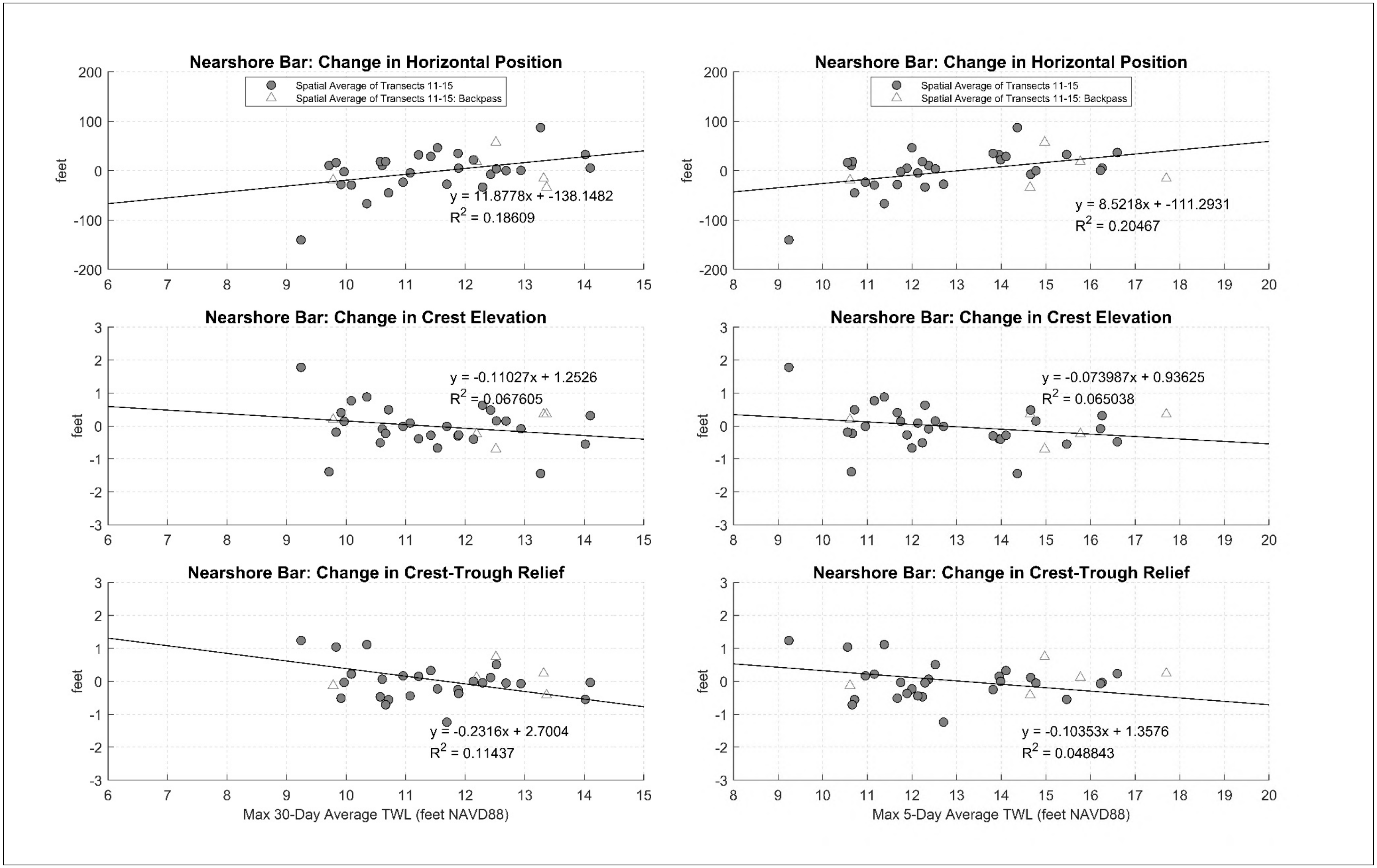
Figure 14 presents the spatially averaged changes in the nearshore bar conditions as a function of the maximum 30- and 5-day average TWL between surveys. Again, the top panel is the change in the horizontal position of the bar crest, the middle panel is the change in crest elevation, and the bottom panel is the change in crest-trough relief. The data presented in Figure 14 was analyzed in the same manner as the offshore bar data described above for Figure 13, and shows the change in the metrics between surveys normalized to represent the change per 30 days. The correlation of the morphologic change of the nearshore bar conditions to the average TWL is weak, similar to the offshore bar, but the plots exhibit similar trends. Generally, with increasing average TWL, the nearshore bar crest moves offshore, but the crest elevation and crest-trough relief relationships are not apparent due to the scatter of the data. As for the offshore bar, effects of the sand backpass events on the nearshore bar are not apparent in the data set. See Appendix A for additional plots.



SOURCE: USGS (2021) Provisional Data; CDIP

Figure 13

Observed changes in spatially averaged offshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) per 30 days as a function of the maximum average total water level between surveys for a 30 day averaging period (left) and 5 day averaging period (right)



SOURCE: USGS (2021) Provisional Data; CDIP

Figure 14

Observed changes in spatially averaged nearshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) per 30 days as a function of the maximum average total water level between surveys for a 30 day averaging period (left) and 5 day averaging period (right)

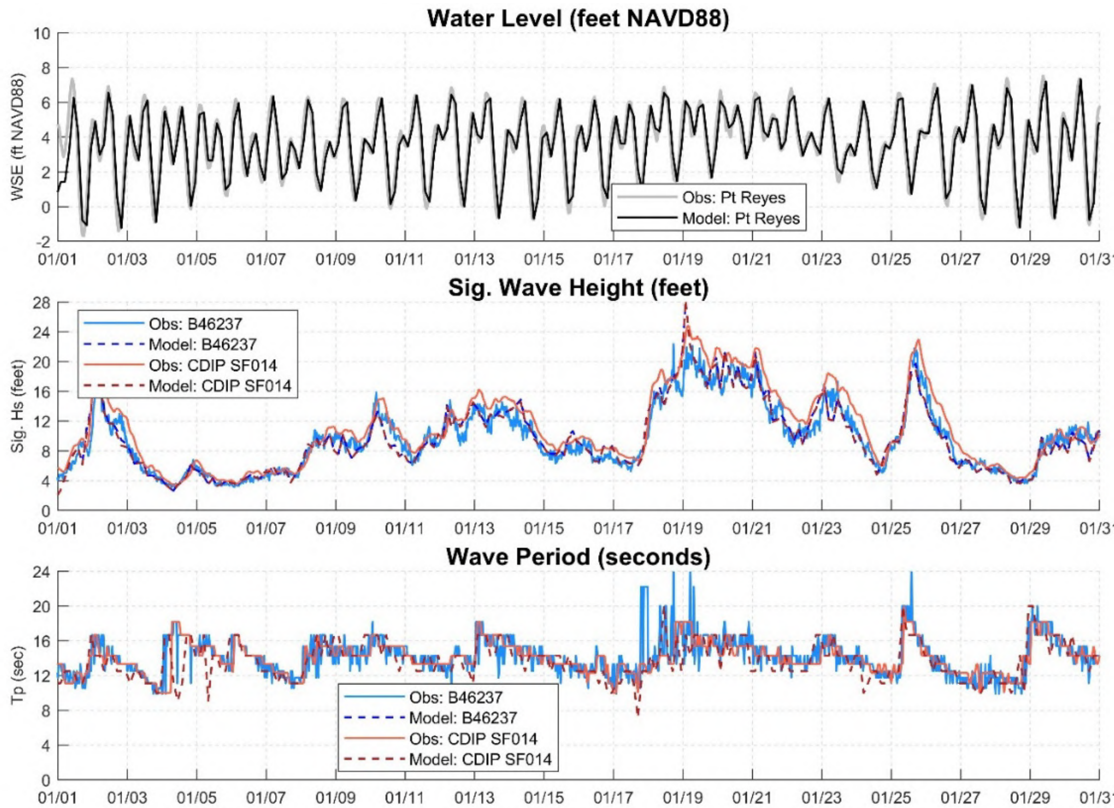
3.2 Modeling Output

We ran the CMS model for multiple conditions, including verification, baseline conditions, and project conditions. The CMS model was set up as described in Section 2.3. The following sections present the results of the numerical modeling completed for the study.

3.2.1 Baseline Condition and Verification

Two model verification runs were completed to qualitatively assess the ability of the CMS model to replicate the performance of a prior study by the USACE in 2011 that used an earlier version of CMS, and to compare model results for January 2017 against observations from the USGS.

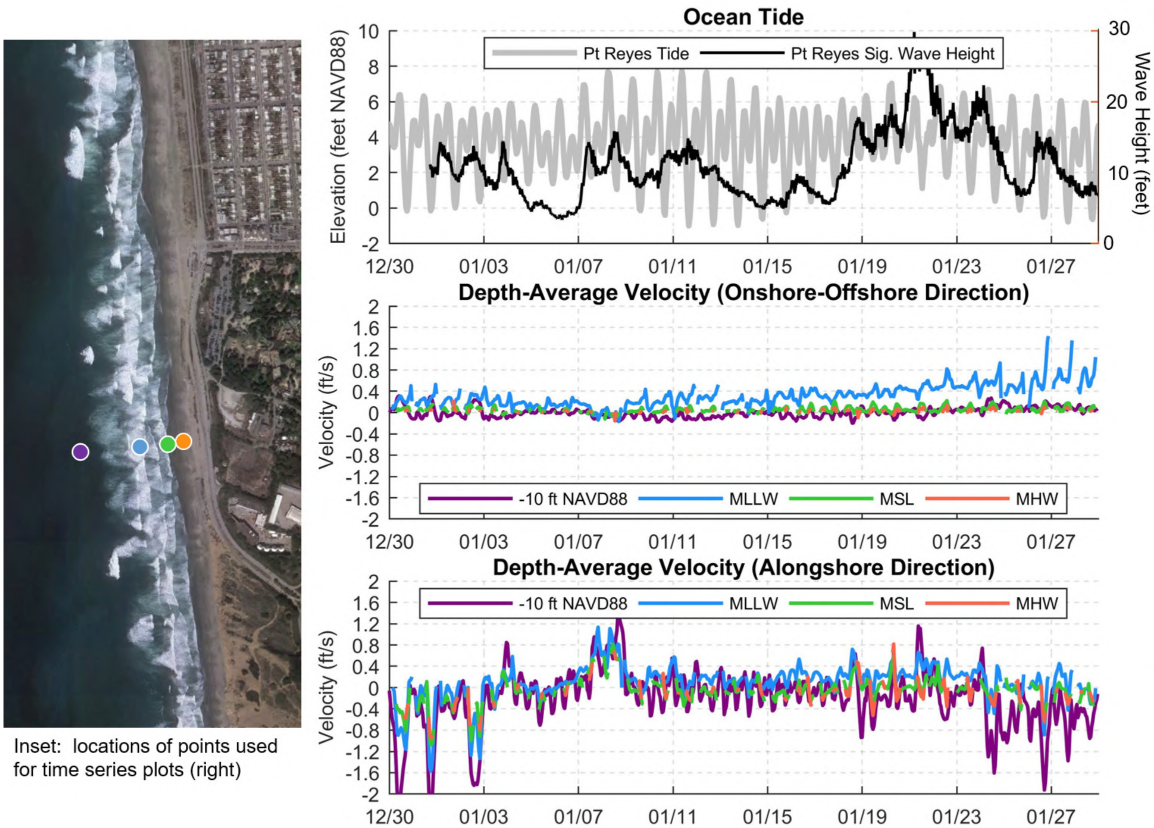
The first step was comparison of model output for the month of January 2010 to available field data and to results from the USACE study. **Figure 15** presents model output compared to publicly available field measurements: the top panel shows water levels or tides at the Point Reyes tide gauge, the middle panel is wave height at the San Francisco Bar (NOAA NDBC 46237, CDIP SF014), and the bottom panel is peak wave period at the same locations. Overall, the model output shows good agreement with the measurements, indicating that the model is doing a reasonable job simulating the hydrodynamics of the system.



SOURCE: CDIP, NOAA

Figure 15
Comparison of modeled and observed tide elevation, wave height, and wave period for January 2010

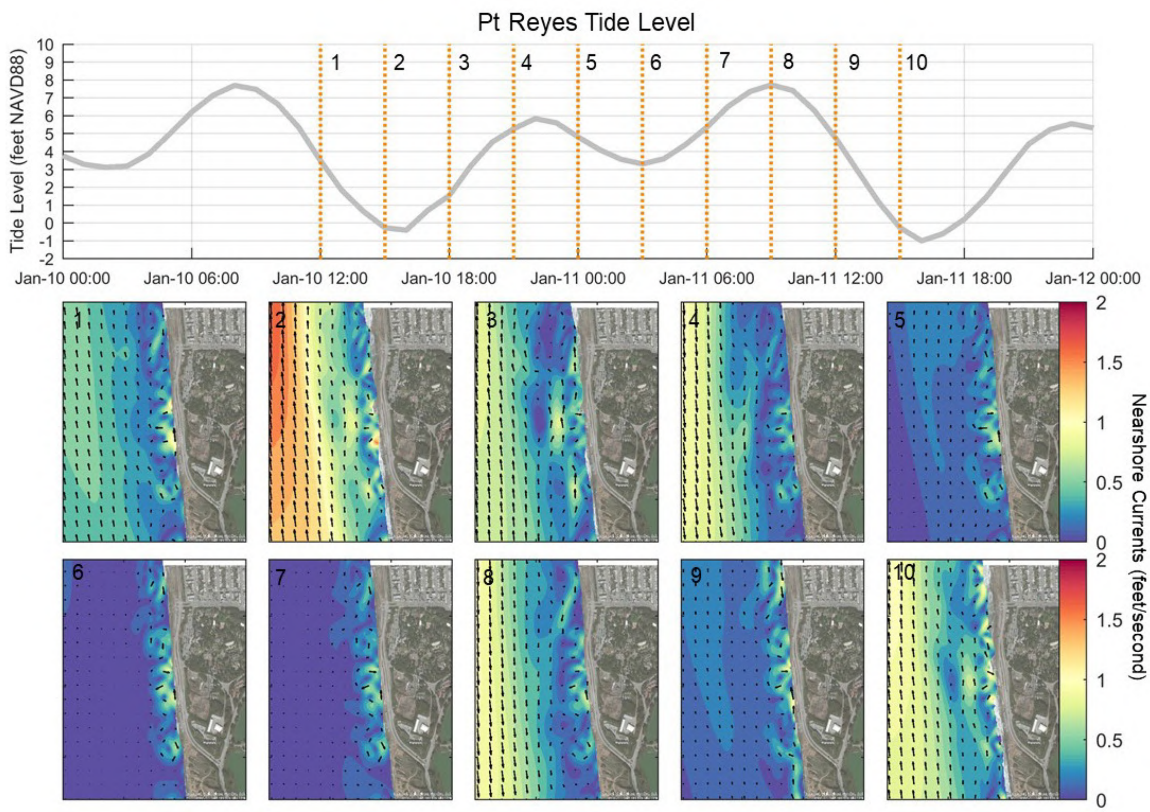
The next run we completed was for the month of January 2017, which was used as a second verification to measurements and as the baseline condition. The following series of plots present the model output of currents, water levels, waves, and morphological change, with comparison to field measurements where available. **Figure 16** presents a plot that shows the current magnitudes in the cross-shore (middle panel) and the alongshore (bottom panel) over time at multiple locations in the surf zone. The currents are heavily influenced by the tides and waves (top panel). A general trend of the currents indicates maximum cross-shore currents were simulated in the vicinity of the MLLW contour located in the surf zone, while the current magnitudes decreased closer to shore and further offshore. Note that higher onshore velocities are predicted during periods of greater wave energy in early and late January. The along shore current magnitudes also appear to be heavily influenced by tides and the swell conditions. During the larger, long period swell events the currents outside the surf zone (i.e., -10 feet NAVD contour) tend to be directed to the south with the currents closer to the beach directed northward. Based on observations from local surfers during long-period swells, the currents inside and outside the surf zone often will be in opposite directions. During winter storm with strong winds from the south, such as that occurring on January 8-9, the currents inside and outside the surf zone were directed to the north. These results indicate the complex interaction of the waves, tides, wind, and morphology on the distribution of the currents in the surf zone at South Ocean Beach.



SOURCE: ESA CMS Model

Figure 16
Depth-averaged current velocity magnitudes in the cross-shore and alongshore directions where the bed intersects with the MSL and MLLW elevations

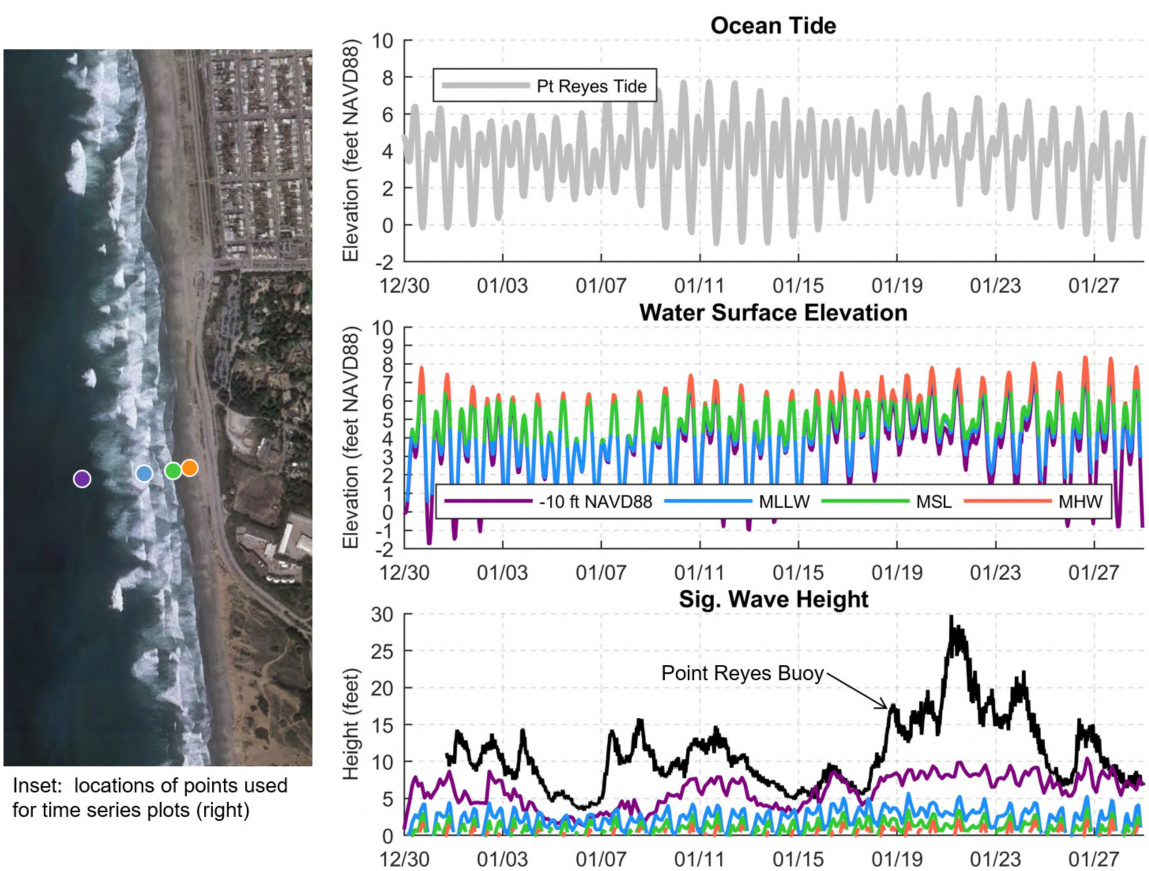
Figure 17 shows plan-view maps of the current magnitudes and vectors over an example tidal cycle extracted from the model output. Note the influence of the tide on the directions and magnitudes of the currents. For example, panel 2 shows primarily northward flows offshore of the site when the tide is near its low point, but then flows are directed south when the tide is close to its high point (panel 4). Some of the panels also show that the currents near the shore may be directed in the opposite direction of the currents offshore (see panel 8). Overall, these results indicate the complex nature of the currents in the surf zone, and the importance of considering the dynamic conditions resulting from the interplay of the tides and morphology, as well as the waves and wind. Investigation of areas close to shore indicate that there tend to be variability in the current magnitudes, which may represent rip currents or areas of preferential flow from nearshore to offshore. Because rip currents are complex, three-dimensional features, they are difficult to assess using the two-dimensional depth-averaged results shown in the figure. Overall, the results appear to provide a reasonable simulation of the currents at South Ocean Beach, although we do not have measurements of the currents in the surf zone to verify these results. Surface currents would likely exceed the values in these plots, which show the depth-averaged currents.



SOURCE: ESA CMS Model

Figure 17
Depth-averaged current velocity magnitudes (color scale) and directions (arrows) for a modeled tidal cycle from January 2017, for baseline conditions; panel numbers correspond to times/tides in the top panel

Figure 18 presents a time series of the water levels (middle panel) at different locations across the surf zone, and the corresponding wave heights (bottom panel) at the same locations. The shading of the colored lines of the water level model output darken from offshore at the -10 feet NAVD contour (light blue line) to onshore at the MHW contour (purple line). The black line in the bottom plot shows the measured wave heights at the Point Reyes buoy. Note that during periods of relatively larger waves, during the early and later parts of January, the water levels near shore tend to be elevated above the tides by up to 2.5 feet. Because the model couples the hydrodynamics of the tides and the waves, the momentum of waves in the nearshore is translated into higher water levels at the shore, which is a physical phenomenon called *wave setup*. Based on inspection of these results, we assume that the apparent wave setup in the model is the *static* wave setup, which is an average increase in the water level for the wave event, and different than *dynamic* wave setup, which is a fluctuation of the water levels around the mean or static wave setup. In environments like South Ocean Beach, the dynamic wave setup can be much larger than the static wave setup, on the order of 10 feet, and is an important factor for determining the extreme wave runup at the shore. Furthermore, the wave setup plays an important role in morphological change, as it temporarily increases the local water levels and facilitates wave interaction with the shore at relatively higher elevations.

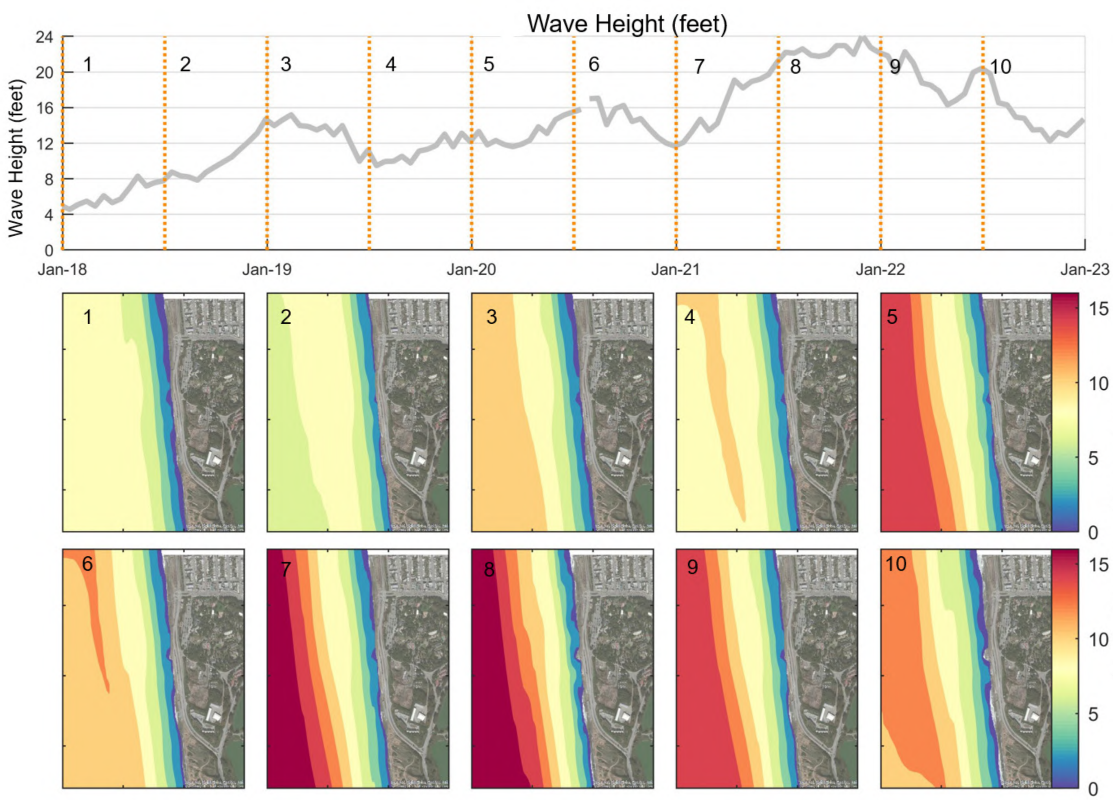


Inset: locations of points used for time series plots (right)

SOURCE: ESA CMS Model

Figure 18
Baseline January 2017 simulated water levels and waves across the surf zone

Figure 19 presents a series of plan-view plots of the wave height over a five-day period during the largest swell observed in January 2017. Note that the modeled wave height for this period is shown in the top panel, indicating a peak swell at approximately 24 feet at approximately January 21-22, 2017. The plan-view panels illustrate the decrease in the wave height across the surf zone, where the waves are larger in the offshore and smaller near the shore. This decrease in the wave height is due to the dissipation of the waves across the surf zone as waves are breaking. Because the CMS-Wave module is a phased-average wave model, some of the real-life complexities of waves at Ocean Beach are simplified and lost. For example, as a typical winter swell approaches the region from the northwest, the waves refract around the San Francisco Bay ebb shoal (outer bar) and then propagate toward ocean beach from two directions: waves that cross the bar and slow down continue approaching from the west-northwest, while other wave energy moving faster through deep water south of the ebb shoal refracts and bends northward, approaching Ocean Beach from the southwest. When these waves cross, they form peaky waves that make Ocean Beach a popular big wave surfing spot. Because the model is phase-averaged, it is unable to simulate waves from multiple directions at any location in the model domain, but it appears to do a reasonable job with general pattern of wave heights incident to South Ocean Beach.

