BIOLOGICAL ASSESSMENT

FOR

MILITARY OCEAN TERMINAL CONCORD PIER MAINTENANCE DREDGING CONTRA COSTA AND SOLANO COUNTY, CALIFORNIA

Submitted to the
U.S. Fish and Wildlife Service

OCTOBER 2019

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1.0 Introduction

This Biological Assessment (BA) was prepared to meet the consultation requirements under section 7 of the Endangered Species Act (ESA), pursuant to 50 C.F.R. § 402.12. The purpose of this BA is to analyze the potential effects from the proposed maintenance dredging of Piers 2 through 4, and Barge Pier at the Military Ocean Terminal, Concord, California (MOTCO), (proposed action) on ESA-listed threatened and endangered species and their designated critical habitat within the project's action area. This BA is a component of the environmental compliance for a Dredged Material Management Office (DMMO) dredging permit.

Formal or informal section 7 consultation with the United States Fish and Wildlife Service (USFWS), would be initiated by Military Ocean Terminal, Concord (MOTCO), as necessary.

1.1 Project Location and Action Area

MOTCO is located on Suisun Bay, 30 miles northeast of San Francisco, in Contra Costa County. MOTCO's infrastructure was constructed by the U.S. Navy beginning in WWII and operated as a Navy installation. The U.S. Army MOTCO began operations in 1997. Under a Base Realignment and Closure (BRAC) process, the installation was transferred to the Army in 2008. This installation is the primary West Coast common-user transshipment terminal, home to the SDDC's 834th Transportation Battalion.

Maintaining deep-draft access to MOTCO's piers is critical. The MOTCO installation accounts for 72% of the Army's West Coast ammunition handling and approximately 25% of the nation's total ammunition throughput capability. The U.S. Navy dredged the piers, pier navigation approach, and the South Seal Island Channel on average every two years from 1943 through 1981 (Table 1). More than 1.8 million cubic yards was dredged over this time period averaging 87,000 cubic yards per dredge event. Since 1981, additional dredging events are documented from 1986 and 1994. MOTCO does not have any documentation of dredge events between 1994 and 2008. Dredging has not occurred since the U.S. Army assumed the property in 2008 at the conclusion of the BRAC process. Sediment accumulation around the piers has resulted in sediment elevations above the proposed depth of 35 feet (MLLW) at Piers 2-4, and 20 feet (MLLW) at the Barge Pier, and is currently impacting military operations by restricting the times that the MOTCO piers can be used. Dredged material from MOTCO was historically placed on upland levee sites and infrequently at the Carquinez Straight (SF-9) and Suisun Bay disposal sites (SF-16) (see Figure 2).

Figure 1 - Dredging and Material Placement Sites

1.1 Action Area

The action area includes MOTCO's Barge Pier and Piers 2 through 4. Disposal at the Carquinez Strait (SF-9), SF-16, Montezuma Wetlands Restoration Project (MWRP), Cullinan Ranch Restoration Project (CRRP), and the Antioch Dunes National Wildlife Refuge (ADNWR) are excluded from the action area, as these sites are fully permitted to accept dredged material for wetland restoration, including complying with the ESA. Other direct and indirect impacts (e.g., noise) of the proposed action would likely affect a smaller footprint of the action area.

This BA incorporates by reference information contained in the *LTMS National Marine Fisheries Service Biological Opinion* (NMFS 2015b). This document transmits the National Marine Fisheries Service (NMFS) Biological Opinion (BO) for the LTMS Program and its effects on Federally-listed species under NMFS' jurisdiction at the time the consultation was completed. The BO outlines implementing procedures and minimization measures that would be used by MOTCO for dredging and material placement.

2.0 MOTCO Piers and Project Description

This section provides a discussion of the proposed action to conduct maintenance dredging of MOTCO's Barge Pier and Piers 2 through 4 from 2020 to 2030; as well as a detailed project description and description of future maintenance dredging.

Table 1. Historic MOTCO Dredging

Year	Dredge Volume	Document
1943	620,000	1975 LTMS EIS[1]
1944	298,000	
1945	70,500	
1950	82,300	
1951	48,500	
1953	37,000	
1957	108,700	
1959	20,900	
1960	69,700	
1962	40,000	
1965	52,000	
1967	36,800	
1969	30,000	
1970	63,200	
1975	78,000	
1976-1981	171,035	USACE (1995, 2015)
1986	unknown	
1994	unknown	
TOTAL	**1,826,635**	

NOTES:
1- http://www.spn.usace.army.mil/Missions/Dredging-Work-Permits/LTMS/December-1975-Volume-1/

Under MOTCO's Proposed Action/Project Alternative, MOTCO would perform dredging practices to maintain operational and mission capacity for Piers 2, 3, 4, and Barge Pier (totaling 38 acres). Dredging would be conducted under the LTMS. The frequency of dredging to be conducted, and volumes dredged would maintain suitable depths for navigability and cargo operations at piers 2-4 (35 feet MLLW) and the barge pier (20 feet MLLW). Maintenance dredging includes dredging to the respective project's regulatory depth, plus up to 2 feet of overdepth. MOTCO dredging operations would use a clamshell dredge depending on DMMO permit and equipment availability. Local water velocities appear to slow sediment deposition, therefore, MOTCO currently expects to dredge every 2 years when necessary to maintain navigability.