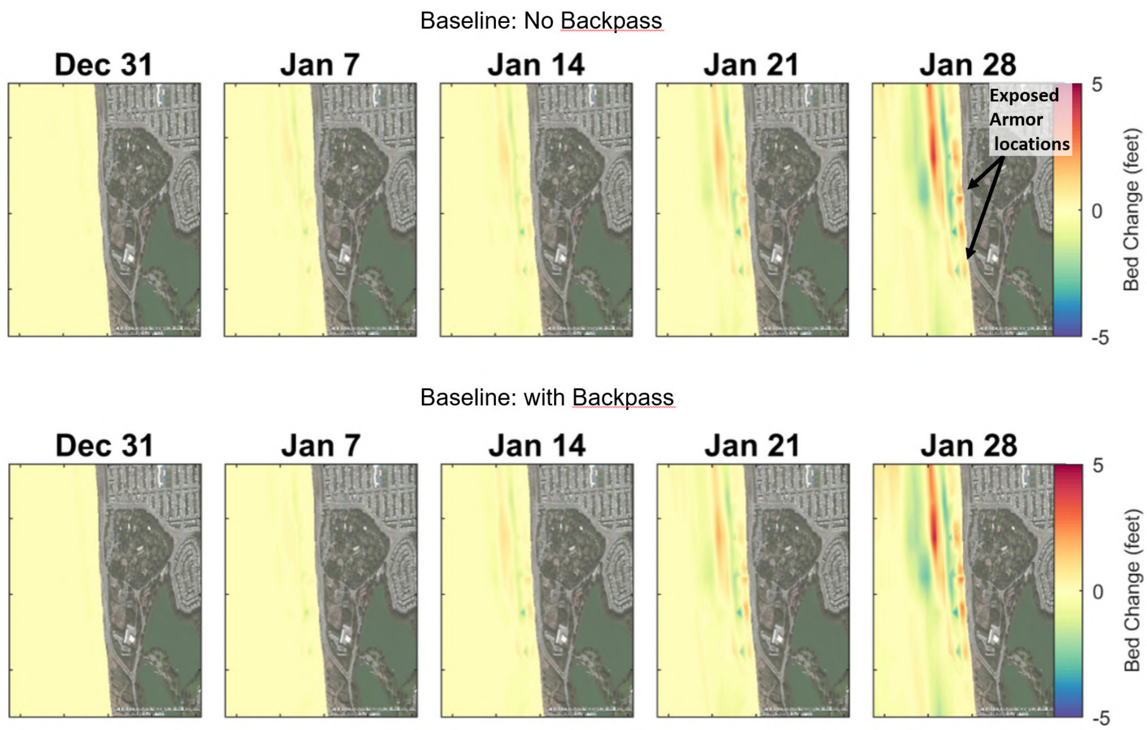


SOURCE: ESA CMS Model

Figure 19
Significant wave height for a modeled wave event from January 2017, for baseline conditions; panel numbers correspond to times labeled on the top panel

Figure 20 presents the evolution of morphologic change, or bed change, for the baseline condition, which includes a baseline condition with no backpass (top panel) and a baseline condition with a 70,000 cubic yard backpass, similar to the backpass project constructed in November-December

2016. The *bed change* is a measurement of how the bed morphology changes as a result of the wave- and current-driven sediment transport in the model. Each panel in the evolution shows the amount of bed change relative to the conditions at the start of the simulation. The red colors indicate accretion, or an increase in the bed elevation, and the blue colors indicate erosion, or a decrease in the bed elevation. Note that the results from both of the baseline conditions are quite similar, where there are alternating patterns of small-moderate accretion and erosion moving across the surf zone. For the baseline conditions with the backpass, a slightly greater amount of accretion was observed, likely due to the presence of more sand available on the shore to be moved by waves and currents. This is generally consistent with observations following sand placement at South Ocean Beach (often called "backpass") when sand on the shore was moved laterally along the beach, and portions of shore widened.[105] However, the small magnitudes and locations of the bed change indicate that the profile is "relaxing" or being smoothed, rather than building a more-defined offshore bar that was expected.[106] We attribute this to the complex physics that govern the processes that is not being replicated by the model. While the model is showing sand movement, it is not accurately replicating the development and evolution of the sand bars.



SOURCE: ESA CMS Model

Figure 20
Bed change evolution for modeled baseline (top) and baseline with backpass (bottom) conditions

[105] Environmental Science Associates (ESA), 2020, 2019-2020 Monitoring Report, Ocean Beach Short-Term Erosion Protection Measures Project, Prepared for San Francisco Public Utilities Commission, June 2020.

[106] Bascom, W., 1964, *Waves and Beaches: The Dynamics of the Ocean Surface*, Anchor Books, Garden City, NY, 286 pp.

3.2.2 Project Conditions

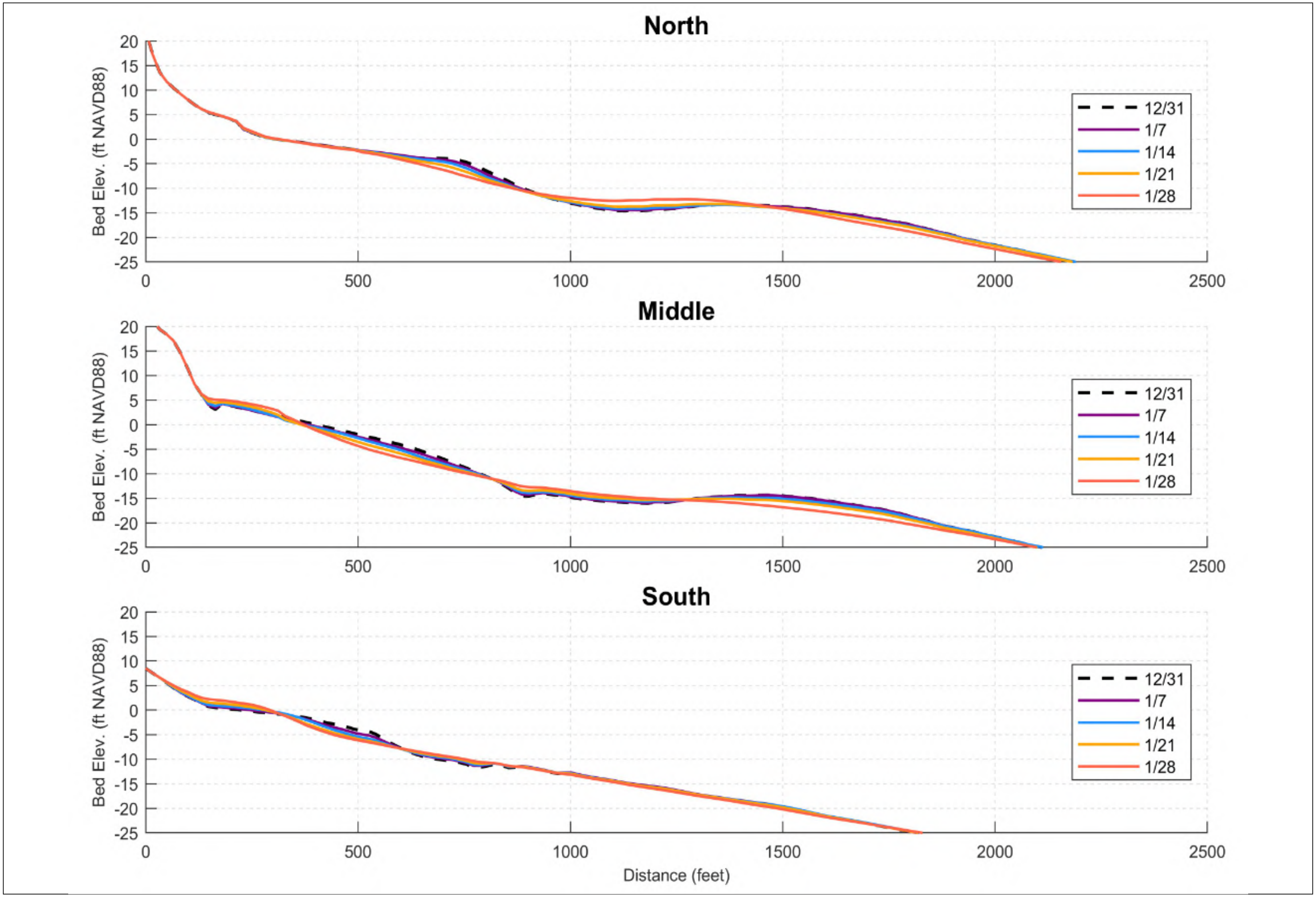
For the project conditions, four cases were simulated as described in Section 2.3: project with small (sand) placement, project with large placement, project with partially exposed wall, and project with fully exposed wall. This section presents results for these four cases.

Figure 21 shows three profiles of the bed from the beach through the surf zone located at the north, middle and south portions of the project site for the project condition with small placement. Each panel shows the bed profile at multiple time steps over the duration of the month-long simulation.

In general, the profile appears to become smoothed over the simulation, with the troughs filling, the bars softening and migrating onshore, and an area of accretion at intertidal elevations. The model does not show apparent profile changes at elevations above approximately 5 feet NAVD, which was not expected based on observed changes to the shore during winter conditions, where high water levels and large waves erode the beach. We expected the model to show sand moving from the shore in a seaward direction, with the nearshore and offshore bar migrating seaward and becoming more defined.[107] We attribute this to the complex physics governing the coastal processes that are not being resolved by the numerical model. Note that the shore response varies along the shore, and these three profiles were selected as an example of the changes that were simulated for this project condition.

The October 2016 USGS surf zone survey, which we selected to develop the bed elevation for the initial condition of the model simulation, exhibits winter-like profile characteristics with a well-defined offshore bar, and so may affect the modeled bar change dynamics. Inspection of the October 2016 surf zone survey data suggests that the summer conditions had not fully recovered from the prior El Niño winter, which had above average winter swells and water levels. Therefore, the selection of this data as the initial condition could potentially affect the direction and magnitude of bar change over the simulation period. However, based on testing of the CMS model for simplified conditions, we found that while the model could move sediment in the surf zone, it would not build the offshore bar that is representative of winter conditions at Ocean Beach.

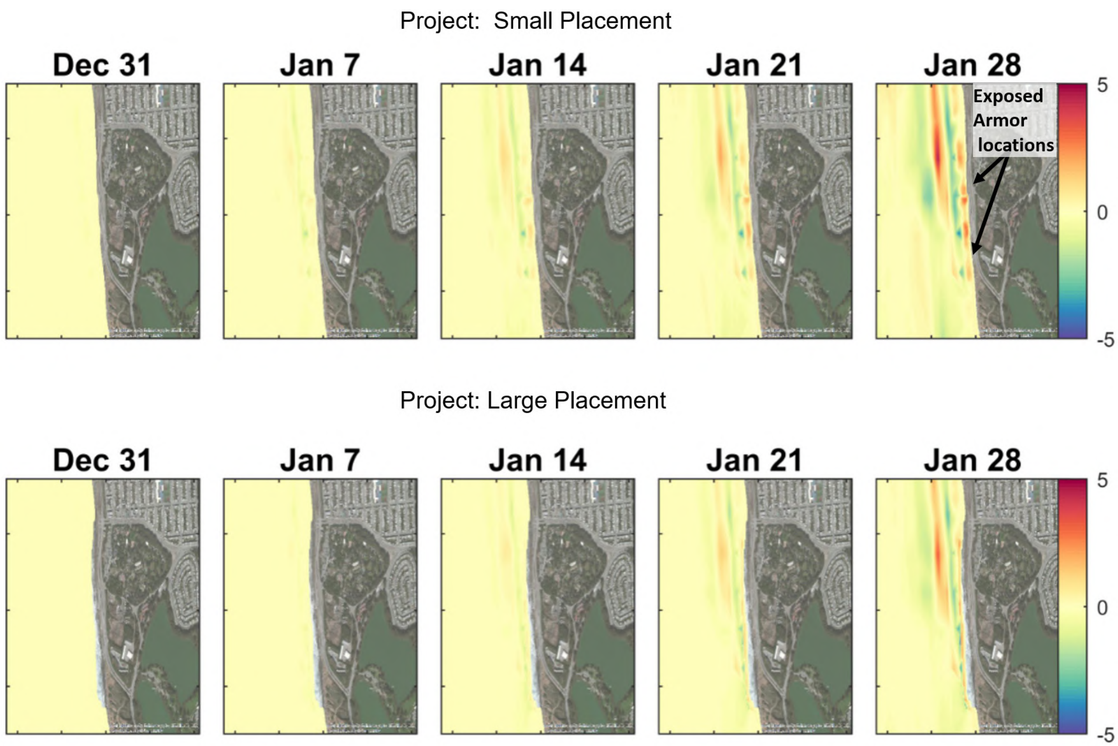
[107] Bascom, W., 1964, *Waves and Beaches: The Dynamics of the Ocean Surface*, Anchor Books, Garden City, NY, 286 pp.



SOURCE: ESA CMS model

Figure 21
Shore-perpendicular transects at the north, middle, and south end of the project area showing bed change over January 2017 for project conditions with small placement

Figure 22 presents the evolution of morphologic change for the project condition with small placement (top panel) and project condition with large placement (bottom panel), which are sand placements of 85,000 and 300,000 cubic yards, respectively. The project condition with small placement shows a greater amount of bed changes in the nearshore and offshore zones of the area compared to the project condition with the large placement. The reason for this may be that the large sand placement suppresses erosion in the surf zone, such that there is less sand moving into the bars, or the large placement morphology is out of equilibrium on the nearshore end and more sand is moving offshore, filling in troughs. Based on observations of sand placement during backpass events at South Ocean Beach, the waves and tides initially tend to move the sand into the surf zone and along the shore rapidly, and then at a slower rate as time progresses.[108] The model is not showing the rapid movement of sand from beach elevations into the nearshore as may be expected, but there is some movement of sand shown in the plots.



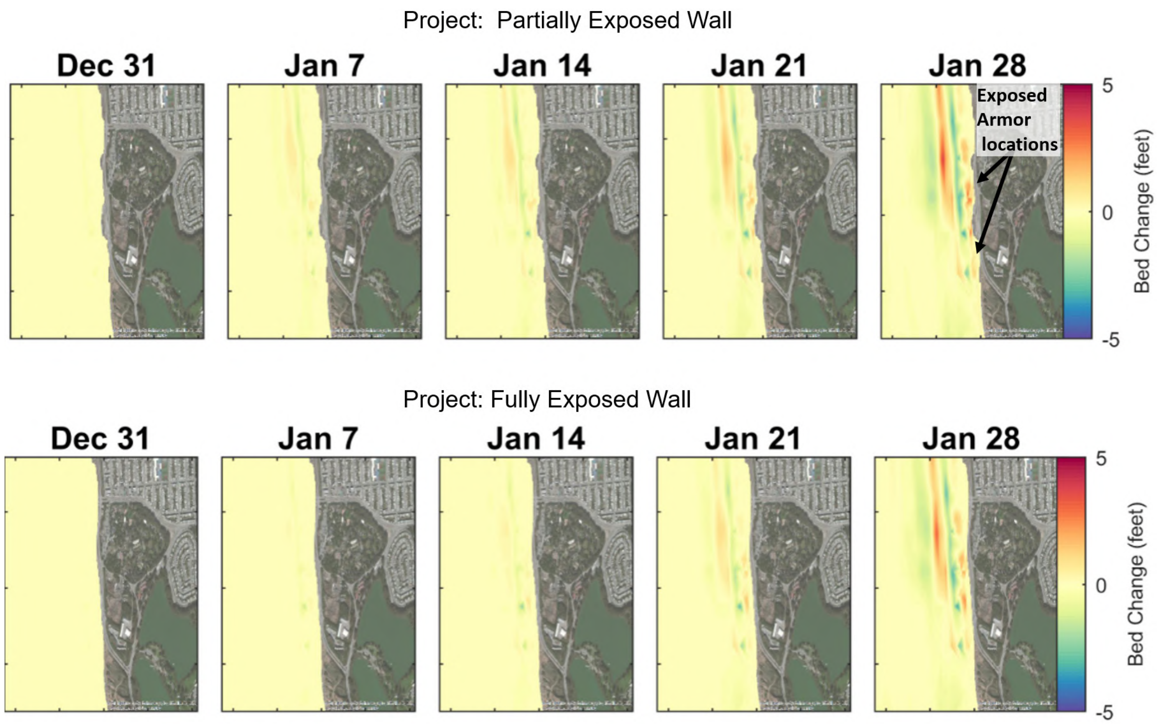
SOURCE: ESA CMS Model

Figure 22
Bed change evolution for modeled project with small placement (top) and project with large placement (bottom) conditions

Figure 23 presents the evolution of morphologic change for the project condition with partially exposed wall (top panel) and project condition with fully exposed wall (bottom panel). The partially exposed wall includes three 500-foot-long segments of shore, approximately half of the total length of the proposed wall that are eroded to mean sea-level (approximately 3 feet NAVD), exposing the proposed wall to waves. The fully exposed wall condition assumes that the entire beach in front of the wall erodes to mean sea-level, the beaches north and south of the project are

108 Environmental Science Associates (ESA), 2020, 2019-2020 Monitoring Report, Ocean Beach Short-Term Erosion Protection Measures Project, Prepared for San Francisco Public Utilities Commission, June 2020.

in an eroded condition, and the dunes and bluffs north and south of the project area have eroded landward to be approximately in alignment with the horizontal location of the proposed wall.



SOURCE: ESA CMS Model

Figure 23
Bed change evolution for modeled project with partially exposed wall (top) and project with fully exposed wall (bottom) conditions

The modeled output in the plots below indicates that some areas of sand movement along the shore exhibit length-scales of approximately 500 to 800 feet, consistent with observations of rip current embayment morphology. However, there does not appear to be a noticeable difference in the erosion and accretion in the offshore bars, which may be because the modeling period of one month was too short. The model also does not show localized scour in front of the exposed wall, which might be expected under actual conditions when waves and tides interact with a coastal structure. While not addressed in the modeling, the exposed wall conditions are presumed to be limited in extent and infrequent because of the proposed trigger-based management actions, which would place sand along the beach when ongoing project monitoring finds that the wall is exposed.[109] Furthermore, the eroded conditions that were simulated are considered to be relatively rare, extreme events that are not representative of typical conditions. The fully exposed wall condition has a low probability of occurrence, and its occurrence was estimated as three to four times over a period of 80 years.[110]

109 Moffatt & Nichol Engineers, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020a, Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements, Prepared for San Francisco Public Utilities Commission. July 2020.

110 Ibid.

3.3 Assessment of Project Effects Relative to Baseline Conditions

This section provides a description of how project effects are assessed relative to the baseline conditions. For this assessment, we used the modeled output of the different project and baseline conditions runs, and then compared the morphological changes of the bar and end effects to the historical measurements of conditions described in Section 3.1.

3.3.1 Project Effects on Offshore and Nearshore Bars

Results from Numerical Model

A comparison of the numerical model results to the observed bar change relationships is included in Appendix B. As described in Section 3.2, the numerical model tended to produce unrealistic and unexpected bed changes in the surf zone for the simulation period. We note that the model runs produce results that show the profile shapes “relaxing,” or smoothing out, with bars eroding and troughs filling relative to the initial conditions of the run, which is counter to what we expect based on observations, experience and engineering literature. Under the simulated conditions, we would expect that the bars would migrate offshore, deepen, and become more defined. We suspect that the model is not able to replicate the complex physical processes that are responsible for shaping the surf zone bar system.

Because these data do not inform the central questions of the study, the comparison of predicted bar changes (from the numerical model) to the observed bar changes (from data analysis of observations) is located in Appendix B. Appendix B includes a series of plots showing how the modeled bed elevations evolve under baseline and project conditions, as well as the difference between the project and baseline conditions, for project with small placement, project with large placement, project with partially exposed wall, and project with fully exposed wall, respectively. The baseline condition used in these figures did not include the 70,000 cubic yard backpass, constructed in November and December 2016. These results were not used to assess the potential effects of the project on the sand bars.

Discussion of Model Output Relative to Anecdotal and Theoretical Expectations

As discussed in Sections 3.2 and 3.3.1 above, the CMS model appears to relax or smooth defined profiles over the course of a model run with winter wave and water level conditions, counter to the bar changes that we expect based on observations from monitoring, first-hand experience surfing at Ocean Beach, and based on theory. The expected condition was that, under the forcing of winter water levels and waves, the beach would erode and narrow, and sand bars would migrate offshore with deeper crests and more refined troughs.[111] However, we suspect that the model was not able to resolve the physics that govern these complex coastal processes.[112]

Although the model analysis does not provide a meaningful result that can be used to show the potential effects of the project on the bars, insight from professional judgment and experience indicates that the project would be unlikely to negatively affect surfing conditions overall at South Ocean Beach for the following reasons:

- The existing condition (eroded state) is characterized as a degraded condition that is defined by the presence of large rock revetments and rubble. The engineered and de-facto shore protection structures cause waves to reflect seaward, which induces local erosion and scour of the nearshore trough, as well as potentially interfering with incident waves causing “backwash.” In areas where reflection-induced scour creates deep nearshore troughs, rip currents can form and carve “rip embayments” into the shore – a small, arc-shaped feature in the shore characterized by a very narrow beach and a persistent rip current that extends offshore. While surfers utilize the rip currents to assist their movement from shore to the outer bar, this condition has resulted in periods of relatively less desirable surfing conditions due to currents, sand bar establishment and reflections.

- Immediately following sand backpass projects, the existing condition (nourished state) can provide temporarily improved surfing because of sand that has migrated into the nearshore zone and widened the beaches. As sand is placed on the shore in a sacrificial berm, waves break on the berm face and mobilize sand. Although there are often wave reflections associated with the sand backpass projects, these are temporary and have been observed to diffract and decrease in height until their effects are negligible in areas where surfing typically occurs.[113] As sand moves along and across the shore, the beaches widen and sand bars build in the nearshore, sometimes creating improved surfing conditions. However, these improvements are temporary as the sand continues to move through the system and the shore continues to erode to its pre-nourished condition.[114]

- The project conditions will remove the armor, rubble, and fill to construct a new wall at the toe of a slope, which will widen the beach by approximately 80 feet. Two scales of sand placement are proposed for the project: a small placement to restore the design grades, which would entail a widened beach and a buried wall, and a large placement that would construct a large, approximately 20-foot-tall sand berm along the shore. The small placement project resembles the existing condition in a nourished state, but with less prominent armoring. The large placement project would have approximately 3.5 times more sand along the shore and in the beach-bar system as a whole, and would likely persist for longer periods.[115] This suggests that the project with sand placed would improve the surfing conditions relative to the baseline condition, by softening the shore and maintaining a more regular sand source that

111 Bascom, W., 1964, *Waves and Beaches: The Dynamics of the Ocean Surface*, Anchor Books, Garden City, NY, 286 pp.

112 It may be possible that the model could be used to accurately simulate the bar changes, but this would require additional testing and time to refine the model grids and settings. The uncertainty of producing improved model performance and output did not warrant the substantial effort to further refine the model.

113 Observations by study authors Louis White, PE, and Bob Battalio, PE, following sand backpass projects in 2012, 2016-2017, 2018, 2019-2020.

114 Personal communication, Joe Hill, civil engineer and local surfer, August 11, 2021.

115 Moffatt & Nichol Engineers, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020a, Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements, Prepared for San Francisco Public Utilities Commission. July 2020.

would support the nearshore bars where the majority of the surfing at South Ocean Beach occurs.

- The project condition may be impacted by storms, resulting in a partially or fully exposed wall, which would increase the wave reflections. This condition is expected to be rare and infrequent.[116] However, the proposed management approach is to place sand along the shore if the wall becomes exposed, and thereby these eroded impacts are expected to be minor and temporary.

Implications of Sand Size on Beach and Sand Bars

The project design will rely on the periodic placement of sand at the project area in small and large placements of 85,000 cubic yards and 300,000 cubic yards, respectively. The sand is expected to be sourced from the San Francisco ebb shoal (i.e., the San Francisco bar) through dredging of the Main Ship Channel by the USACE, and/or from North Ocean Beach (see Figure 1). The most recent data available for the main ship channel suggests median grain size within the dredging area is around 0.15 to 0.19 millimeters. By comparison, median grain sizes from samples collected along South Ocean Beach are between 0.18 and 0.32 millimeters.[117] This section briefly describes general information concerning the implications of sand grain size on the project's potential nearshore and offshore sand bar effects.

- Studies have suggested that the sediment system that encompasses Ocean Beach is becoming finer in areas outside of the ebb tidal delta and in the vicinity of the project area and a pattern of coarsening has been observed on the crest and inner portion of the ebb tidal delta, but the overall trend is not clear.[118,119] Over time, the sand grain size at Ocean Beach appears to have decreased, and the sand grain size of sediment being dredged from the MSC has significantly decreased.[120]

- Sand grain size compatibility is an important consideration in beach nourishment design, and often requires a significant data collection effort to characterize the native and the source grain sizes. Very little data exists to characterize the native grain size at South Ocean Beach, aside from samples that have been collected in the swash zone on the beach face where waves break.[121] Sand grain sizes in the swash zone tend to be the coarsest sediment across the entire active coastal profile. The recommended approach for determining the native grain size for compatibility to nourishment materials is by developing a composite grain size, which is based on samples from the dunes and back-beach, across the beach face, the intertidal zone, and to subtidal depths seaward to the depth of closure, estimated to be at least -30 feet NAVD

[116] Ibid.

[117] ESA, 2021, Comparison of San Francisco Main Ship Channel and Ocean Beach Sediment Grain Sizes, Memorandum from Hannah Snow, PE (ESA) to Karen Frye (SFPUC), January 28, 2021.

[118] Barnard, P.L., Hansen, J.E., Erikson, L.H., 2012, Synthesis study of an erosion hot spot, Ocean Beach, CA (USA), *Journal of Coastal Research*, **28** (4), 903-922.

[119] Barnard, P.L., Foxgrover, A.C., Elias, E.P.L., Erikson, L.H., Hein, J.R., McGann, M., Mizell, K., Rosenbauer, R.J., Swarzenski, P.W., Takesue, R.K., Wong, F.L., and Woodrow, D.L., 2013, Integration of bed characteristics, geochemical tracers, current measurements, and numerical modeling for assessing the provenance of beach sand in the San Francisco Bay Coastal System, *Marine Geology*, 336, 120-145.

[120] Battalio, R.T., 2014, Littoral processes along the Pacific and bay shores of San Francisco, California, USA, Shore & Beach, 82(1), Winter 2014, 3-21.

[121] Barnard et al., 2007, Coastal Processes Study at Ocean Beach, San Francisco, CA: Summary of Data Collection 2004-2006, United State Geological Survey (USGS), Open-File Report 2007–1217.

contour or deeper.[122] Collection of the samples across the surf zone constitutes a significant effort – especially at locations with large surf and wide surf zones like Ocean Beach. Composite sand samples that do not include samples from back-beach and subtidal areas, which tend to be finer than samples in the swash zone, will suggest that the native beach grain size is larger than exists across the beach and subtidal portions of the shore profile.

- Existing shore protection is likely contributing to the transport of finer sands away from the shore at South Ocean Beach, due to breaking waves, turbulence and currents.
- If beach nourishment sand is finer than the native sand, it would mobilize faster and transport at higher rates than the native sand. Typically, in design considerations, the designer would increase the volume of sand to be placed to make up for the more rapid losses expected with finer sand.
- If finer sand is placed in a beach nourishment project, the beach slope would be flatter than the existing profile, also influencing transport rates, and potentially sand bar morphology.[123]
- Finer sand could be distributed across the surf zone further as well as faster, and would be expected to contribute to offshore bars.

3.3.2 Project End Effects

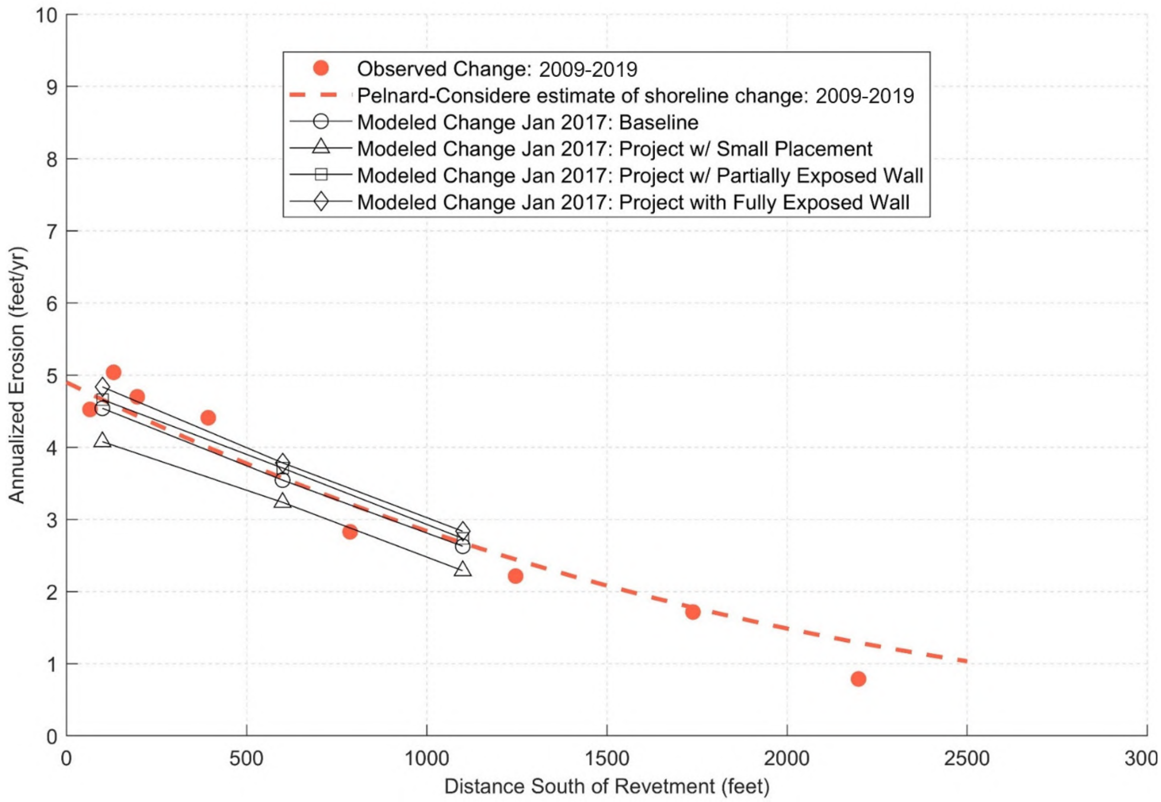
To assess the potential effects of the project on the end effects at the south end of the proposed project, we annualized erosion over an approximately ten-year period from 2010 to 2019, and compared the observations to potential erosion rates for baseline and project conditions predicted using the Pelnard-Considère model described in Sections 2.21 and 3.1.1. The assessment also includes consideration of the project's landward shift in the shore position and wider beach, as well as implementation of the Sand Management Plan.

Figure 24 presents annualized end effect erosion rates for observations and modeled conditions. The red points represent annualized observed erosion over the approximately ten-year period, and the dashed red line is the annualized Pelnard-Considère equation fit to the measured historical data (see Section 3.1.1). We note that this averaging yields an erosion rate that would be less than expected for a shorter duration of time in the first few years after construction of a structure when end effect erosion is typically at its maximum rate. However, we considered a duration of ten years a reasonable amount of time for assessing the comparison between baseline and project conditions. We note that the predicted erosion represents a long-term average comprised of intermittent and episodic erosion events.

Also shown on Figure 24 are the backshore (i.e., bluff toe) erosion estimates using the Pelnard-Considère equation for the baseline and project conditions. For each of the baseline and project scenarios we used the average nearshore wave height extracted from the numerical model and the likely beach berm elevation as inputs into the annualized Pelnard-Considère equation. The likely beach berm elevation was determined using applied geomorphology and reference data, as well as

[122] Dean, R.G., 2002, *Beach Nourishment Theory and Practice*, Advanced Series on Ocean Engineering – Volume 18, World Scientific, River Edge, NJ, 399 pp.
[123] Ibid.

interpretation of the proposed project design. We selected a likely beach berm elevation for each modeled scenario that would be expected under the corresponding conditions (i.e., recently nourished with dry back-beach, eroded, etc.). The baseline condition presented here yields results similar to the observed historical data, but it is based on an independent application of the Pelnard-Considère equation using information extracted from the numerical modeling of the surf zone, and provides a basis for comparing to the project scenarios simulated over the same time period.



SOURCE: USGS, ESA Analytical Model

Figure 24
Annualized end effect erosion rates for observations and modeled conditions

Table 4 summarizes the results of the baseline and project conditions, and compares to the estimated rate for the historical data. The results show that baseline conditions agree well with the observed historical data after calibration to the selected time period 2009-2019, providing some confidence that the Pelnard-Considère analytical model is applicable to the project area. For the project scenarios, the implication is that sand placement decreases the potential erosion, and the project conditions with exposed wall slightly increase the erosion rates above baseline conditions. However, the increase in erosion rate for the project conditions with exposed wall is less than 0.5 feet per year, which is within the expected natural variability of the historical data. Recall that the likelihood of beach conditions with a fully exposed wall are low, approximately three to four times over an 80-year period.[124] Furthermore, because the project sets the new wall and shore back

[124] Moffatt & Nichol Engineers, AGS, McMillen Jacobs, CHS Consulting Group, and San Francisco Public Works, 2020a, Sand Management Plan – Ocean Beach Climate Adaptation Project, Long-term Improvements, Prepared for San Francisco Public Utilities Commission. July 2020.

from the existing bluff, and includes a transition to the south and north, the end effects are likely not to occur until a relatively large amount of background erosion of the entire shore takes place, and so this is a theoretical future condition, but which we expect to be muted and managed by trigger-based beach nourishment based on long-term monitoring of the project. Regardless, this analysis indicates that the future end effects erosion is not expected to exceed the erosion observed under baseline conditions.

TABLE 4
ESTIMATED ANNUAL BASELINE AND PROJECT EROSION

Project Scenario	Potential Erosion South of Project (feet)		
Distance from project (feet):	**100**	**600**	**1,100**
Historical Data[a]	4.7	3.6	2.7
Baseline[b]	4.5	3.5	2.6
Project + Small Sand Placement	4.1	3.2	2.3
Project + Large Sand Placement	3.5	2.4	1.9
Project + Partial Wall Exposure	4.7	3.7	2.7
Project + Full Wall Exposure	4.8	3.8	2.8

NOTES:

a. Erosion associated with “historical data” is computed by fitting the Pelnard-Considère analytical model to observations from 2009 to 2019.

b. The “Baseline” condition is based on an independent application of the Pelnard-Considère equation using information extracted from the numerical modeling of the surf zone, and which provides a basis for comparing to the project scenarios simulated over the same time period.

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4 CONCLUSIONS

The following summarizes the data analysis and modeling conducted for this study, and the conclusions of the study:

- Fifteen years of field measurements collected by the USGS, ESA, and others, including beach and bluff topographic surveys and surf zone bathymetric surveys, were used to develop relationships characterizing the changes in offshore and nearshore bar conditions as a function of average wave power and average total water level over a 30-day period.

- Fifteen years of bluff surveys collected by the USGS using structure-from-motion techniques were used to develop series of bluff and beach profiles over time, from which bluff toe erosion rates were computed over space and time. The bluff toe erosion data from an area immediately south of the 2010 emergency revetment was used to calibrate a simplified model of long-term shore change (Pelnard-Considère equation), which was used to inform an assessment of how project conditions with a low-profile wall that is set back further landward than the existing bluffs would affect bluff erosion adjacent to the project.

- A numerical model that coupled hydrodynamics, sediment transport and bed change was developed using the U.S. Army Corps of Engineers' Coastal Modeling System. The model was used to simulate tides, currents, waves, sediment transport, and morphology change of the surf zone for baseline and project conditions. The model's simulated tides, currents and waves appeared reasonable in comparison to available field data and other modeling. However, counter to expectations based upon coastal engineering literature and historic observations, the model's profile response showed relaxing or smoothing of the profile, rather than the offshore migration of sand bars that become more defined over the simulated winter month. Therefore, we concluded that the numerical model did not accurately predict how the bars would respond to baseline and project conditions.

- Given the model limitations noted above, we relied upon coastal engineering professional judgment and anecdotal observations of the project area to inform our assessment of potential project effects on sand bars. For project conditions with the new, low-profile wall set-back landward of the existing bluff, the coastal processes in the surf zone are expected to form a more natural geomorphic beach condition relative to the existing baseline condition, which is constrained by armor and rubble. For periods when the wall is exposed, there may be temporary increases in wave reflections that could contribute to local scour in front of the wall, and possibly affecting currents and formation of rip currents, but we expect these to be recoverable through natural seasonal fluctuations and the proposed management actions (e.g., monitoring and beach nourishment).

- Modeled end effect erosion indicates that the project conditions would increase the annualized erosion rate over a ten-year period by up to 0.3 feet per year at the south end of the project for conditions where the wall is exposed. However, the exposed wall conditions are expected to have relatively low likelihoods and would be managed by trigger-based beach nourishment to be informed by long-term project monitoring.

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Appendix A

Sand Bar Responses to Coastal Conditions at South Ocean Beach

APPENDIX A

Sand Bar Responses to Coastal Conditions at South Ocean Beach

This appendix presents figures of sand bar metrics extracted from five USGS shore-perpendicular survey transects at the South Ocean Beach portion of the Ocean Beach Climate Change Adaptation Project area and subsequent analyses.[1] The figures include time series of the metrics at each transect, as well as plots of changes in the bar metrics as a function of the coastal conditions. These relationships were used in the study to provide insight into the natural variability of the sand bar system at South Ocean Beach, and to support assessment of potential effects of the project on the bars.

The transects are composite profiles of elevation developed from a combination of USGS beach topography data and surf zone bathymetry data. The survey data represents approximately two surveys per year over a 15-year period from 2004 to 2019. Gaps in the profiles were reviewed and, if determined to not be excessively far, were filled using a spline fit. Five bar metrics, or indicators for evaluating change, were extracted from each profile: mean high water, nearshore bar trough, nearshore bar crest, offshore bar trough, and offshore bar crest. This constituted extracting the metrics from approximately 75 survey profiles.

Figures A-1 through A-5 present time series plots of the bar metrics extracted from surveyed profiles for transects 11 through 15, respectively. Transect 11 is located at the north end of the project area near Sloat Boulevard; Transect 12 is located approximately 500 feet south of Sloat Boulevard; Transect 13 is located at the 1998 emergency quarrystone revetment; Transect 14 is located north of the 2010 emergency riprap revetment; and Transect 15 is located south of the 2010 emergency riprap revetment. Also shown on Figures A-1 through A-5 are the coincident time series of wave height at a CDIP MOP station[2] SF014 located offshore of the site, non-tidal residual, which was computed as the difference of the observed and predicted tides at Point Reyes, and sand backpass volumes that indicate the timing and volumes of recent sand placement events at South Ocean Beach.

Figures A-6 through A-29 present plots showing the change in bar metrics, including the change in horizontal location of the bar crests, the change in elevation of the bar crests, and the change in the bar relief[3], for nearshore and offshore bars, as a function of the coastal conditions. In addition

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[1] USGS provisional data

[2] CDIP MOP station refers to the Coastal Data Information Program Monitoring and Prediction System, which hosts a network of virtual buoys along the coast of California based on numerical modeling. For this analysis we used data from CDIP MOP station SF014.

[3] Bar relief is defined as the height of the bar crest relative to the trough located immediately shoreward of the bar.

to presenting the bar change metrics for individual transects (left panel on Figures A-6 through A-29), for each bar metric we computed a spatial average across all transects as a way to reduce the variability, which we partially attribute to the three-dimensional nature of morphological change in the surf zone, and based on an approach that averaged shoreline variations over 500-meter-long reaches to analyze the response of the MHW shoreline at Ocean Beach to wave conditions.[4] The relationships of the spatially averaged bar metrics are shown on the right panel of Figures A-6 through A-29.

Figures A-6 through A-29 include plots that show the absolute change in the bar metrics measured between surveys, over an approximately four- to six-month period, and the amount of change normalized for a 30-day period. The normalized change was computed using a linear scaling over the duration between each successive survey. We note that the linear scaling approach might work for durations that span purely a winter or summer period, but which could break down if the duration includes both winter and summer periods when the direction of bar change is expected to reverse. Other scaling approaches were tested, but did not yield improved results and so the simple linear approach was selected.

The changes in bar metrics are presented for two different indicators of coastal conditions: average wave power and average total water level (TWL).

Wave power was estimated using wave height and period from a CDIP MOP station SF014 located offshore of the project area. Wave power derived using linear (small amplitude) wave theory can be described by the equation

$$P = \frac{\gamma g H^2 T}{32\pi}$$

where P is wave power (ft-lbf/sec/ft of crest length), γ is the unit weight of sea water (64.1 lbf/ft^3), g is the acceleration of gravity (32.2 ft/s^2), H is the root-mean-square (rms) wave height (ft), and T is wave period (sec). This equation can be reduced to P=20.5H^2T by combining the constants. The wave power is also referred to as the wave energy flux, or the rate of wave energy that is transmitted per unit of wave crest length. The use of the wave power as the independent variable in the bar metric plots is similar to approaches by others who have assessed beach changes as a function of wave energy.[5,6,7]

The TWL was computed as the sum of the observed tide at the Point Reyes tide gauge[8] and the coincident wave runup. Wave runup was computed using the Stockdon equation, which is a

4 Hansen, J.E., and Barnard, P.L, 2009, The observed relationship between wave conditions and beach response, Ocean Beach, San Francisco, CA, Proceedings of the 10th International Coastal Symposium, Lisbon, Portugal, *J. Coast. Res.*, SI 56, 1771-1775.

5 Ibid.

6 Hansen, J.E., and Barnard, P.L, 2010, Sub-weekly to interannual variability of a high-energy shoreline, *Coastal Engineering*, Volume 57, Issues 11–12, 2010, 959-972.

7 Yates, M.L., Guza, R.T., O'Reilly, W.C., Hansen, J.E., and Barnard, P.L., 2011, Equilibrium shoreline response of a high wave energy beach, *Journal of Geophysical Research*, Vol. 116, C04014.

8 NOAA NOS Station 9415020 Point Reyes

parameterized equation that predicts the 2%-exceedance runup for natural beaches.[9] Because most the backshore of South Ocean Beach is steep and armored, the runup computed using the Stockdon equation is not expected to be an accurate calculation of the TWL on the shore, but it is a useful indicator of the wave and water level conditions at a given time. The TWL was selected as a potential independent variable because its value includes both the effects of incident swash and the low-frequency wave setup, which can be a significant contribution to coastal water levels, as well as the tide and any non-tidal residuals associated with low pressure storm systems and other North Pacific pressure anomalies.

We applied three different averaging periods to the wave power and TWL: average between surveys or approximately six months, maximum 30-day average between surveys, and maximum 5-day average between surveys. The maximum 30- and 5-day averages were computed as the maximum value from a running mean with 30- and 5-day windows between successive surveys. Each figure includes a plot with data from each transect and the spatially averaged data.

Table A-1 provides a key to Figures A-6 through A-29, including whether the figure is for offshore or nearshore bar, absolute or normalized change, and type of independent parameter for the coastal condition.

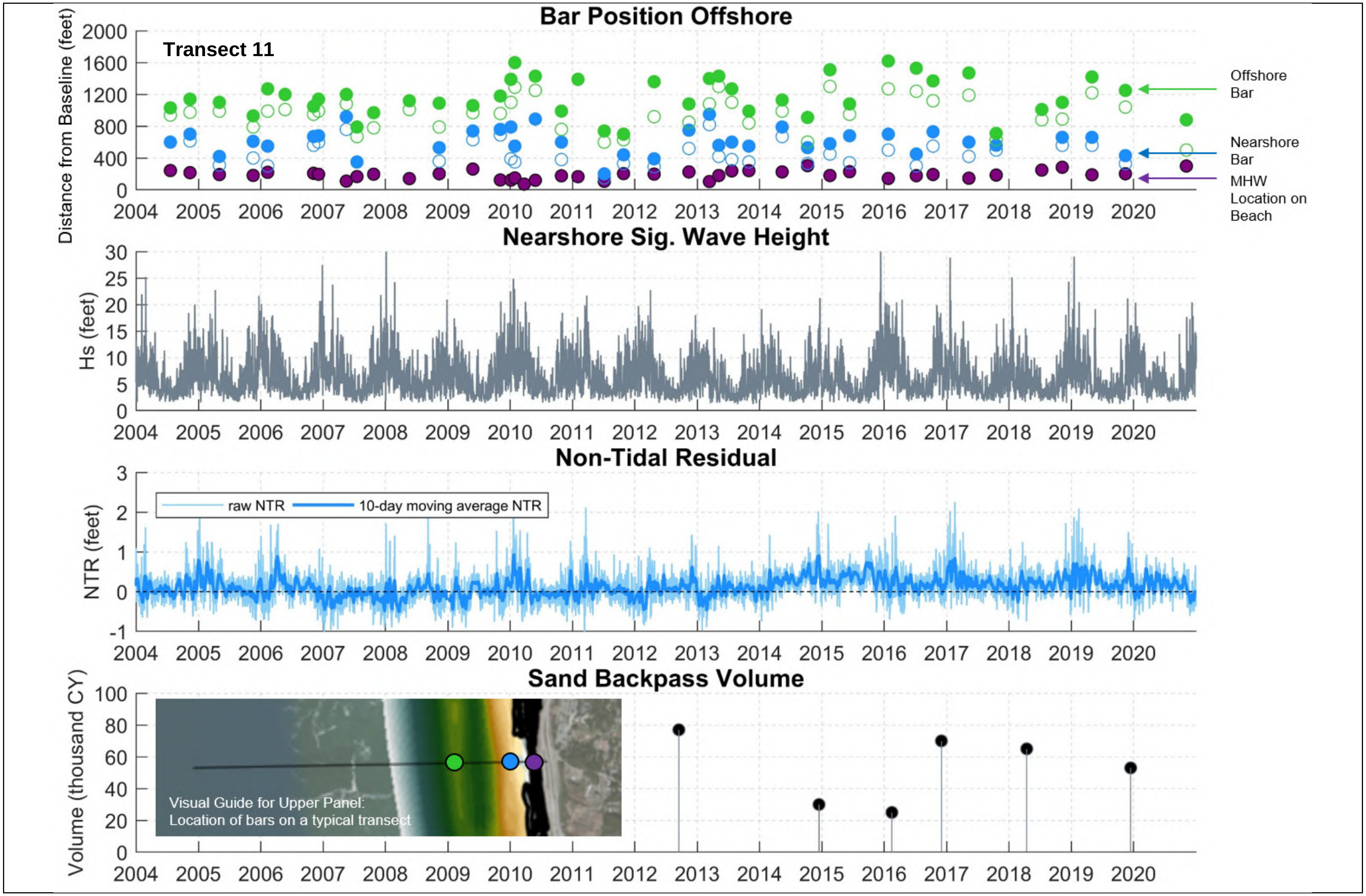
9 Stockdon, H.F., Holman, R.A., Howd, P.A., and Sallenger, Jr., A.H., 2006, Empirical parameterization of setup, swash, and runup, *Coastal Engineering*, 53, pp. 573-588.

TABLE A-1
KEY OF FIGURES A-6 THROUGH A-29

Figure	Offshore Bar	Nearshore Bar	Absolute Change Between Survey	Normalized Change Per 30 Days	Average Between Surveys (6 months±)	Max 30-Day Average	Max 5-Day Average	Left Panel	Right Panel
A-6	X		X		WP[a]			All Transects	Spatially Averaged Transects
A-7	X			X	WP			All Transects	Spatially Averaged Transects
A-8	X		X		TWL[b]			All Transects	Spatially Averaged Transects
A-9	X			X	TWL			All Transects	Spatially Averaged Transects
A-10	X		X			WP		All Transects	Spatially Averaged Transects
A-11	X			X		WP		All Transects	Spatially Averaged Transects
A-12	X		X			TWL		All Transects	Spatially Averaged Transects
A-13	X			X		TWL		All Transects	Spatially Averaged Transects
A-14	X		X				WP	All Transects	Spatially Averaged Transects
A-15	X			X			WP	All Transects	Spatially Averaged Transects
A-16	X		X				TWL	All Transects	Spatially Averaged Transects
A-17	X			X			TWL	All Transects	Spatially Averaged Transects
A-18		X	X		WP			All Transects	Spatially Averaged Transects
A-19		X		X	WP			All Transects	Spatially Averaged Transects
A-20		X	X		TWL			All Transects	Spatially Averaged Transects
A-21		X		X	TWL			All Transects	Spatially Averaged Transects
A-22		X	X			WP		All Transects	Spatially Averaged Transects
A-23		X		X		WP		All Transects	Spatially Averaged Transects
A-24		X	X			TWL		All Transects	Spatially Averaged Transects
A-25		X		X		TWL		All Transects	Spatially Averaged Transects
A-26		X	X				WP	All Transects	Spatially Averaged Transects
A-27		X		X			WP	All Transects	Spatially Averaged Transects
A-28		X	X				TWL	All Transects	Spatially Averaged Transects
A-29		X		X			TWL	All Transects	Spatially Averaged Transects

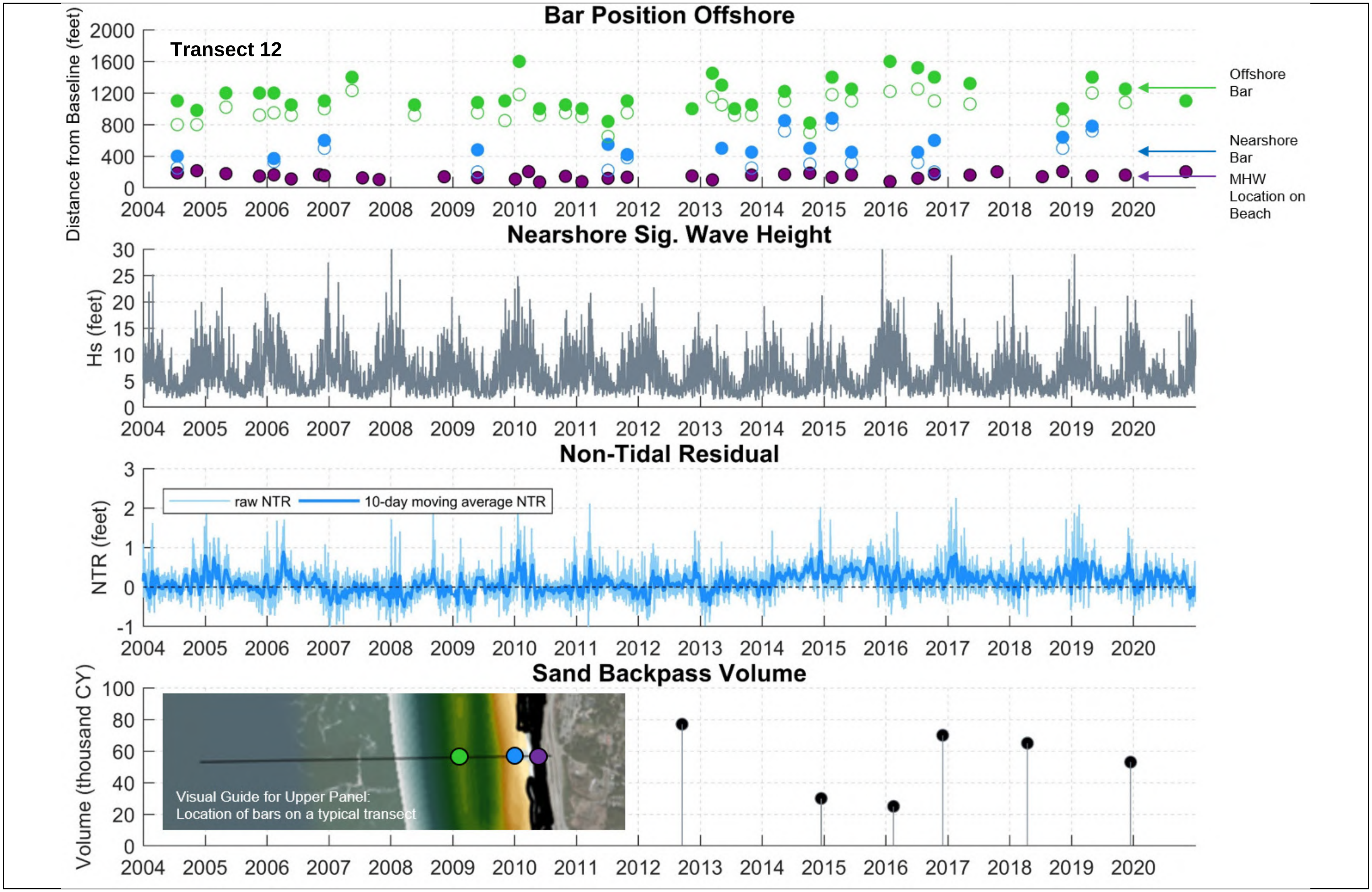
NOTES:

a. WP = Wave Power
b. TWL = Total Water Level



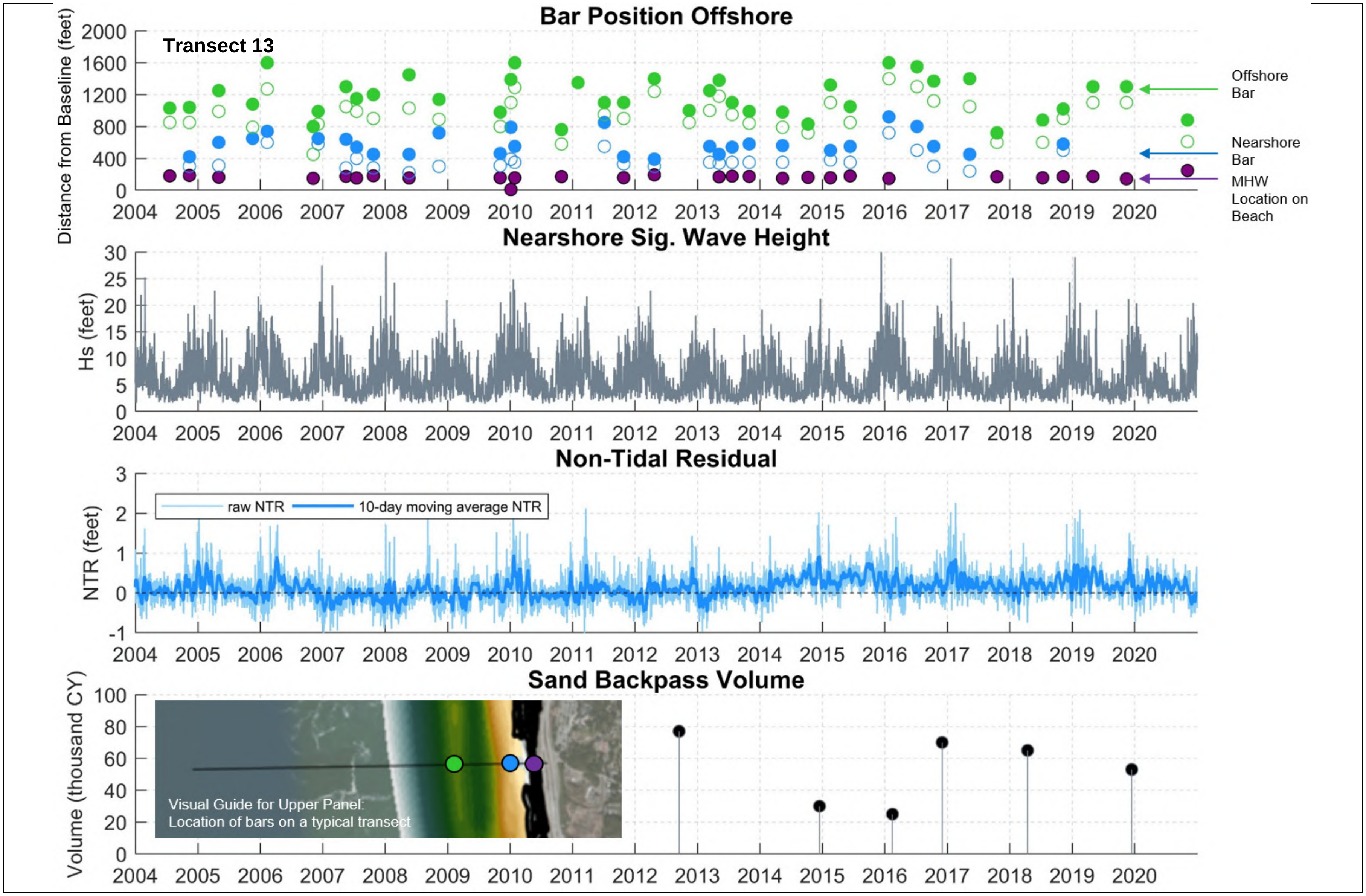
SOURCE: nearshore significant wave heights estimated by CDIP at MOP station SF014. Non-tidal residuals based on NOAA Pt Reyes tide station.