Sediment testing will be performed to identify appropriate placement sites for dredge material. Current conditions and estimated dredge event volume and area are provided in Table 2. Table 3 identifies the preferred Federal standard placement site and proposed alternate placement sites that would be used for each location, as well as expected dredge volumes. MOTCO would beneficially reuse dredged material to the maximum extent its authorities allow. Although it is assumed for the purpose of this BA that placement would occur at the identified Federal standard

sites, MOTCO would place dredged material at beneficial reuse sites when costs are equivalent to the Federal standard.

Table 2. Pier area conditions with proposed dredging actions.

Pier	Hydrographic Survey Date	Proposed Dredge Parameters Year	Depth	Volume (CY)	Area (acres)
Barge	13-Mar-2019	2020	-22'	7,835	2.57
2	13-Mar-2019	2020	-37'	75,225	29.26
3	13-Mar-2019	2020	-37'	2,602	1.03
4	7-Jun-2018	Post-2020	-37'	12,571	4.73
Proposed 2020 Dredging				85,662	32.87
Post-2020 Dredging				12,571	4.73

Table 3. Summary of the proposed dredging action.

Location	Dredge Type	Initial Dredge Volume (CY)	Dredge Frequency	Range of Volume Dredged (CY)	Median Volume Dredge (CY)	Proposed Action Placement Site
Piers 2, 3, 4, and Barge Pier	Clamshell	85,662	1-2	2,602-75,225	28,000	MWRP, CRRP, ADNWR, SF-9, SF-16

Dredging and placement would be conducted in accordance with the conditions described under the DMMO permit and associated compliance documents. For the purposes of this BA, dredging is defined as mechanical dredging with removal of loose- or hard-compacted materials by clamshell, bucket, excavator, dipper, or ladder dredges.

Dredging would be conducted using mechanical dredges, with material being placed in a bottom-dumping scow. Once full, the scow will be transported by a tug to the dredged material placement site for disposal. The maximum anticipated volume of material proposed for maintenance dredging the first year is approximately 85,662 cubic yards (cy). If the dredging is continuous (24 hours a day) and the maximum daily rate of approximately 7,000 cubic yards is achieved dredging, the project could be completed in 13 full days. However, dredging typically does not occur 24 hours per day; rather, the effective work time (actual digging of shoaled material) is often 12 to 16 hours per day. Additionally, crew changes, relocation of the dredge, and other activities (e.g. breakdowns) limit the amount of dredging that occurs. Therefore, completing the proposed action's first year dredging could require anywhere from 30 to 60 days. Future dredging maintenance events are anticipated to be completed in shorter time periods. Dredging would be conducted during the August 1 through November 30 work window.

Mechanical clamshell dredging is the preferred proposed dredge type for this project, in order to minimize and reduce the potential risk of entrainment of special-status fishes. The project proposes to maximize beneficial use by placing dredged sediment at two wetland restoration beneficial use sites. Specifically, sediments would be placed at either MWRP, CRRP, or ADNWR . These proposed dredged material placement sites are already fully permitted to accept

dredged material from Bay Area dredging projects; permits include Endangered Species Act and Magnuson-Stevens Act approvals (NMFS 2001, 2010, 2011, 2015b; USFWS 2001, 2010).

All dredging would be conducted during the existing environmental work windows August 1 through November 30 work window for Suisun Bay (Figure 2, USACE 2014A, 2015), unless expanded environmental work windows are provided through appropriate consultation. Dredging within the environmental work windows would reduce the potential impacts of the proposed action on sensitive life stages of threatened and endangered species.

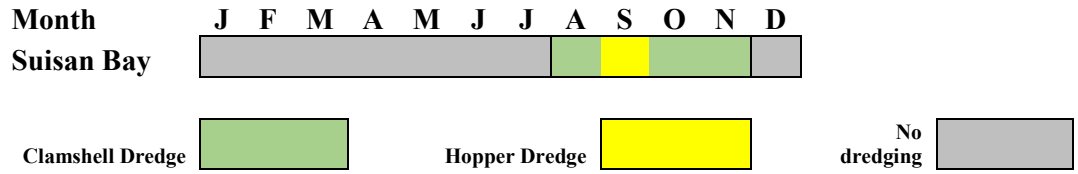

Figure 2 – Suisan Bay dredging work window

2.1 Dredging Methods

This section discusses details regarding the construction methods that would be employed to maintain the Pier Access, transport and place dredged material. The clamshell bucket capacity would range between 20 to 50 cy, depending on dredge availability. Up to seven scows, with a capacity of 2,000 to 4,000 cy, and four 1,800 horsepower (hp) tugs would be used to transport dredged material to placement sites. In addition, one 1,000 hp tender tug would be required to maneuver each dredge plant.