Figure A-1
Location of MHW position on beach and offshore crests (solid circles) and troughs (empty circles) at USGS Transect 11 near Sloat Blvd (Top panel), nearshore wave heights (second panel), non-tidal residual water levels (third panel), and sand backpass volumes (bottom panel)



SOURCE: nearshore significant wave heights estimated by CDIP at MOP station SF014. Non-tidal residuals based on NOAA Pt Reyes tide station.

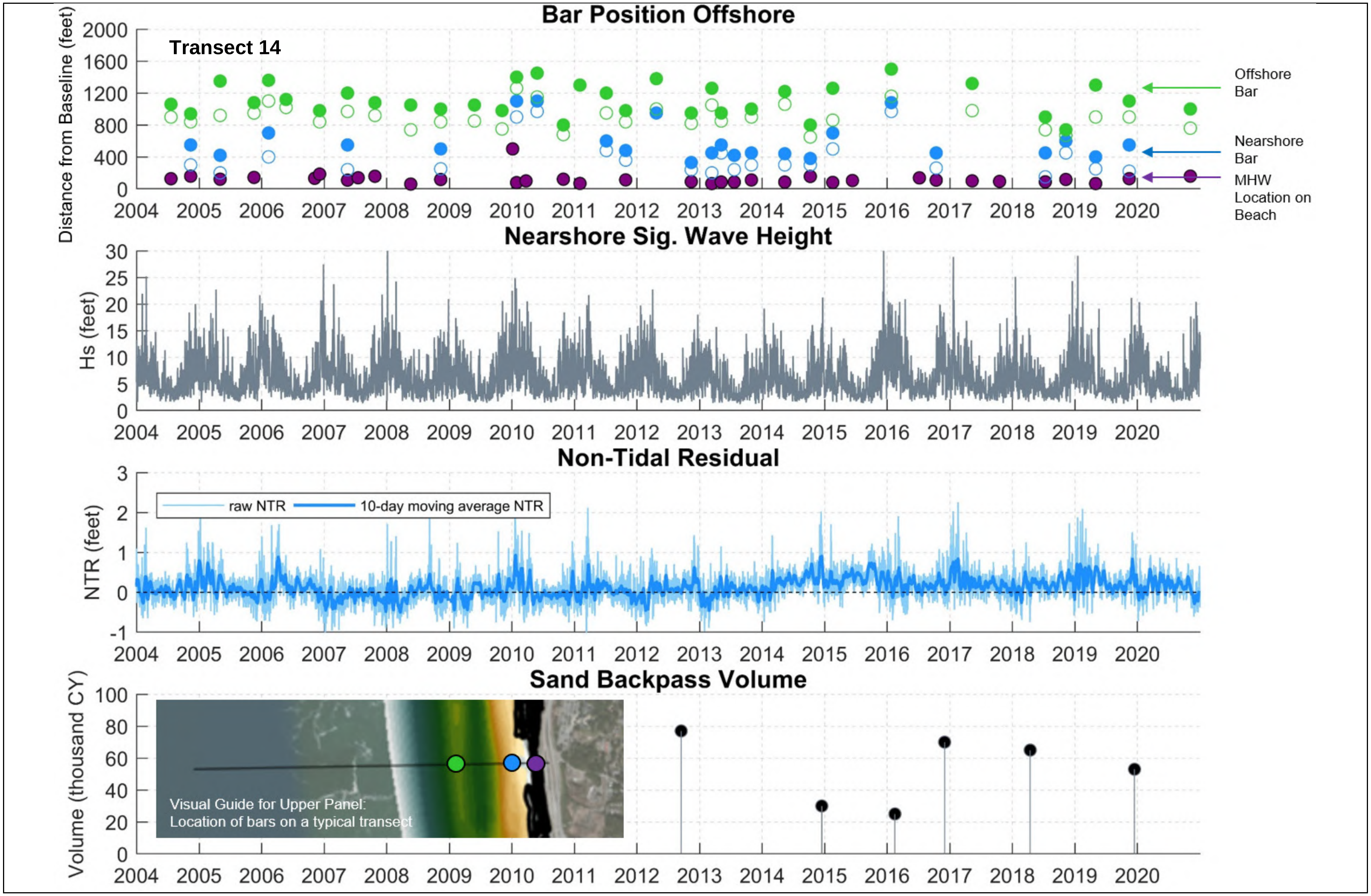
Figure A-2
Location of MHW position on beach and offshore crests (solid circles) and troughs (empty circles) at USGS Transect 12 – 500 feet south of Sloat Blvd (Top panel), nearshore wave heights (second panel), non-tidal residual water levels (third panel), and sand backpass volumes (bottom panel)



SOURCE: nearshore significant wave heights estimated by CDIP at MOP station SF014. Non-tidal residuals based on NOAA Pt Reyes tide station.

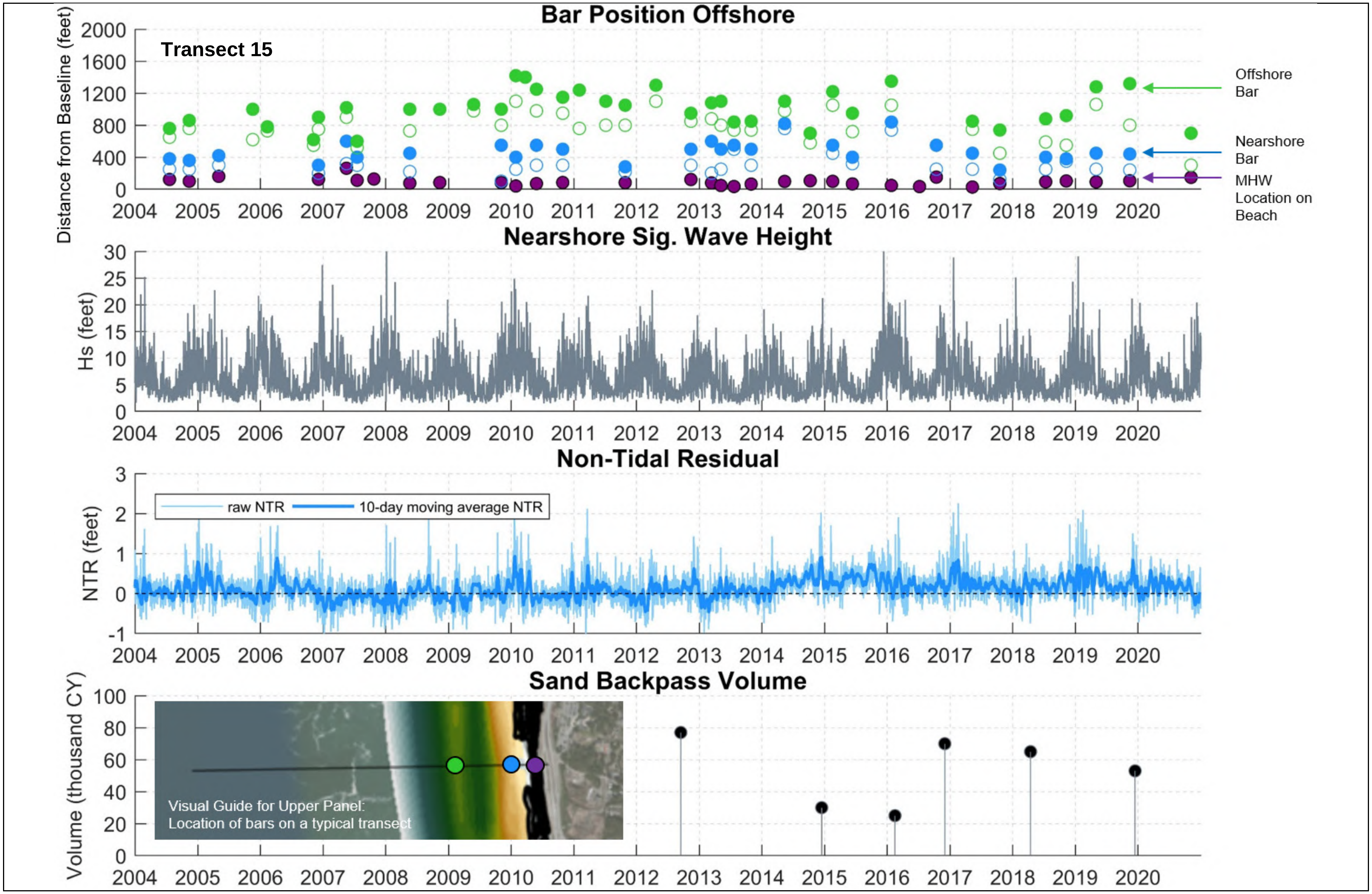
Figure A-3

Location of MHW position on beach and offshore crests (solid circles) and troughs (empty circles) at USGS Transect 13 at EQR (Top panel), nearshore wave heights (second panel), non-tidal residual water levels (third panel), and sand backpass volumes (bottom panel)



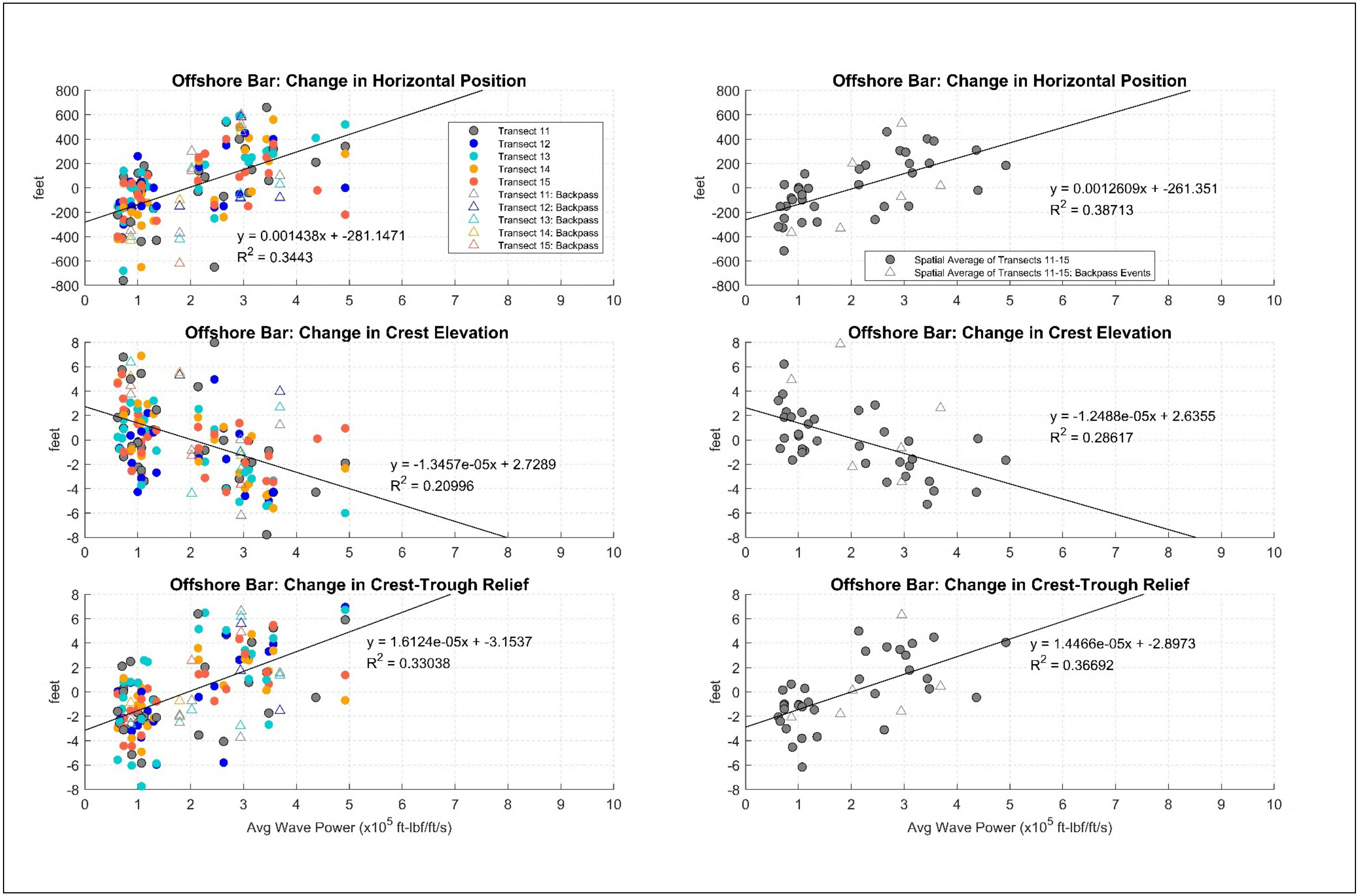
SOURCE: nearshore significant wave heights estimated by CDIP at MOP station SF014. Non-tidal residuals based on NOAA Pt Reyes tide station.

Figure A-4
Location of MHW position on beach and offshore crests (solid circles) and troughs (empty circles) at USGS Transect 14 at Rubble Reach north of the 2010 emergency revetment (Top panel), nearshore wave heights (second panel), non-tidal residual water levels (third panel), and sand backpass volumes (bottom panel)



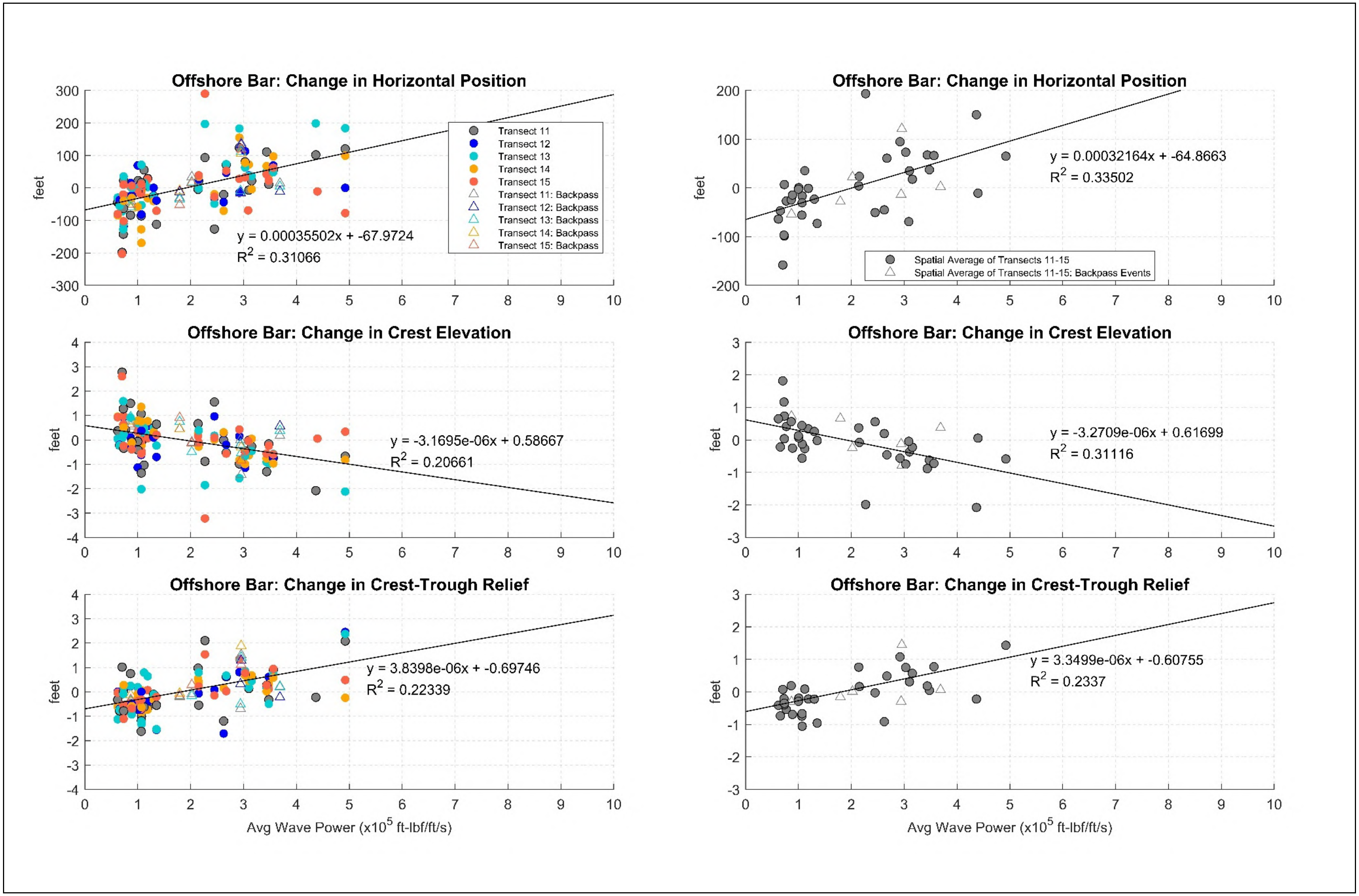
SOURCE: nearshore significant wave heights estimated by CDIP at MOP station SF014. Non-tidal residuals based on NOAA Pt Reyes tide station.

Figure A-5
Location of MHW position on beach and offshore crests (solid circles) and troughs (empty circles) at USGS Transect 15 south of the 2010 emergency revetment (Top panel), nearshore wave heights (second panel), non-tidal residual water levels (third panel), and sand backpass volumes (bottom panel)



SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-6
Observed changes in offshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (approx. 6 months) as a function of the average wave power between surveys; for all transects (left) and for a spatial average across all transects (right)

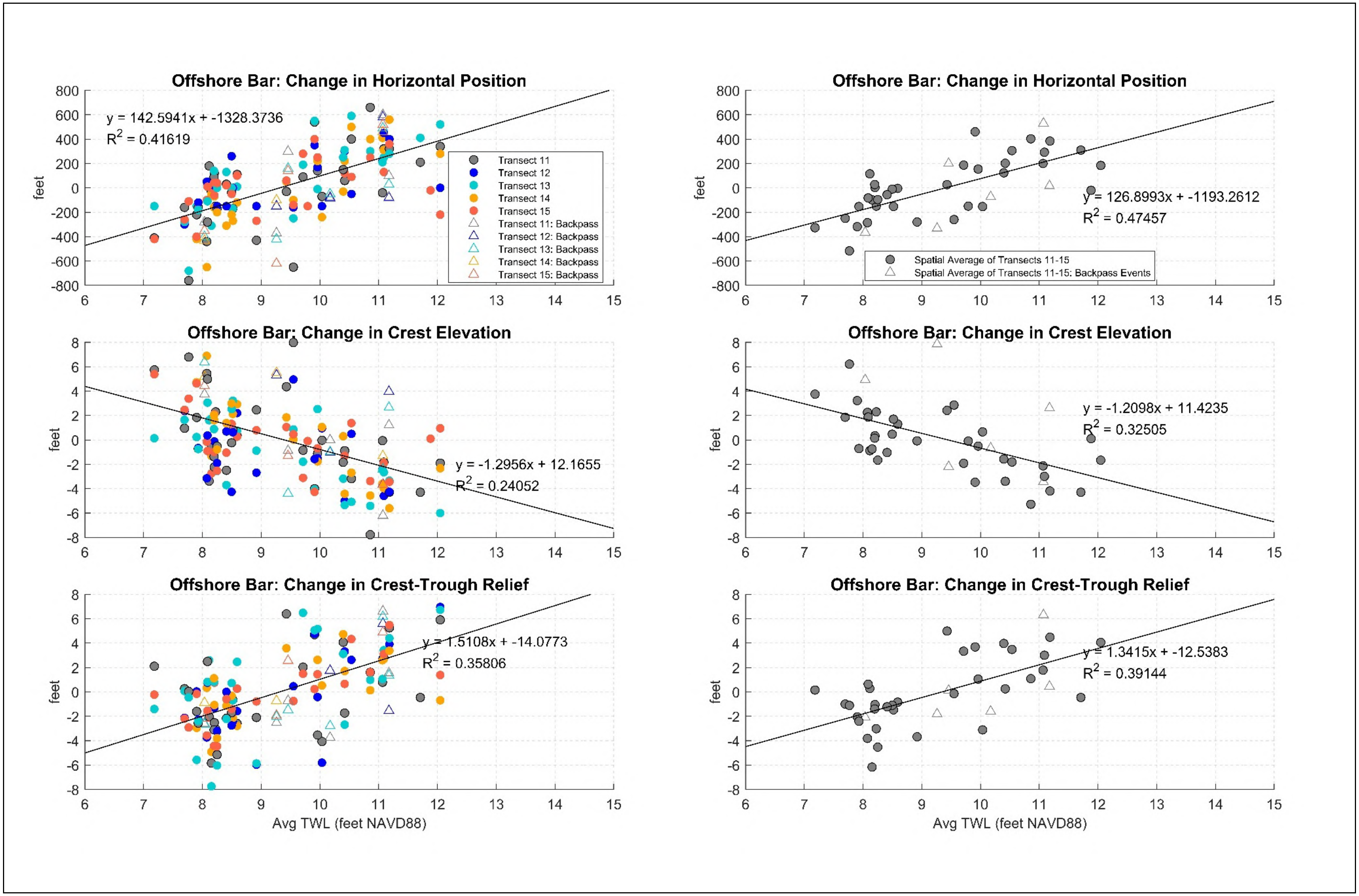


SOURCE: USGS Provisional Data; CDIP

NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

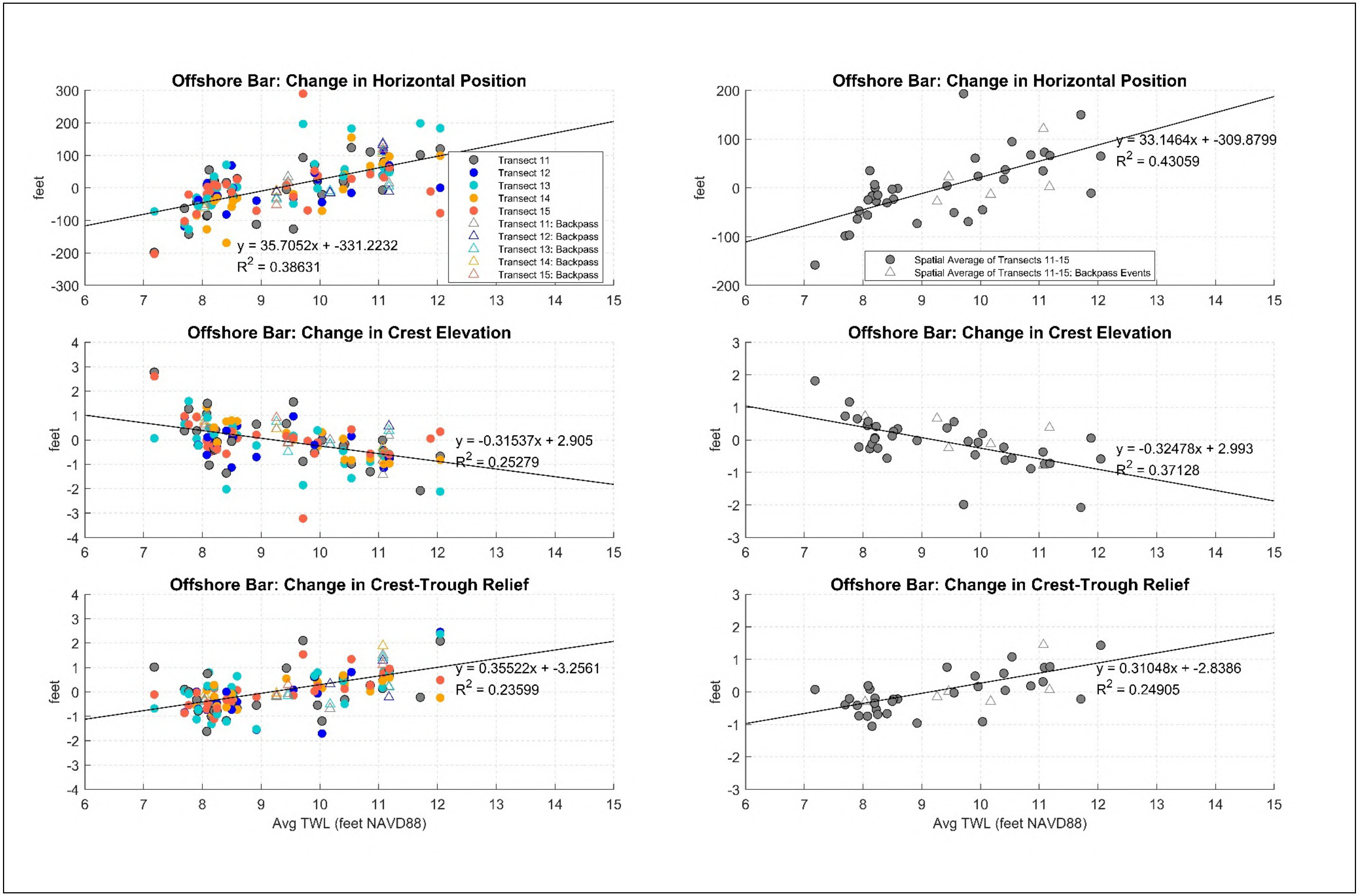
Figure A-7

Observed changes in offshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (normalized to change per 30 days) as a function of the average wave power between surveys; for all transects (left) and for a spatial average across all transects (right)



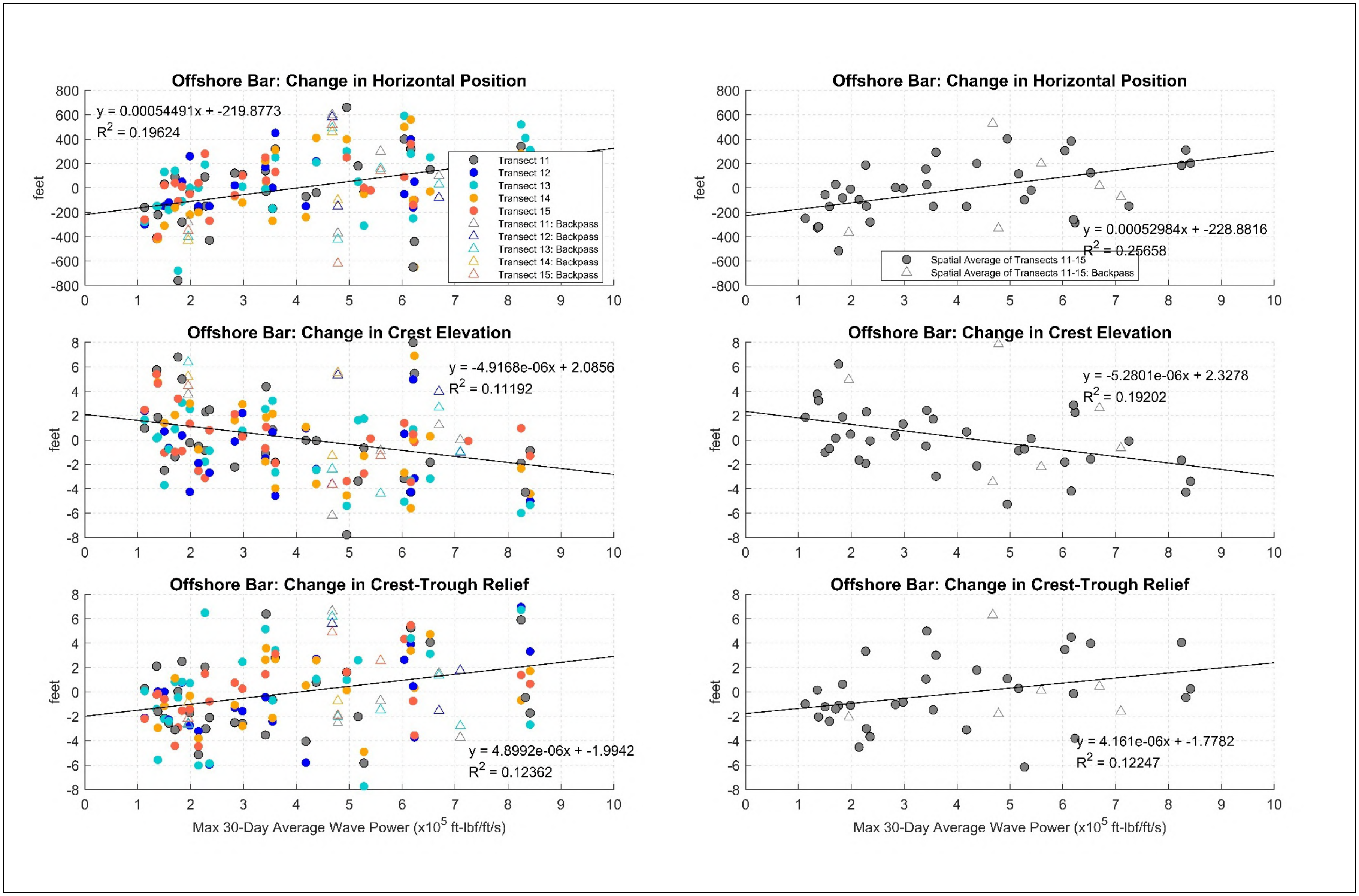
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-8
Observed changes in offshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (approx. 6 months) as a function of the average total water level between surveys; for all transects (left) and for a spatial average across all transects (right)



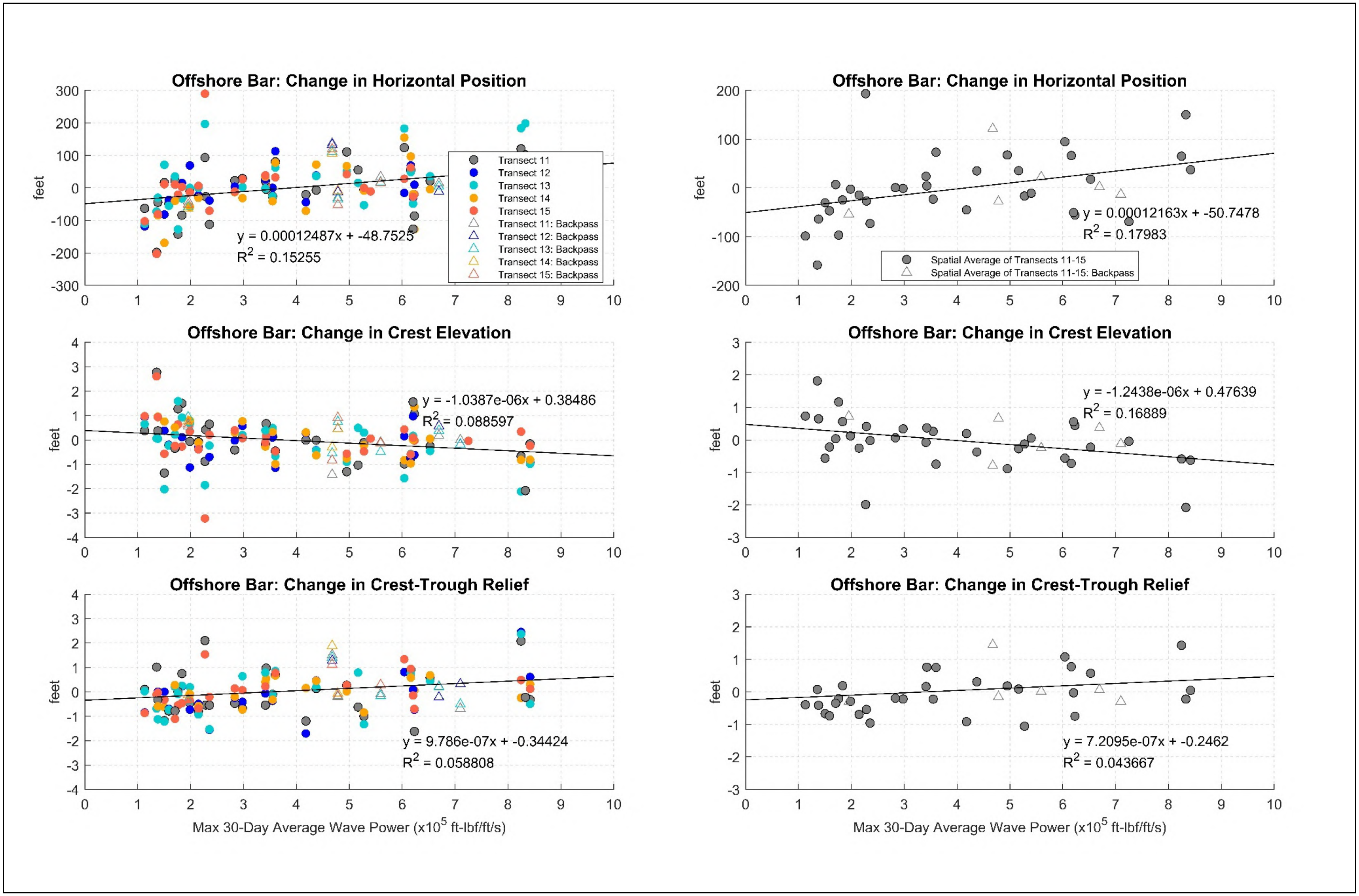
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-9
Observed changes in offshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (normalized to change per 30 days) as a function of the average total water level between surveys; for all transects (left) and for a spatial average across all transects (right)



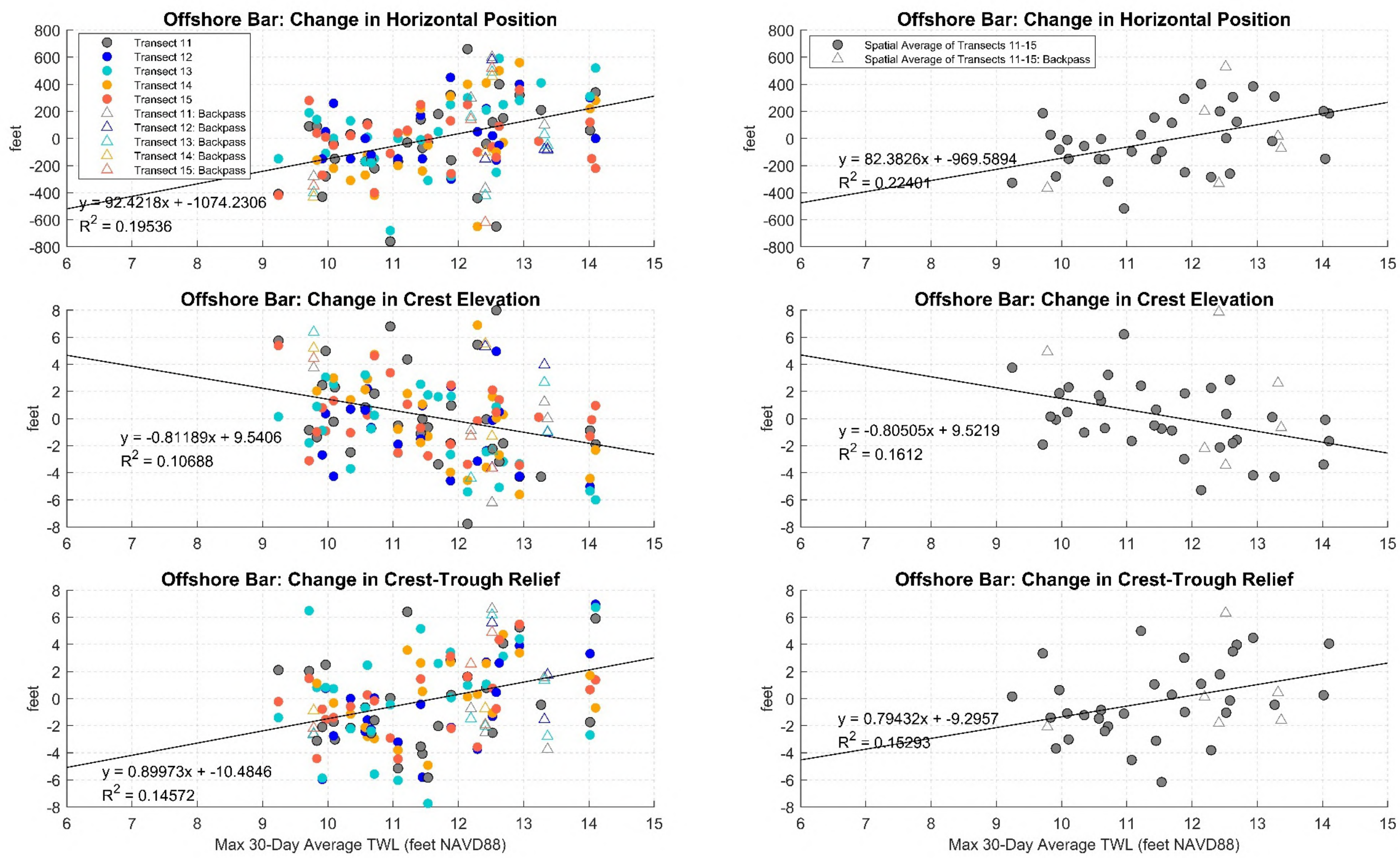
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-10
Observed changes in offshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (approx. 6 months) as a function of the maximum 30-day average wave power between surveys; for all transects (left) and for a spatial average across all transects (right)



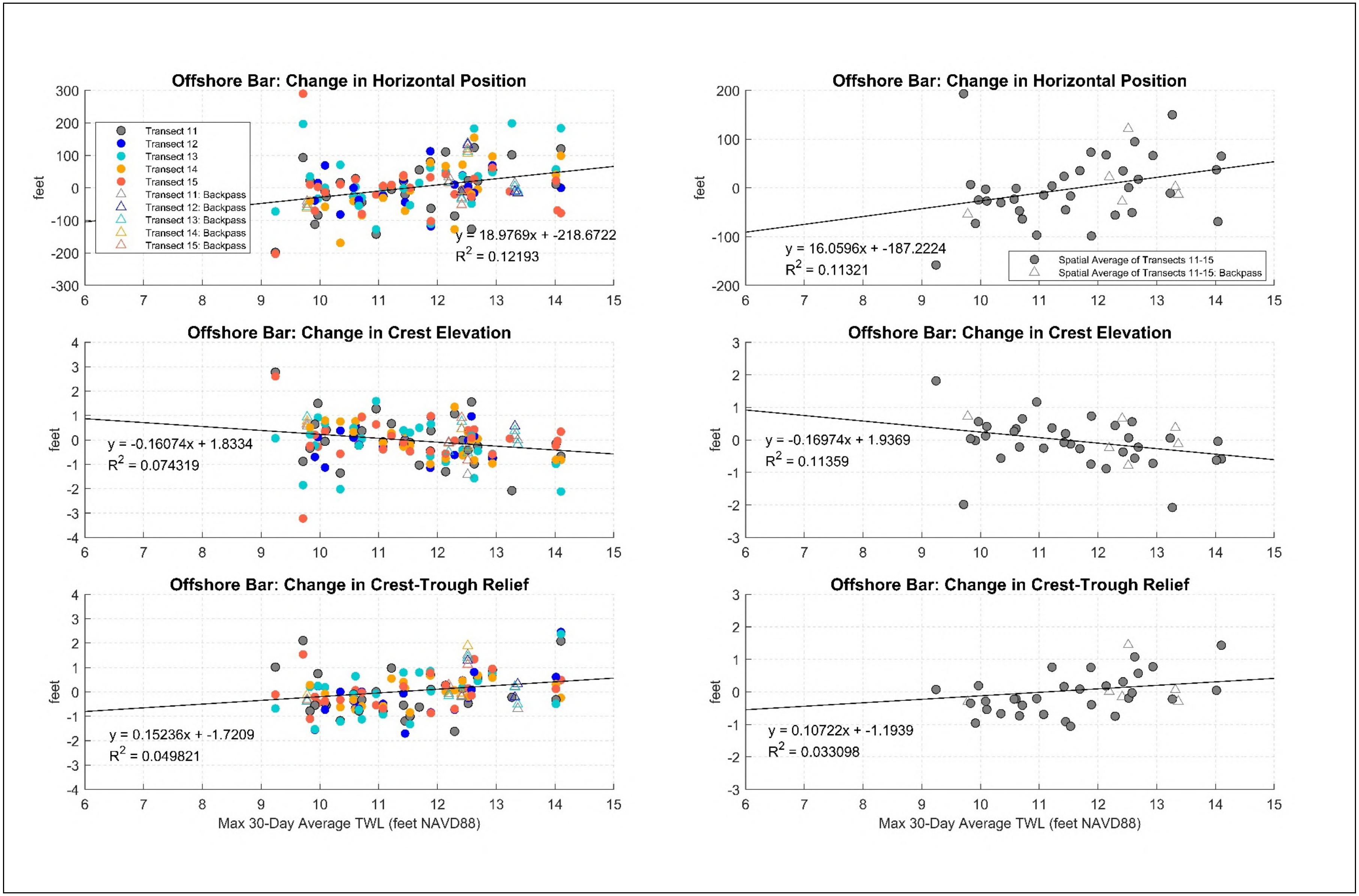
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-11
Observed changes in offshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (normalized to change per 30 days) as a function of the maximum 30-day average wave power between surveys; for all transects (left) and for a spatial average across all transects (right)



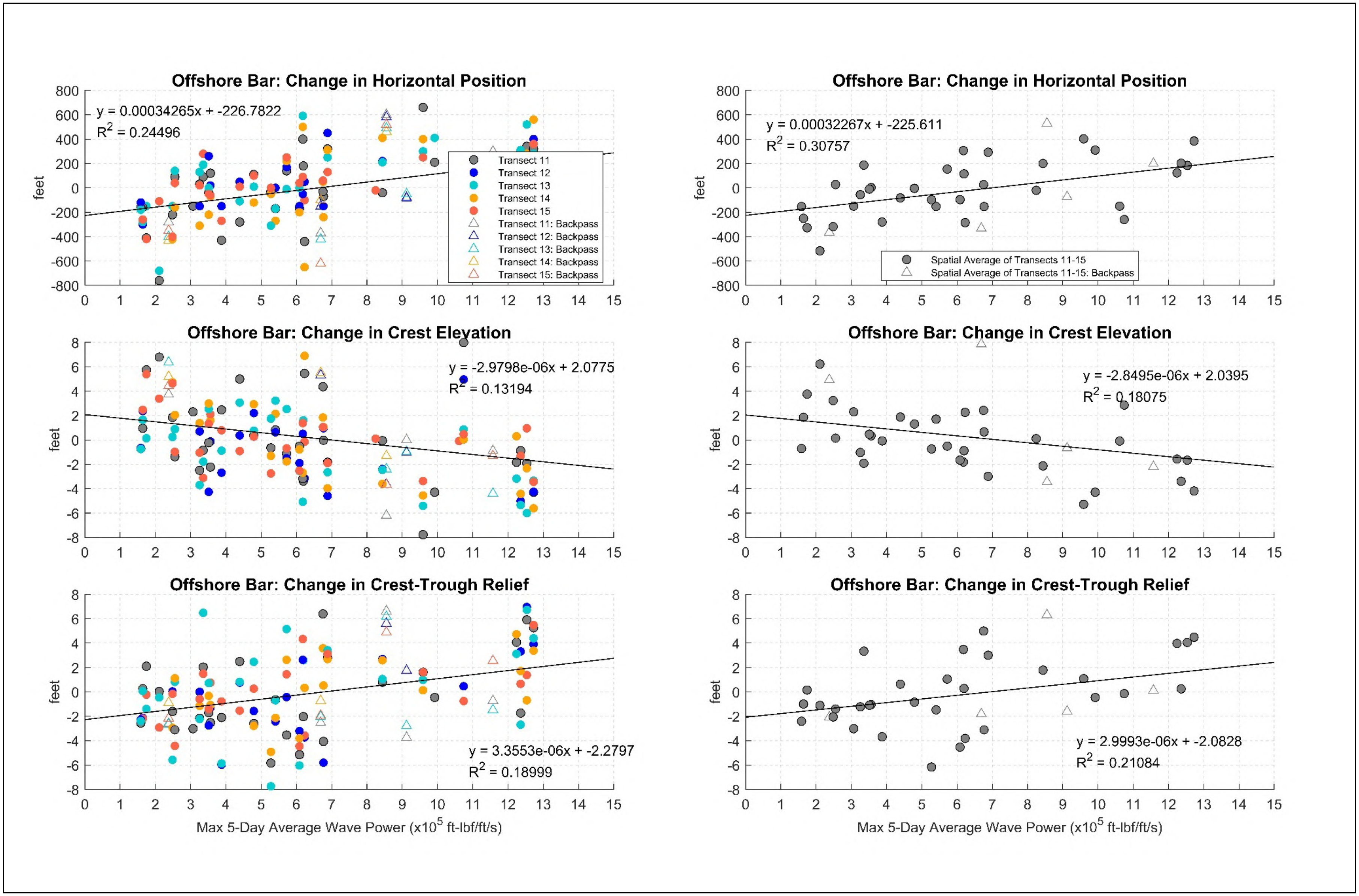
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-12
Observed changes in offshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (approx. 6 months) as a function of the maximum 30-day average total water level between surveys; for all transects (left) and for a spatial average across all transects (right)



SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

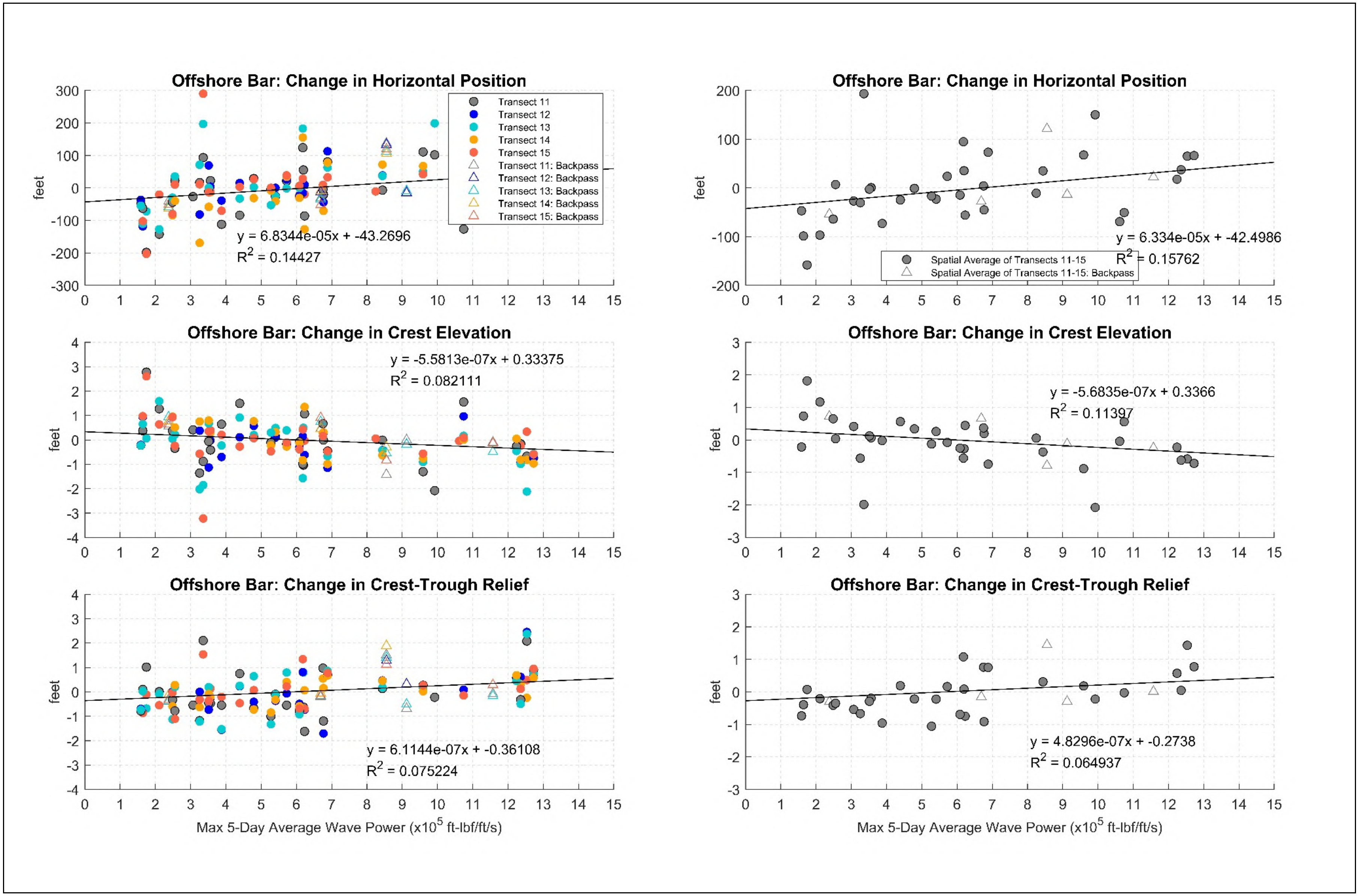
Figure A-13
Observed changes in offshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (normalized to change per 30 days) as a function of the maximum 30-day average total water level between surveys; for all transects (left) and for a spatial average across all transects (right)



SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

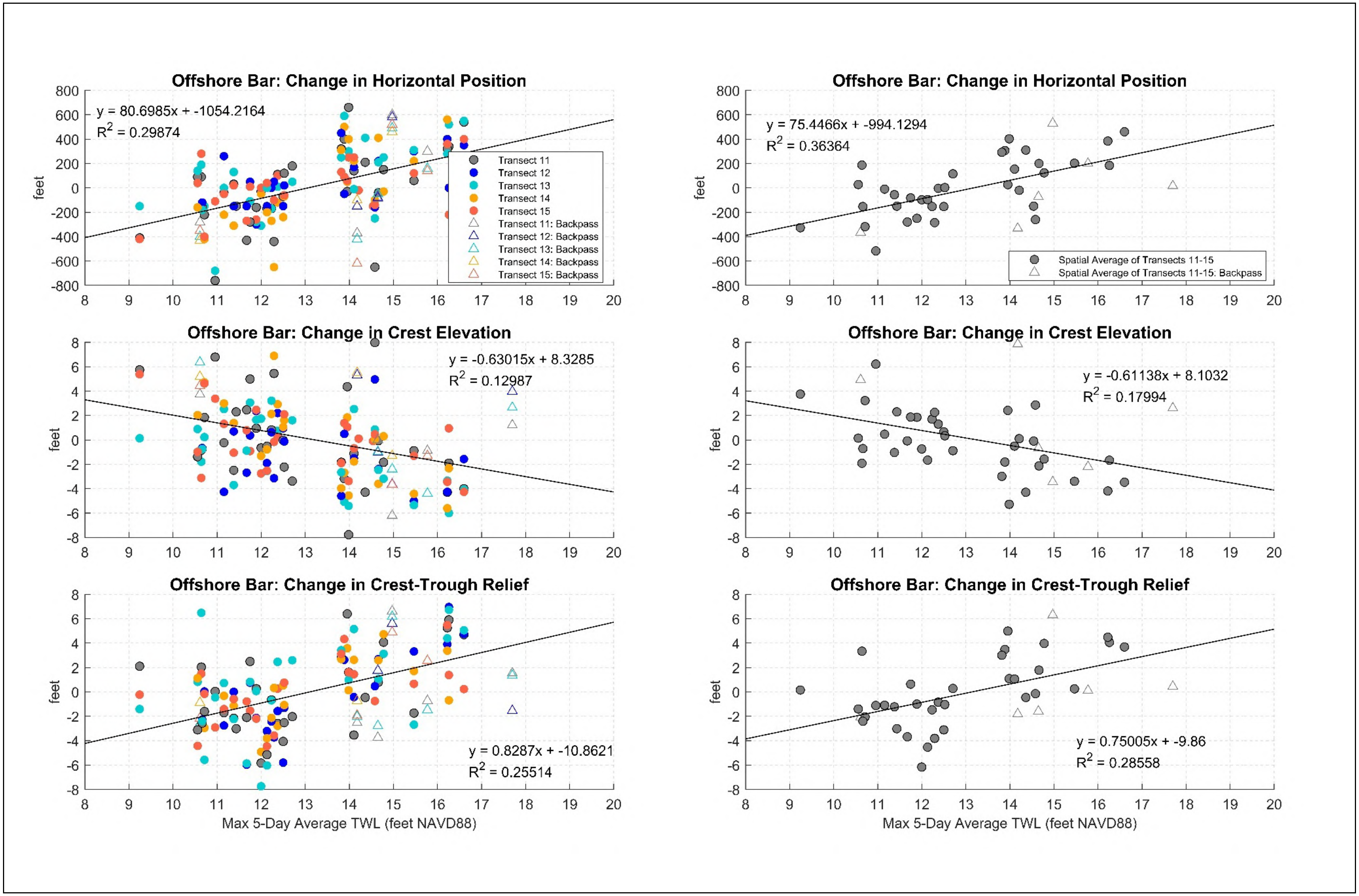
Figure A-14

Observed changes in offshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (approx. 6 months) as a function of the maximum 5-day average wave power between surveys; for all transects (left) and for a spatial average across all transects (right)