The estimated daily production rate would range between 3,100 and 6,600 cy, depending on the location of dredging and the placement site being used. For example, production rate would be approximately 5,000 cy if dredged material were placed at the upland beneficial use sites. The production rate would decrease if material were transported to one of the federal standard disposal sites.

A mechanical clamshell dredge consists of a crane mounted on a floating deck barge, with a clamshell bucket on the end of the crane boom (Figure 3). The deck barge has two to four spud piles attached to the platform, generally at the corners. The spud piles are long pipes that are driven vertically into the bay bottom by hydraulic assistance. The spud piles are used to anchor the dredge barge. Clamshell dredges are not self-propelled so they require a tug boat to tow or push the dredge to and from the dredge sites. Once a tug moves the dredge into place, the spuds are driven into the bay bottom anchoring the dredge. Once the dredge is anchored in place, dredging can begin. Relocating the dredge requires approximately 1 hour to complete. On average, the mechanical clamshell dredge plant for this project would need to be relocated approximately every 3 hours. In addition, when working adjacent to the ship channel, the dredge would need to be moved out of the shipping channel to allow deep draft vessels to transit the channel.

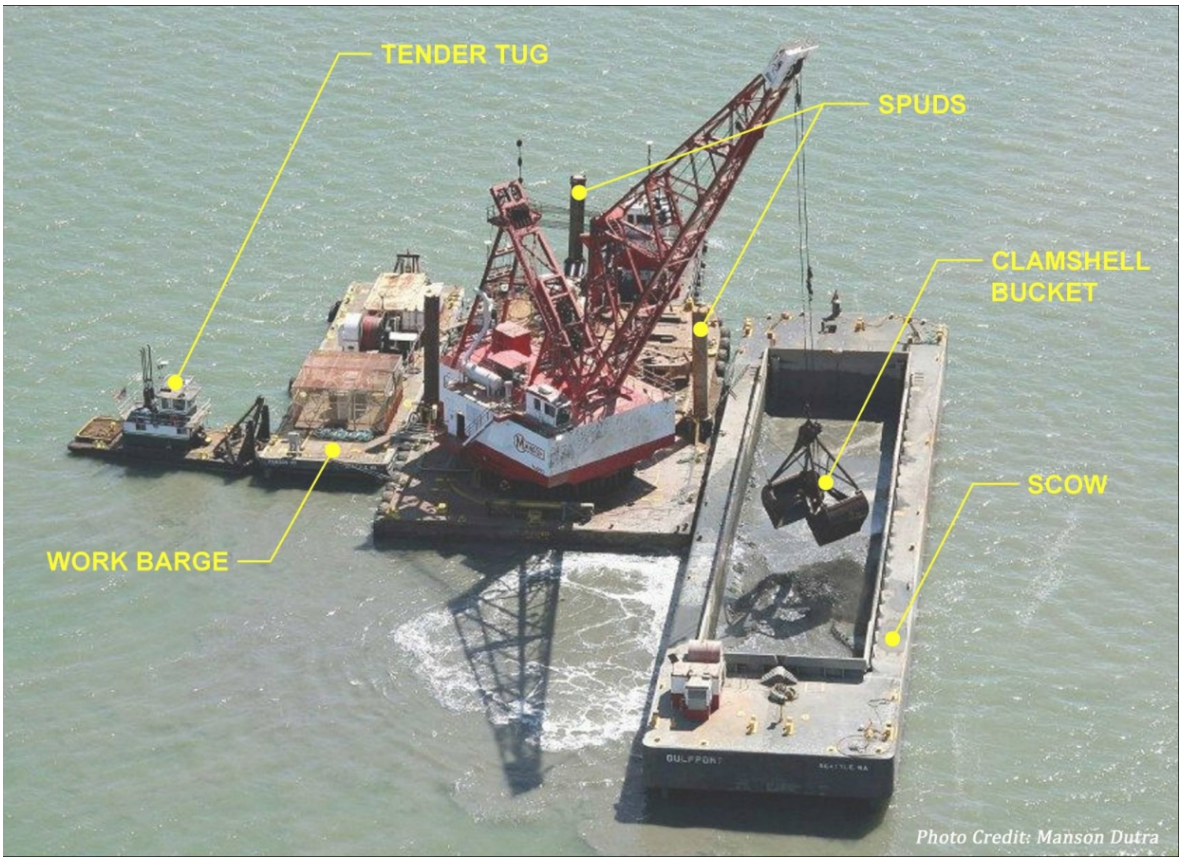

Figure 3 - Typical Mechanical Clamshell Dredge and Scow

The crane has a boom that is long enough to extend out beyond the end of the work barge in any direction and is able to swivel 360 degrees on its mount. A large clamshell bucket is attached to the end of a series of cables at the end of the boom, which allows the bucket to be raised and lowered into the water. The cables also open and close the bucket as it is filled with sediment and then emptied into scows. The scows are open barges that can carry large quantities of sediment and are towed with tug boats to and from disposal sites. As soon as one scow is filled and hauled away, another empty scow is maneuvered into place alongside the dredge and the digging continues.

Clamshell buckets are raised from and lowered to the bottom using a system of cables. The weight of the bucket is sufficient for it to fall through the water column into the bottom sediment. The cables restrict the clamshell from going too deep, or beyond the maximum allowable overdepth. The clamshell then closes and is pulled up through the water column to above the scow. Once over the scow, the clamshell opens and deposits the dredged material into the scow. When all the material within reach of the clamshell is dredged, the spuds are raised and the tender tug transports the dredge and scow to the next area requiring dredging. The process is repeated until all material is dredged from the channel. Following dredging, hydrographic surveys would be conducted to ensure that the entire area is dredged to the desired depth.

During dredging, clamshells place a slurry of sediment and water in the scows. Depending on the sediment type being dredged, the sediment-to-water ratio of the slurry is expected to be approximately 60 to 70 percent sediment and 30 to 40 percent water. To increase the sediment