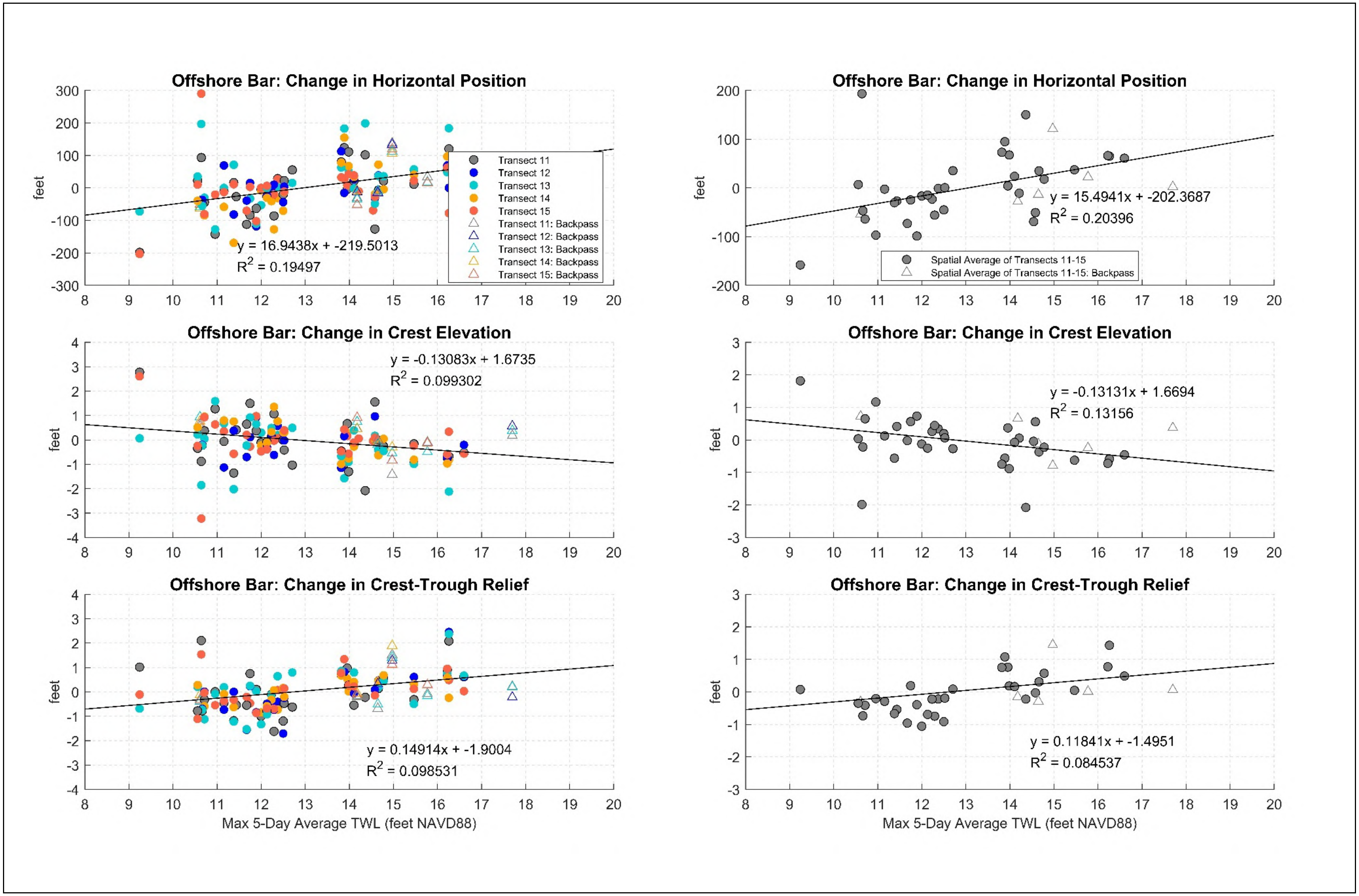
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-15
Observed changes in offshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (normalized to change per 30 days) as a function of the maximum 5-day average wave power between surveys; for all transects (left) and for a spatial average across all transects (right)



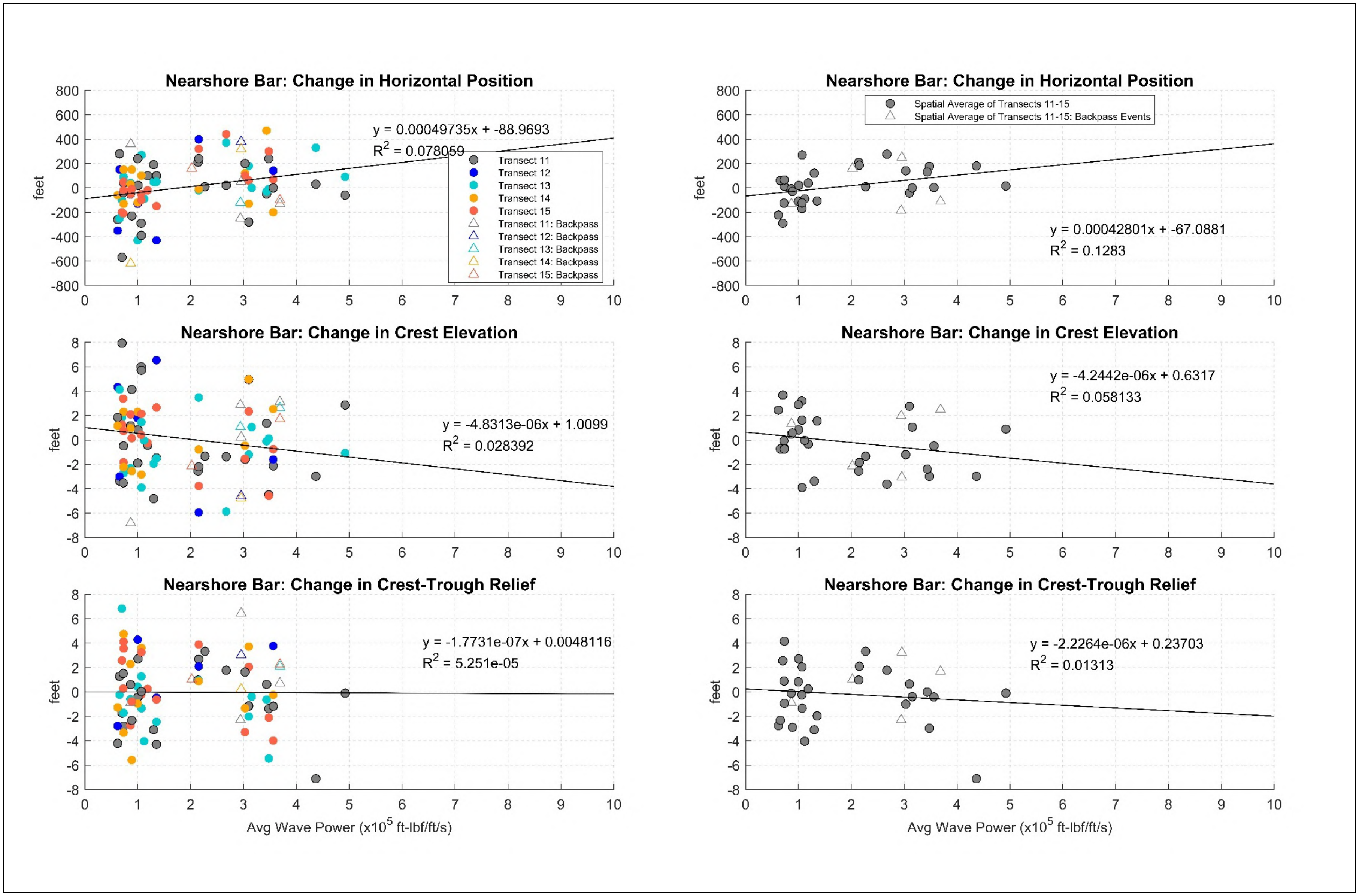
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-16
Observed changes in offshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (approx. 6 months) as a function of the maximum 5-day average total water level between surveys; for all transects (left) and for a spatial average across all transects (right)



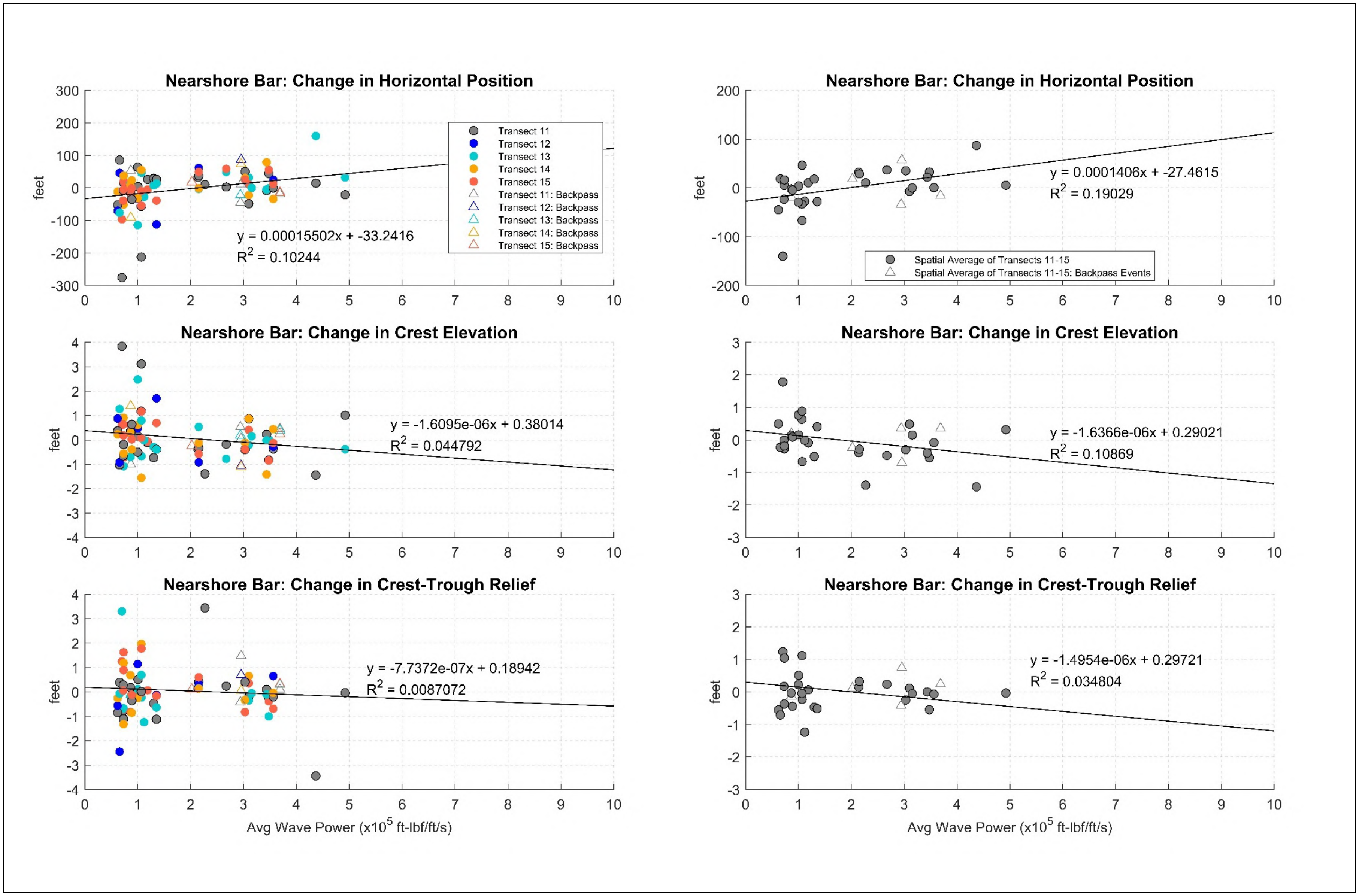
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-17
Observed changes in offshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (normalized to change per 30 days) as a function of the maximum 5-day average total water level between surveys; for all transects (left) and for a spatial average across all transects (right)



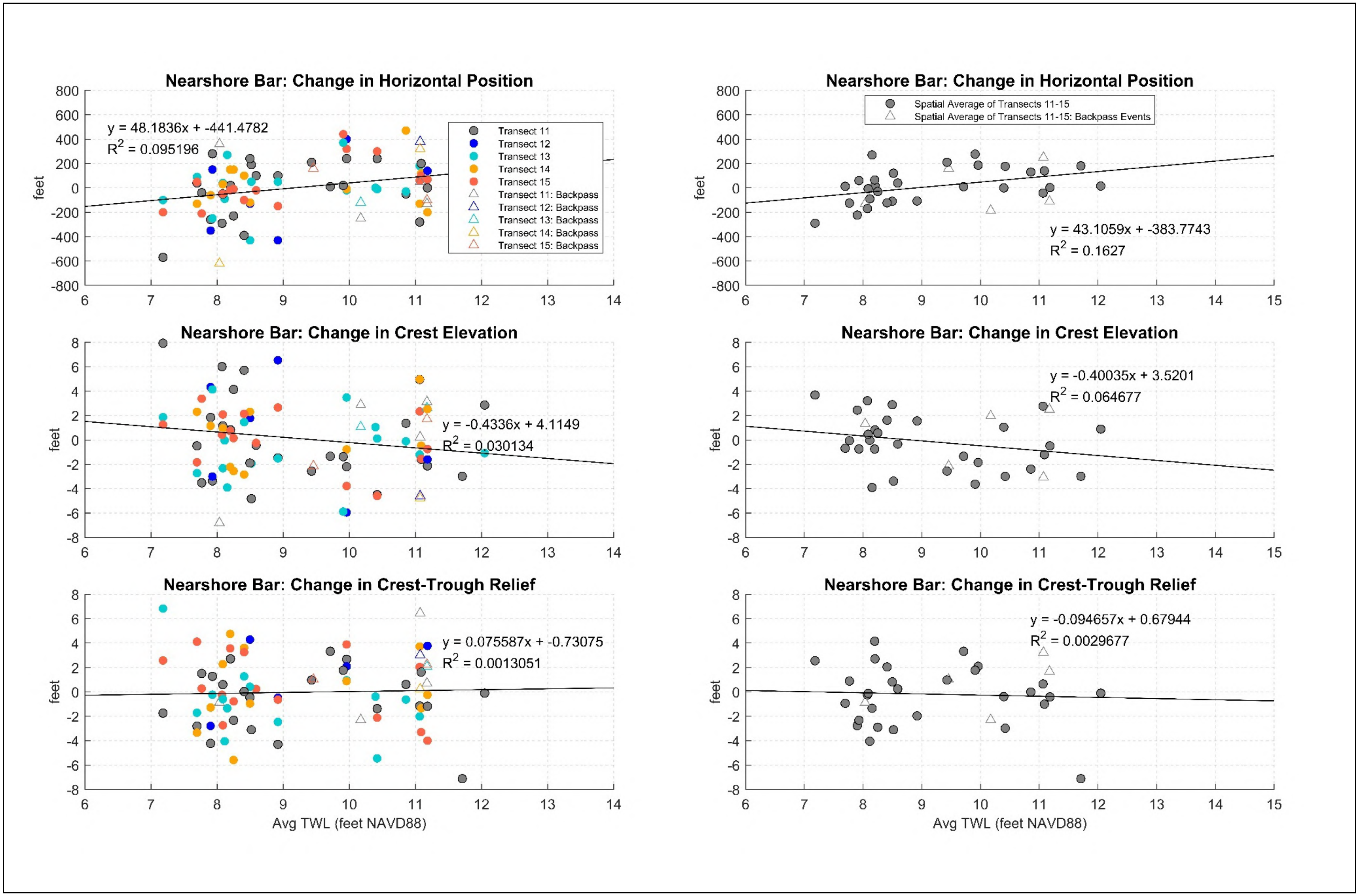
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-18
Observed changes in nearshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (approx. 6 months) as a function of the average wave power between surveys; for all transects (left) and for a spatial average across all transects (right)



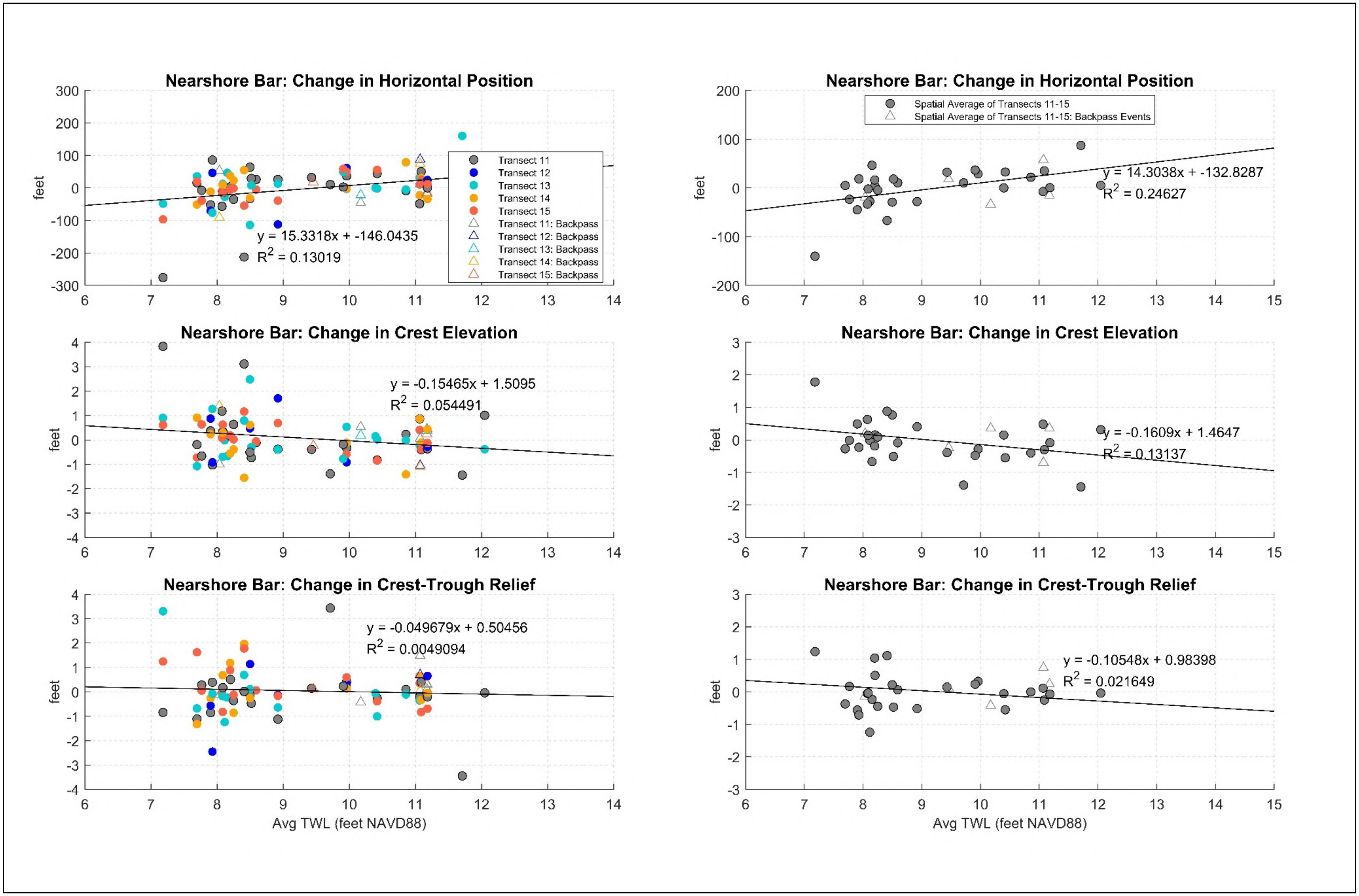
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-19
Observed changes in nearshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (normalized to change per 30 days) as a function of the average wave power between surveys; for all transects (left) and for a spatial average across all transects (right)



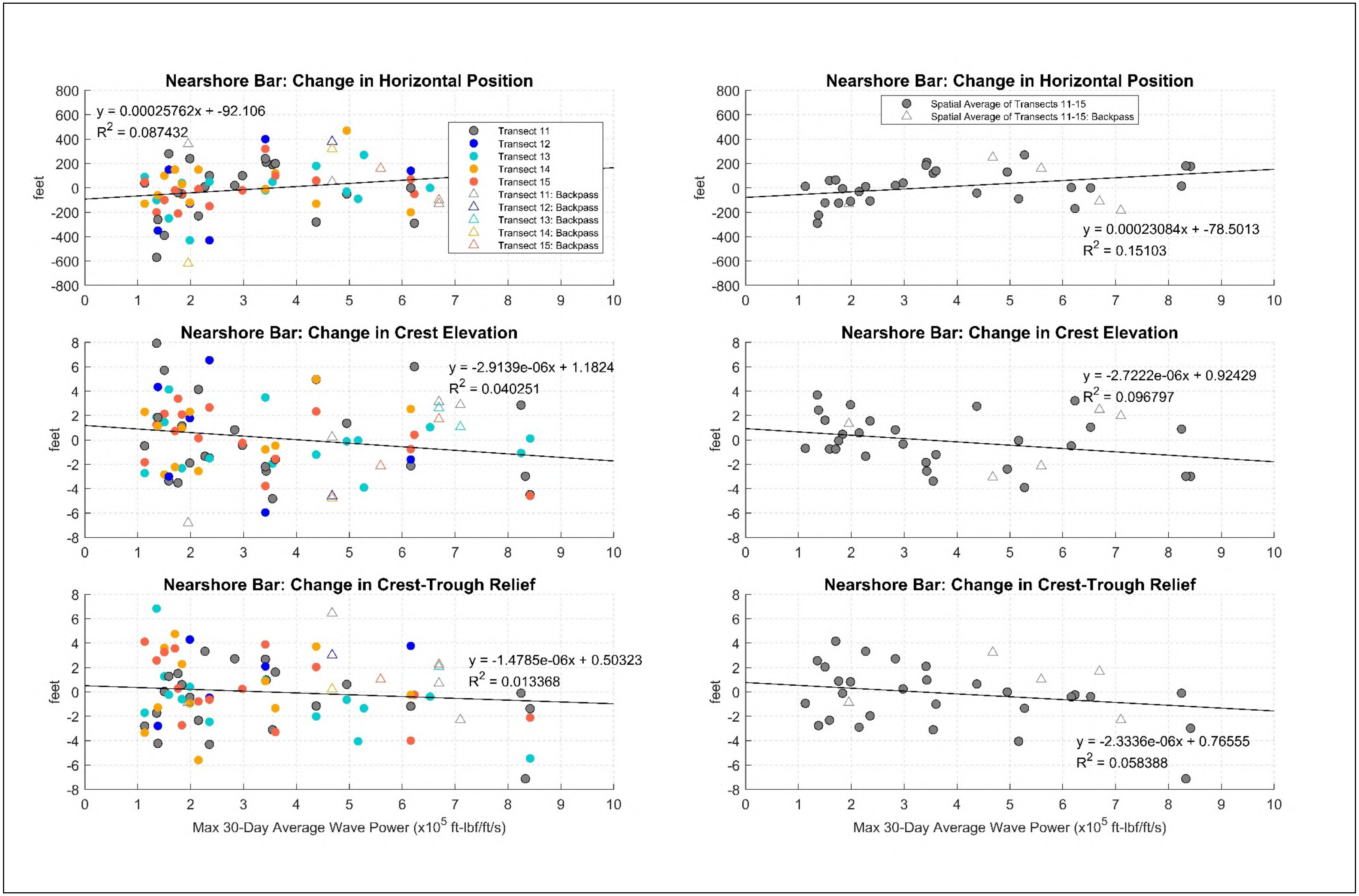
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-20
Observed changes in nearshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (approx. 6 months) as a function of the average total water level between surveys; for all transects (left) and for a spatial average across all transects (right)



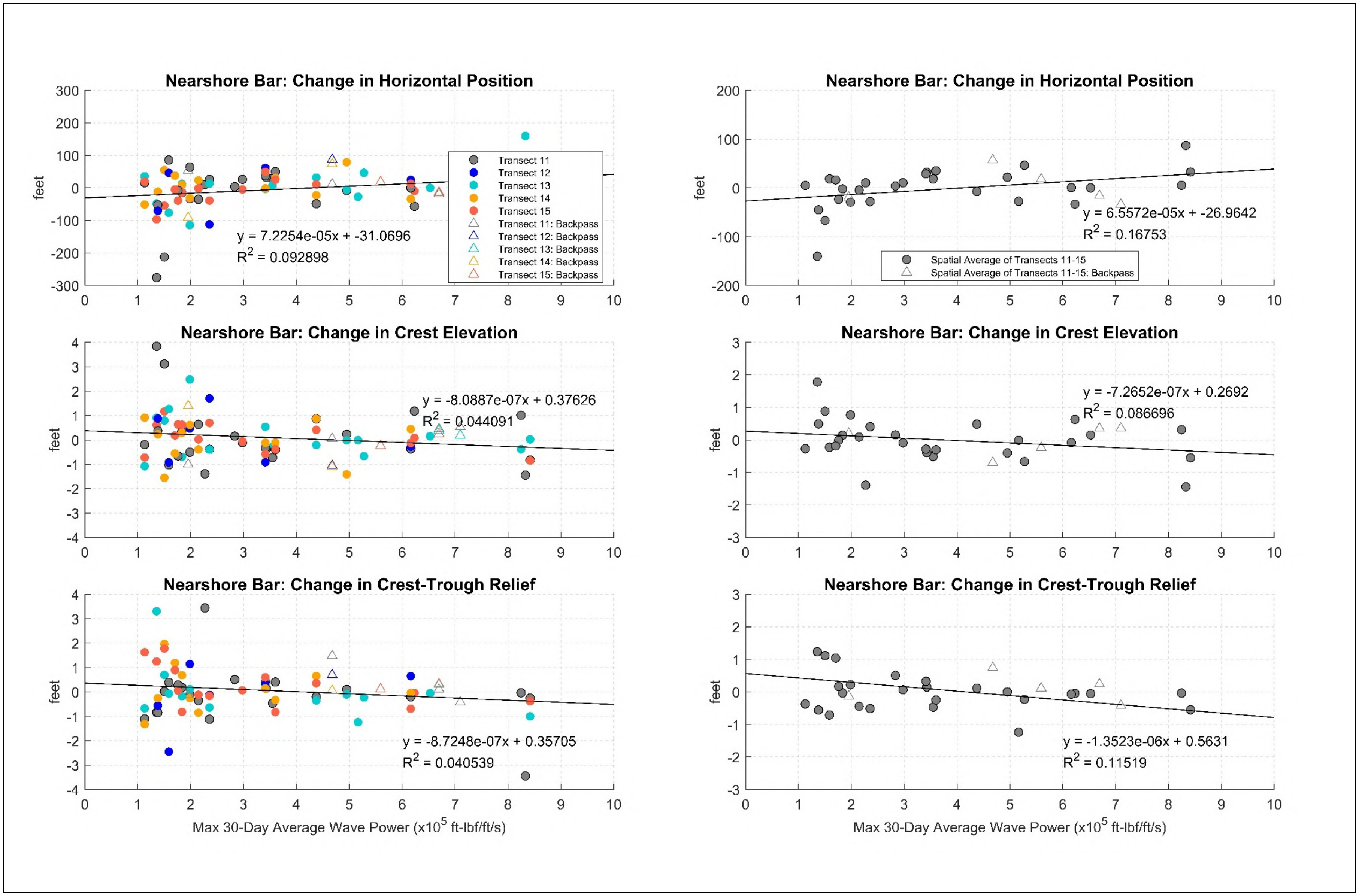
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-21
Observed changes in nearshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (normalized to change per 30 days) as a function of the average total water level between surveys; for all transects (left) and for a spatial average across all transects (right)



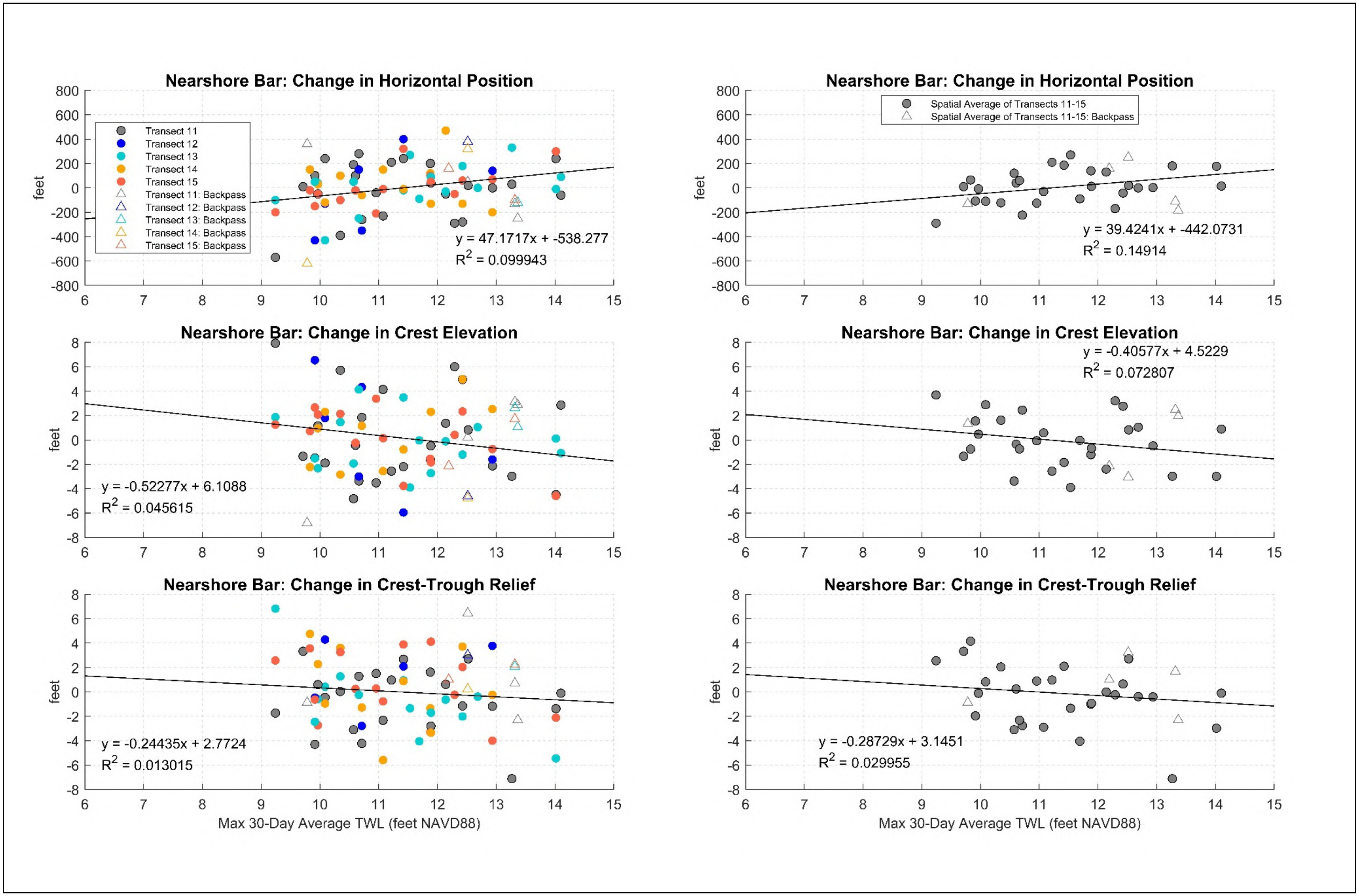
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-22
Observed changes in nearshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (approx. 6 months) as a function of the maximum 30-day average wave power between surveys; for all transects (left) and for a spatial average across all transects (right)



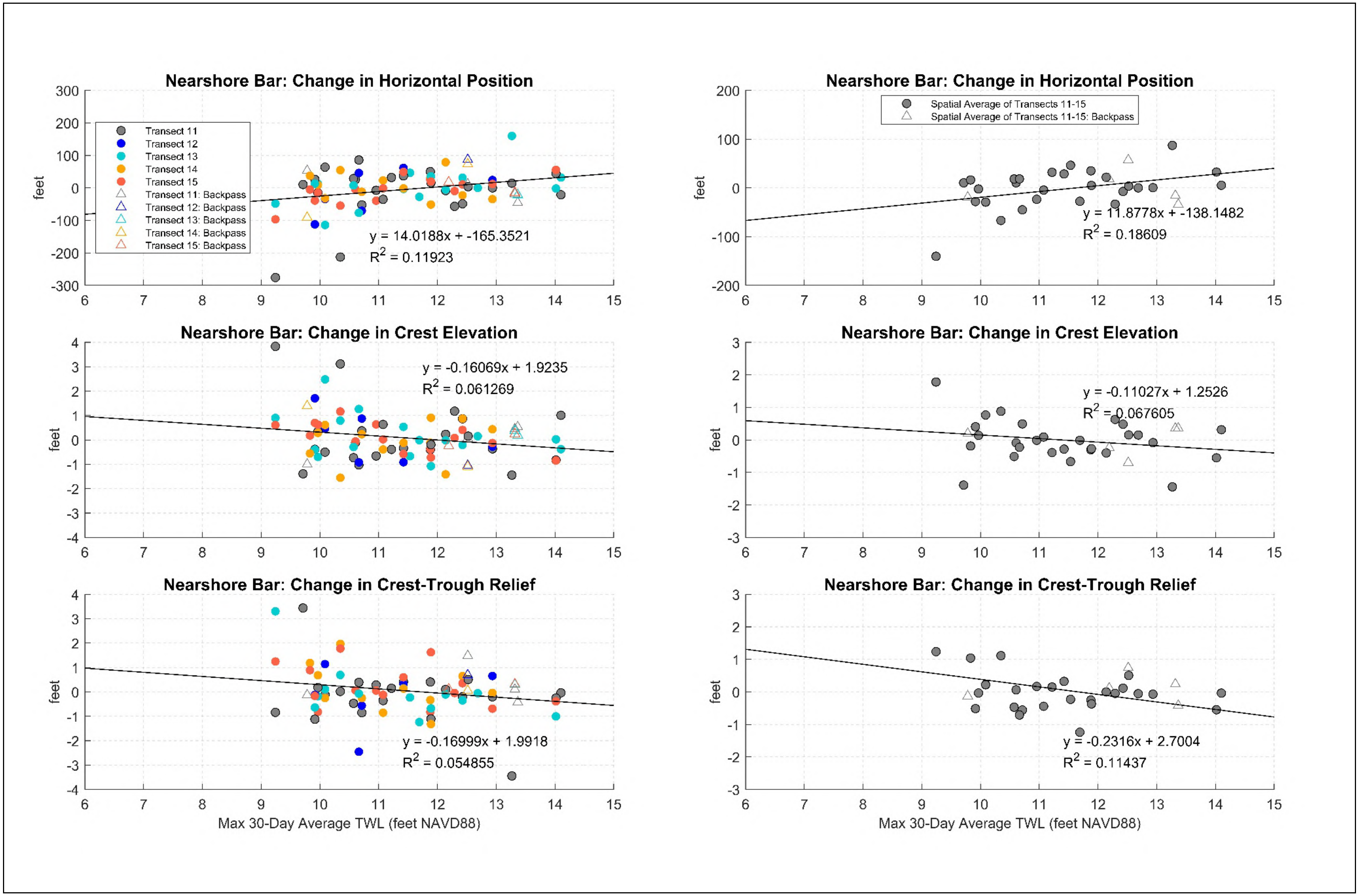
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-23
Observed changes in nearshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (normalized to change per 30 days) as a function of the maximum 30-day average wave power between surveys; for all transects (left) and for a spatial average across all transects (right)



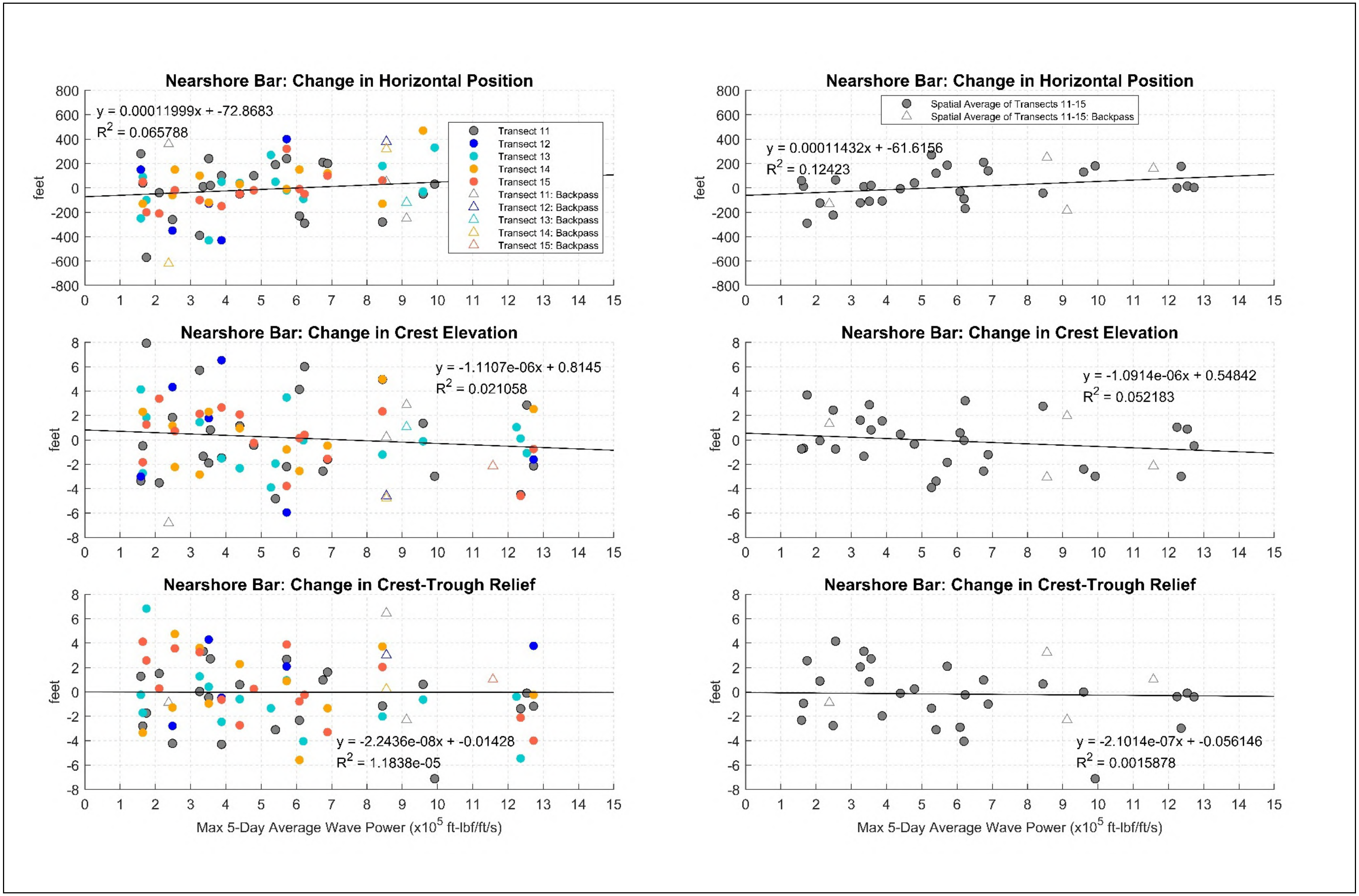
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-24
Observed changes in nearshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (approx. 6 months) as a function of the maximum 30-day average total water level between surveys; for all transects (left) and for a spatial average across all transects (right)



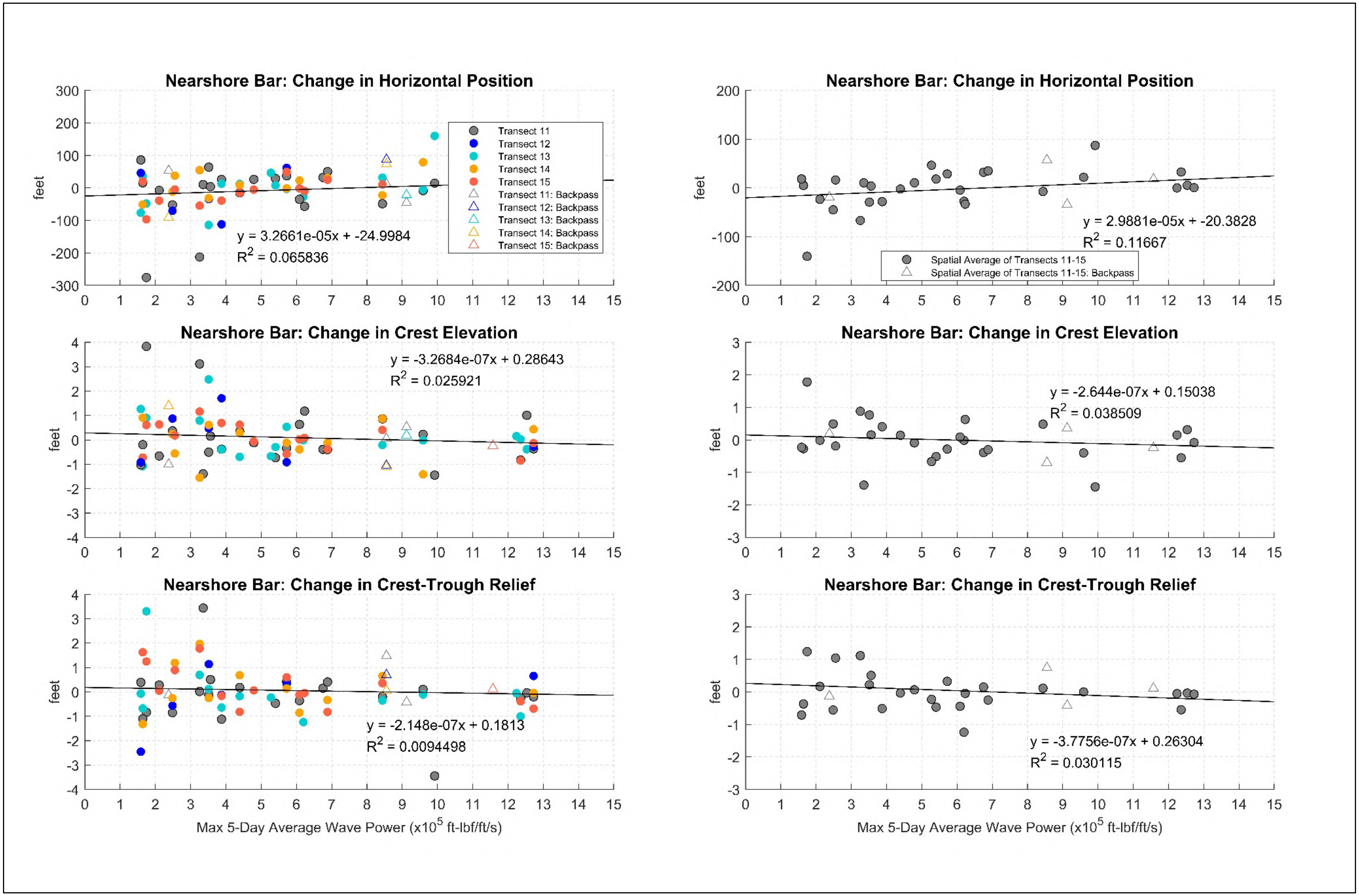
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-25
Observed changes in nearshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (normalized to change per 30 days) as a function of the maximum 30-day average total water level between surveys; for all transects (left) and for a spatial average across all transects (right)



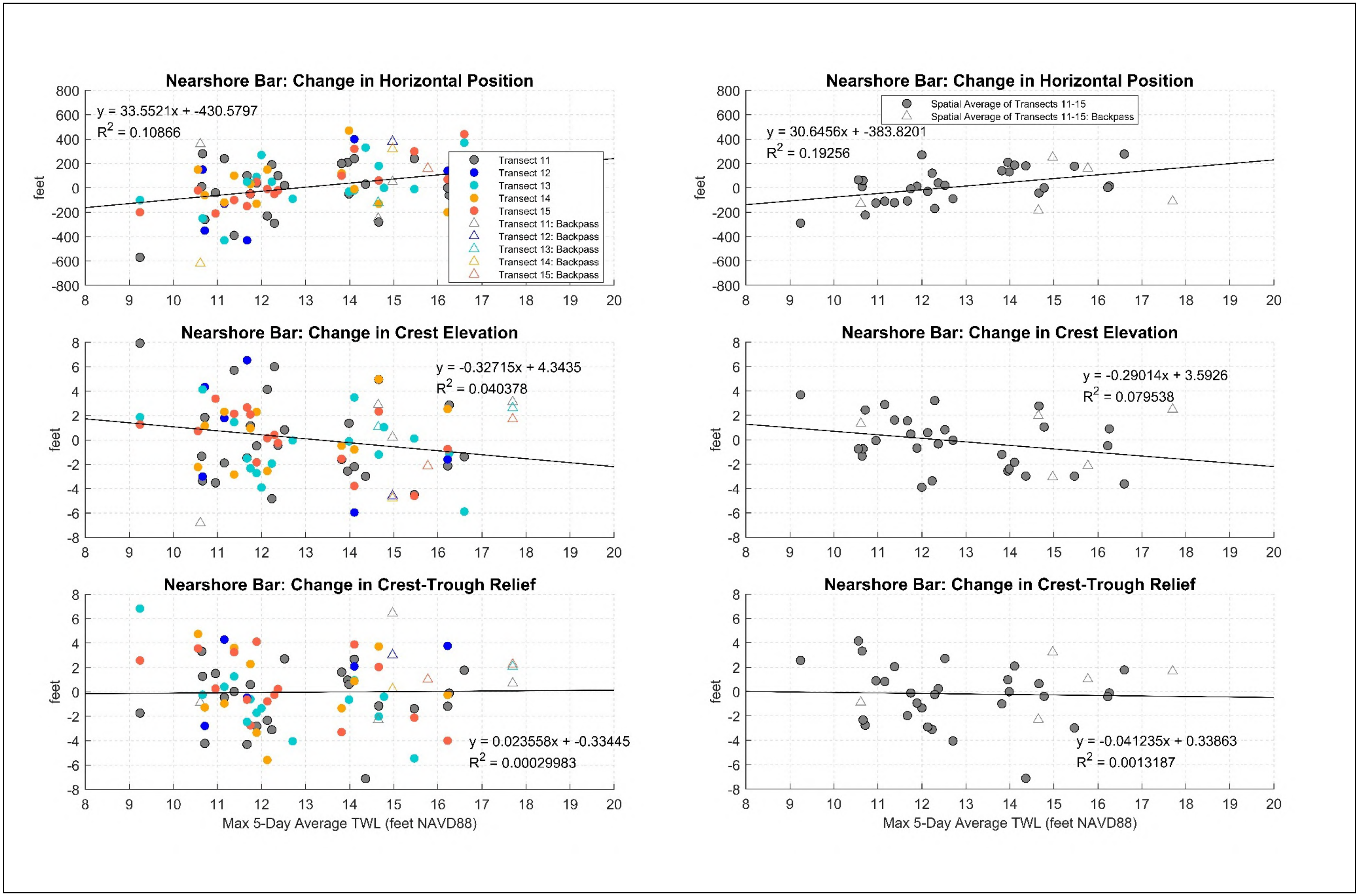
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-26
Observed changes in nearshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (approx. 6 months) as a function of the maximum 5-day average wave power between surveys; for all transects (left) and for a spatial average across all transects (right)



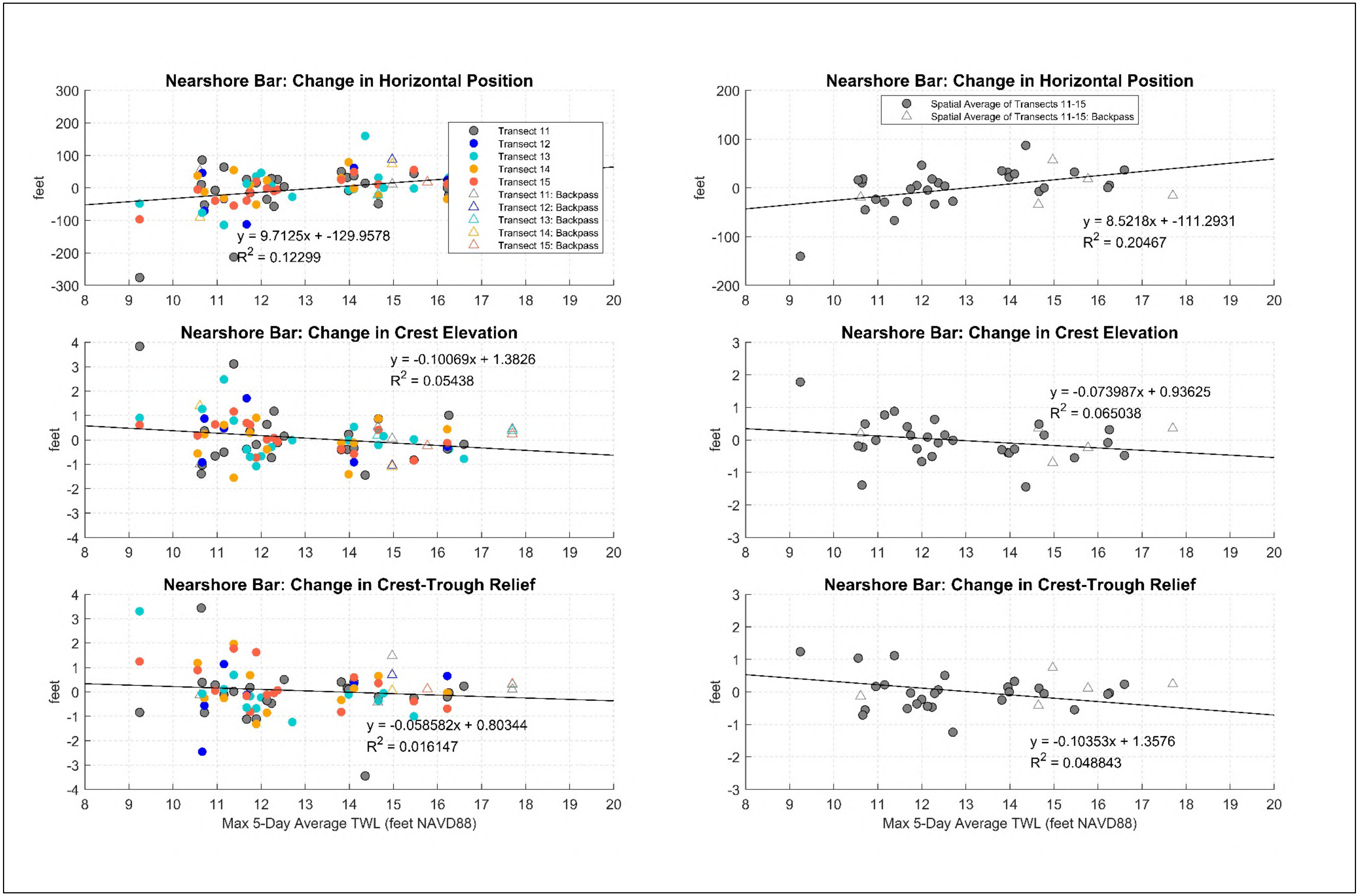
SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-27
Observed changes in nearshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (normalized to change per 30 days) as a function of the maximum 5-day average wave power between surveys; for all transects (left) and for a spatial average across all transects (right)



SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-28
Observed changes in nearshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (approx. 6 months) as a function of the maximum 5-day average total water level between surveys; for all transects (left) and for a spatial average across all transects (right)



SOURCE: USGS Provisional Data; CDIP
NOTE: Backpass data points represent a survey interval in which a sand backpass event occurred. These data points are identified in an attempt to assess potential influence of backpass events on bar change, but regressions lumped all data points together.

Figure A-29
Observed changes in nearshore bar position (top), crest elevation (middle), and crest-trough relief (bottom) between surveys (normalized to change per 30 days) as a function of the maximum 5-day average total water level between surveys; for all transects (left) and for a spatial average across all transects (right)

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Appendix B

Comparison of the Numerical Model Results to the Observed Bar Change Relationships

APPENDIX B

Comparison of the Numerical Model Results to the Observed Bar Change Relationships

Introduction

The City and County of San Francisco (city) has proposed the Ocean Beach Climate Change Adaptation Project (project). As part of the Environmental Impact Report (EIR) for the project, ESA prepared a technical study focusing on assessing the potential effects of the project on coastal processes. This appendix provides supplemental information from the coastal process analysis that was considered, but not directly used in the evaluation of the project's effects on the environment.

This appendix presents a discussion and graphics that compare the numerical model[1] results to the observed bar change relationships[2]. Overall, the numerical model tended to produce unrealistic and unexpected bed changes in the surf zone for the simulation period. However, the model was able to adequately simulate wave transformations from offshore to nearshore, tidal water levels, and currents as compared to available data. Counter to expectations based upon coastal engineering literature and historic observations, the model's profile response showed relaxing or smoothing of the profile, rather than the expected offshore migration of sand bars that would become more defined over the simulated winter month. Given the model limitations noted above, we relied upon coastal engineering professional judgment, literature, historical data, and anecdotal observations of the project area to inform our assessment of potential project effects on sand bars, as discussed in the technical study. Under the simulated conditions, we expected that the bars would migrate offshore, deepen, and become more defined. We suspect that the model is not able to replicate the complex physical processes that are responsible for shaping the surf zone bar system.

The comparison of predicted bar changes (from the numerical model) to the observed bar changes (from data analysis of observations) presented below does not inform the central questions of the

1 The numerical model refers to a coupled hydrodynamic, sediment transport, and morphology change modeling using the U.S. Army Corps of Engineers' (USACE) software Coastal Modeling System (CMS), previously used by the USACE in studies at South Ocean Beach. ESA used the model to simulate baseline (existing) and multiple project conditions to assess the potential effects of the project on coastal processes related to offshore sand bar changes and erosion of the Fort Funston bluffs to the south of the project area.

2 The observed bar change relationships were developed using provisional data of surf zone elevations collected and processed by the USGS over a period of 15 years (from 2004 to 2019). From the data, ESA extracted selected sand bar "metrics," and then related the change in the metrics between surveys to the observed coastal conditions (e.g., wave and water level conditions using computed wave power and total water level, etc.). See main report and Appendix A.

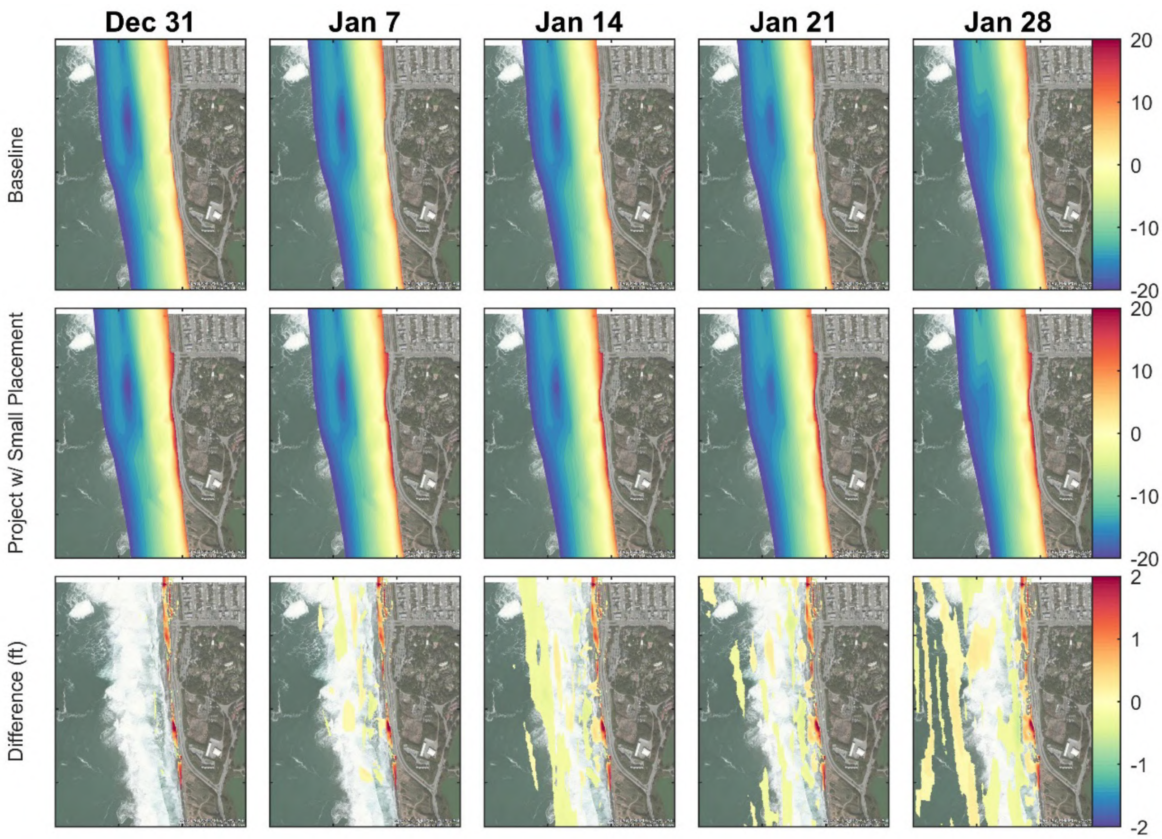
study. The following section includes a series of plots showing how the modeled bed elevations evolve under baseline and project conditions, as well as the difference between the project and baseline conditions, for project with small placement, project with large placement, project with partially exposed wall, and project with fully exposed wall, respectively. The baseline condition used in these figures did not include the 70,000 cubic yard backpass constructed in November and December 2016. These results were not used to assess the potential effects of the project on the sand bars, and are presented for supplemental information for interested readers.

Comparison of Project and Baseline Model Runs: Evolution of Bed Change

Figures B-1, B-2, B-3, and B-4 present a series of plots showing how the modeled bed elevations evolve under baseline and project conditions, as well as the difference between the project and baseline conditions, for project with small placement, project with large placement, project with partially exposed wall, and project with fully exposed wall, respectively. The baseline condition used in these figures did not include the 70,000 cubic yard backpass, constructed in November and December 2016. In general, the model runs show relatively small differences for the project conditions relative to baseline.

We note that the model runs produce results that show the profile shapes “relaxing,” or smoothing out, with bars eroding and troughs filling relative to the initial conditions of the run, which is counter to what we expect based on observations, experience and engineering literature. Under the simulated conditions, we would expect that the bars would migrate offshore, deepen, and become more defined. We suspect that the model is not able to replicate the complex physical processes that are responsible for shaping the surf zone bar system. Regardless, we have compared the findings of the model runs for project conditions with the modeled baseline, although we suspect that the predicted bar changes are not accurate when compared to observations.

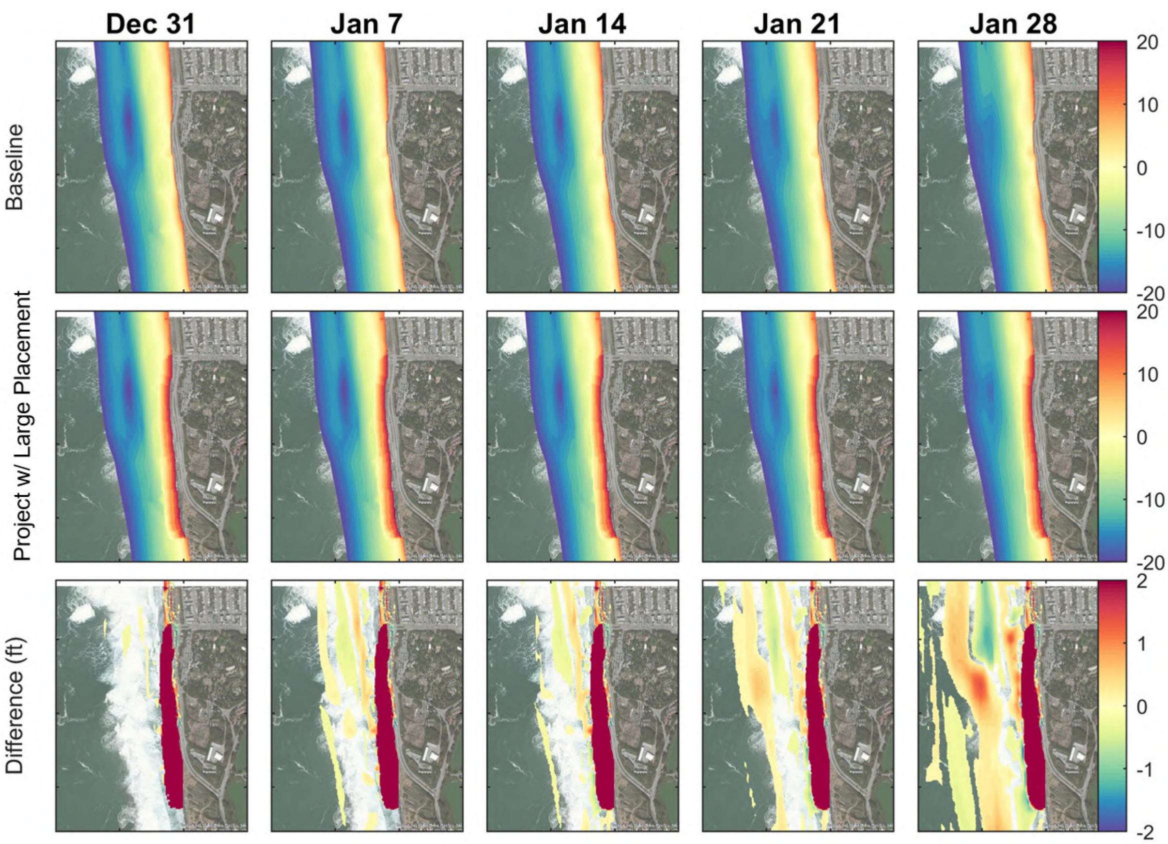
The small placement in **Figure B-1** shows the least amount of difference for all project runs, likely because the project conditions with small placement represents an incremental widening of the backshore by setting the wall back with very little modifications to the beach or profile seaward of its existing location. The differences primarily are a slight increase of less than a foot in elevation immediately adjacent to the shore, slightly lower nearshore elevation by less than a foot, and a slightly higher elevation of the area seaward of the offshore bar location. Otherwise there are no notable differences that can be deduced from the plan view difference plot between the project with small placement and the baseline conditions.



SOURCE: ESA CMS Model

Figure B-1
Evolution of bed elevation in feet NAVD for modeled baseline (top) and project with small placement (middle) conditions, and difference between project and baseline where red and blue are accretion and erosion relative to baseline, respectively, in feet (bottom)

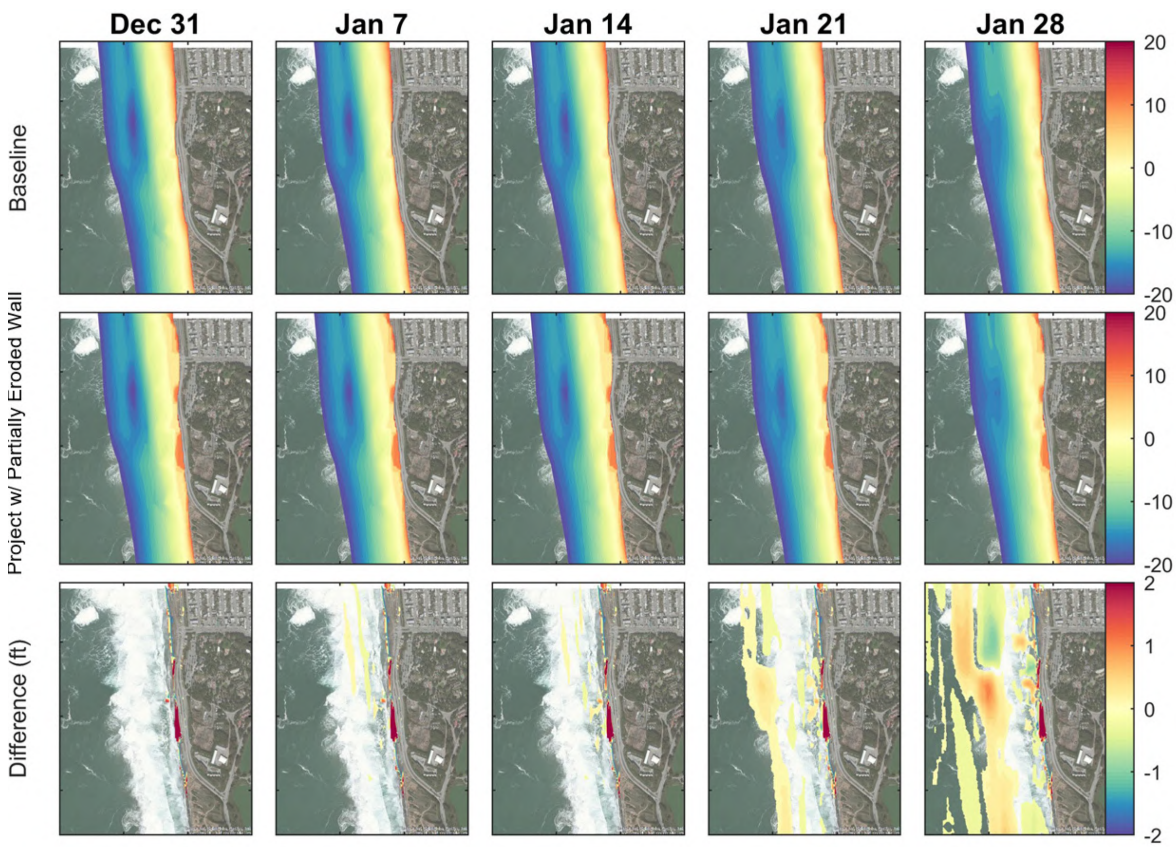
Figure B-2 shows the bed elevation difference of the project with large placement and the baseline conditions. Differences of the two conditions indicate that for project conditions with large placement, there is a general filling of low areas, likely due to the greater amount of sand available in the system, but by only on the order of 1 foot. This is most noticeable at the trough that is located offshore and just south of Sloat Boulevard, where the trough accumulates sand. This project condition also indicates that there is more sand at the beach and increasing the nearshore elevations in front of the project.



SOURCE: ESA CMS Model

Figure B-2
Evolution of bed elevation in feet NAVD for modeled baseline (top) and project with large placement (middle) conditions, and difference between project and baseline where red and blue are accretion and erosion relative to baseline, respectively, in feet (bottom)

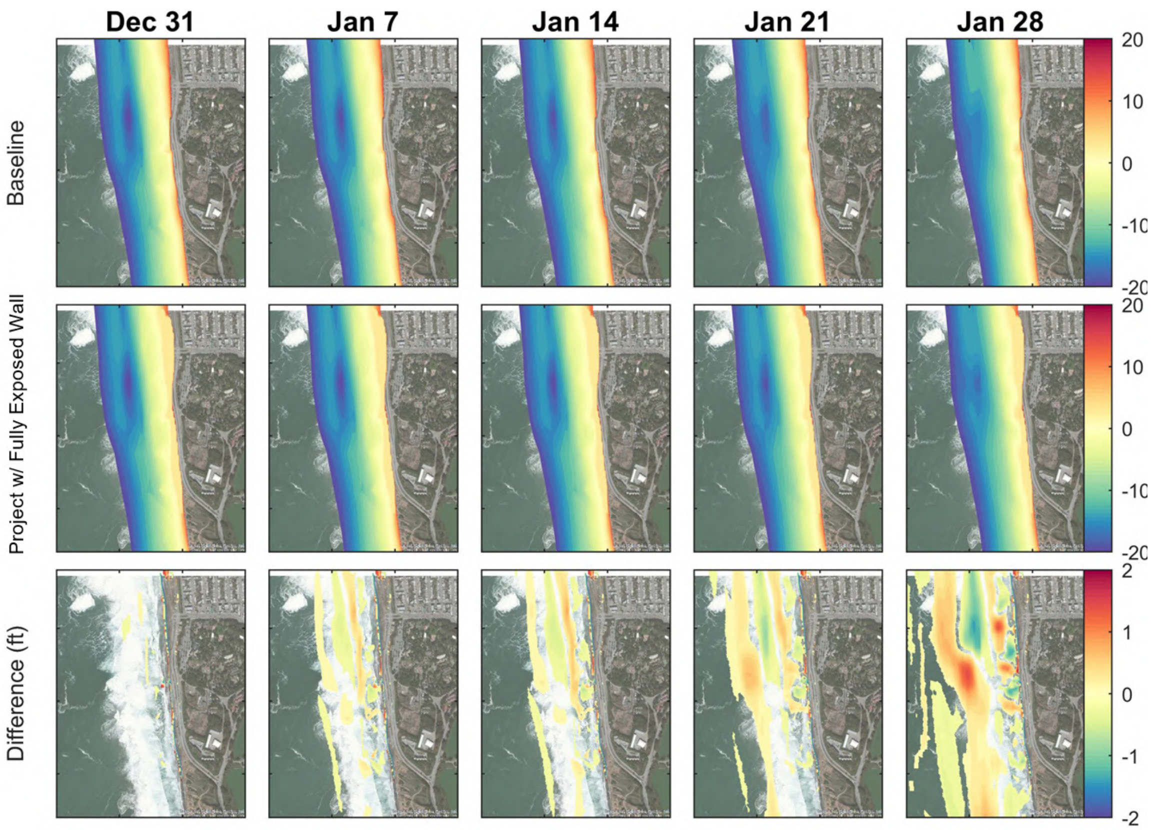
Figure B-3 shows the bed elevation difference of the project with a partially exposed wall and the baseline conditions. The left-most panel in the second row shows the initial condition for the partially exposed wall, where three 500-foot-long segments are eroded to mean sea-level, and areas between the eroded segments are built up to elevation 10 feet NAVD. This condition shows some similarities to the project with large placement, in that there are areas that show slightly higher or lower elevations relative to baseline of less than one foot, which may be due to how the project grades were assigned for the model where the grades in some areas are greater than the baseline condition. Most apparent is that the conditions along the shore indicate lateral sand movement, where the relatively low areas eroded in front of the wall show some zones where the beach is higher than baseline, but much of it is lower than baseline. The evolution of the difference plot shows that the partially eroded case tends to be more eroded in the nearshore by about one foot or less relative to the baseline condition, but there are areas that appear to be higher due to the areas of higher beach.



SOURCE: ESA CMS Model

Figure B-3
Evolution of bed elevation in feet NAVD for modeled baseline (top) and project with partially exposed wall (middle) conditions, and difference between project and baseline where red and blue are accretion and erosion relative to baseline, respectively, in feet (bottom)

Figure B-4 shows the bed elevation difference of the project with fully exposed wall and the baseline conditions. Overall, the project conditions tend to show a slightly higher outer bar and a trough that is filling slightly more than under baseline conditions. The project conditions along the beach appear to have some localized areas that build up higher than baseline, but much of the beach shows a decrease in the elevations relative to the baseline condition by about one foot.



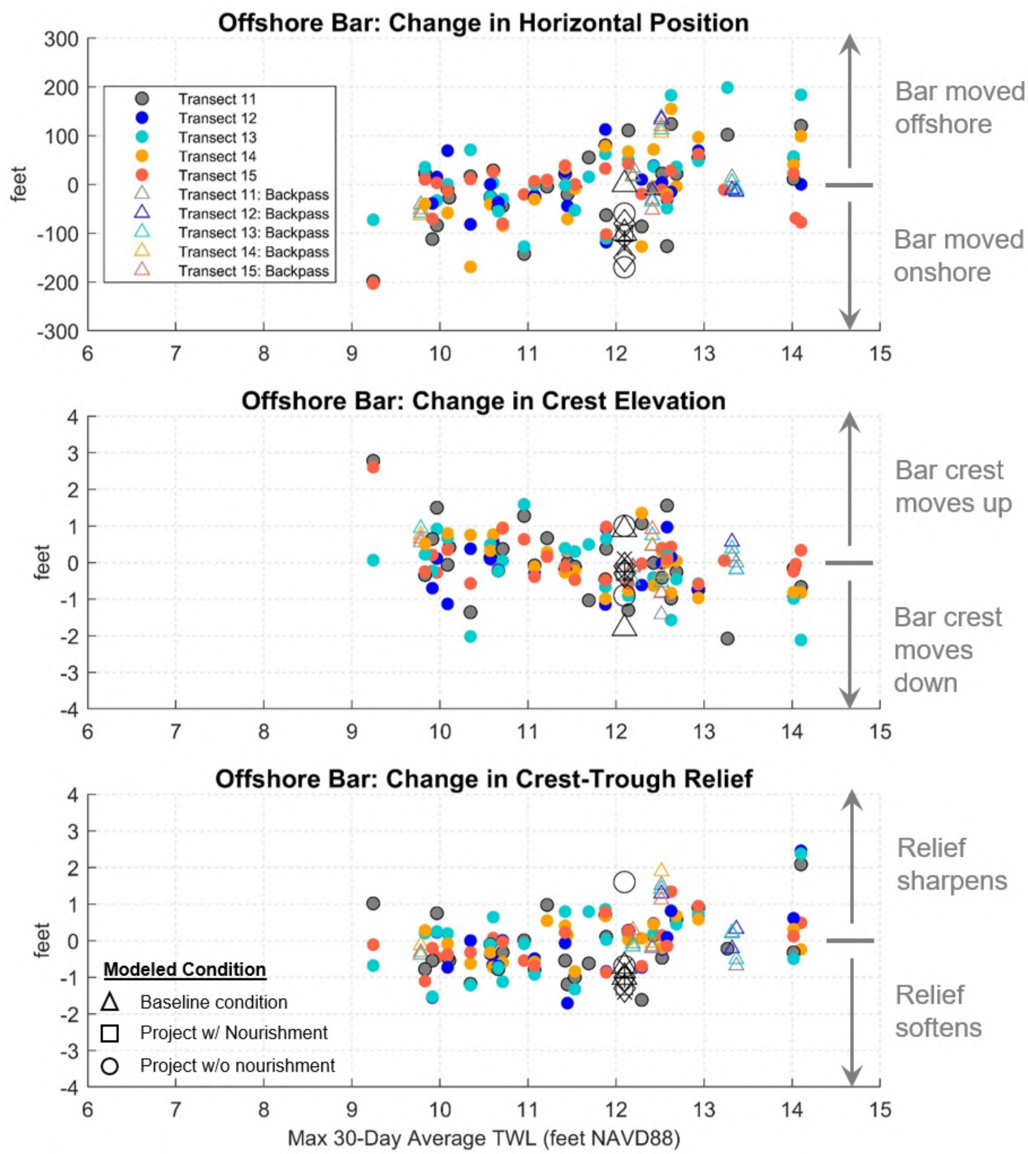
SOURCE: ESA CMS Model

Figure B-4
Evolution of bed elevation in feet NAVD for modeled baseline (top) and project with fully exposed wall (middle) conditions, and difference between project and baseline where red and blue are accretion and erosion relative to baseline, respectively, in feet (bottom)

For each model run we extracted the bar metrics from the five USGS transect locations, as described in Sections 2.2.2 and 3.1.2, at the start and end of the simulations. Using these data we computed the change in each bar metric over a 30 day period, and then compared these data to the historical data presented in Section 3.1.2. We note that the model produced results that tend toward profile relaxation, with the bar crests eroding and troughs filling, when we expected to see more seaward migration of the bars and deepening of the troughs relative to the crests. Therefore, the model results to not appear to be realistic.

Comparison of Modeled Bar Change to Observations

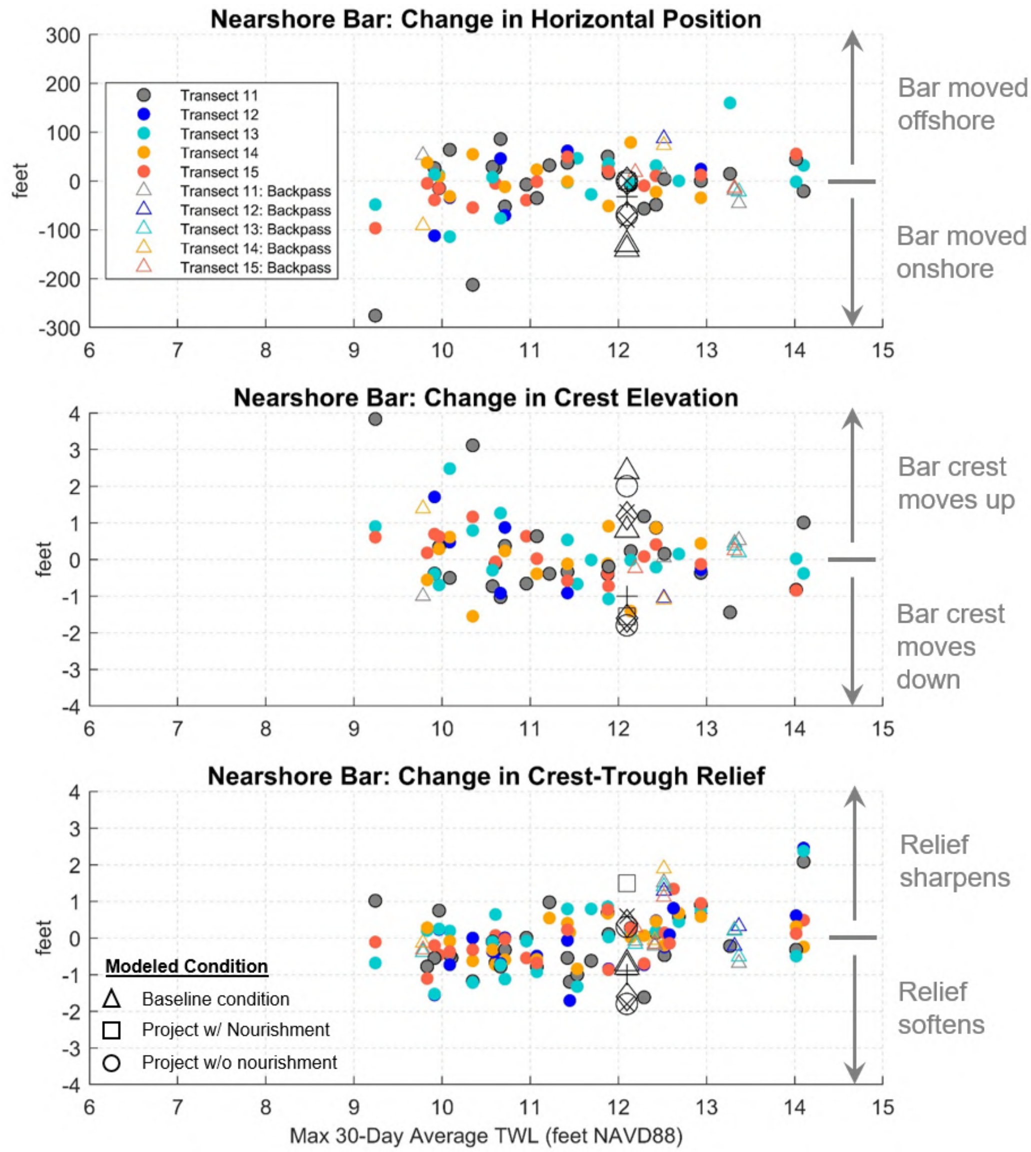
Figure B-5 presents the offshore bar change metrics for historic data as a function of maximum 30-day average TWL with the model results at five profiles for all baseline and project conditions added. The figure shows the change in horizontal position of the offshore bar (top panel), change in crest elevation (middle panel), and the change in crest-trough relief (bottom panel). The colored dots are the historical data of the bar metrics extracted from each individual survey transect (see Appendix A), where the observed change was normalized to change per 30 days; the black shapes represent the modeled baseline and project conditions. Note that these data show the changes measured at each transect and have not been spatially averaged. In general, the modeled data does not fit the patterns of the observed historical data.



SOURCE: USGS, ESA CMS Model

Figure B-5
Comparison of model results and observed historical changes in offshore bar position, crest elevation, and relief for changes normalized to change per 30 days

Figure B-6 presents the nearshore bar change metrics for historic data as a function of maximum 30-day average TWL with the model results at five profiles for all baseline and project conditions added. The figure shows the change in horizontal position of the nearshore bar (top panel), change in crest elevation (middle panel), and the change in crest-trough relief (bottom panel). The colored dots are the historical data of the bar metrics extracted from each individual survey transect (see Appendix A), where the observed change was normalized to change per 30 days; the black shapes represent the modeled baseline and project conditions. Note that these data show the changes measured at each transect and have not been spatially averaged. In general, the modeled data does not fit the patterns of the observed historical data.



SOURCE: USGS, ESA CMS Model

Figure B-6
Comparison of model results and observed historical changes in nearshore bar position, crest elevation, and relief for changes normalized to change per 30 days