volume in the scows, the scows may decant water back to the water column in a process called overflow. Overflowing the scows increases the sediment volume, compared to water, which can decrease the number of scow-tug trips to placement sites, thereby decreasing construction costs. The San Francisco Bay Regional Water Quality Control Board allows unrestricted overflow in San Francisco Bay when sediment is greater than 80 percent sand. When sediment is less than 80 percent sand, overflow is only allowed if turbidity monitoring is conducted within 500 feet of dredging operations to demonstrate that the turbidity plume generated by overflow activities does not increase the ambient turbidity by more than 10 percent, does not reduce dissolved oxygen concentrations to below 7.0 mg/L in Suisan Bay, or result in the pH going below 6.5 or above 8.5.

Sediment proposed for dredging in front of the MOTCO Piers is anticipated to classify as clay, silt, and sand. The alternating layers of silty clay, clayey silt, sandy silt, silty sand, sand, and inter-bedded clay and sand are discontinuous and of varying thickness. Shells, wood debris (e.g., branches, twigs, and rootlets), and organic soils grading to peat also are expected to be encountered. Sediment directly in front of MOTCO Piers 2, 3 and 4, and Barge Pier was <80% sand when analyzed for pier renovations. Therefore, overflow turbidity monitoring would be required to demonstrate that the turbidity plumes are not adversely affecting water quality in the vicinity of the dredge.

2.1.1 Dredge Material Transport and Placement

When the scows are full, they would be transported to the dredged material placement site by diesel-powered tug boats. When the scow arrives at an open water disposal site, the doors at the bottom of the scow would open and dredged sediment would fall through the scow doors to the bottom of the placement site (Figure 4). As material falls through the water column, some sediment is stripped from the descending plume, creating turbidity around the scow. However, most sediment would fall to the bottom of the placement site. Scows transported to beneficial use sites would moor to an offloader at the respective site, such that sediment could be pumped out of the scow and onto the restoration site. Pumping out the sediment, or offloading, typically involves the use of a modified hydraulic pipe dredge, which serves as an offloader. Montezuma Wetlands typically uses the Liberty offloader (Figure 5), which is on a floating barge. Cullinan Ranch uses an offloader that is land-based (Figure 6). Once moored, the offloader would insert a snorkel into the scow, simultaneously injecting water into the scow to create a water-sediment slurry and pumping the slurry from the scow to a designated cell within the site. The offloader's water intake system must be screened in accordance with the California Department of Fish and Wildlife's screening criteria. It takes approximately 2 hours to completely offload dredged sediment from a scow. Scows-tugs from the MOTCO would travel an average of 12 miles to Montezuma Wetlands. The distance from MOTCO to Cullinan Ranch is approximately 19 miles. Scows-tugs would travel approximately 7 knots (8 miles per hour) from dredge sites to the beneficial use sites. On average, each scow-tug trip to and from the beneficial use sites, including offloading, would take approximately 6 hours.

The project proposes to use existing dredged material placement sites, which have all of their environmental approvals in place to currently accept dredged material, including biological opinions, incidental take permits, and EFH conservation recommendations. The intent would be to maximize beneficial use of dredged material for construction of wetlands. Dredged material placement sites included in the project description are discussed below.

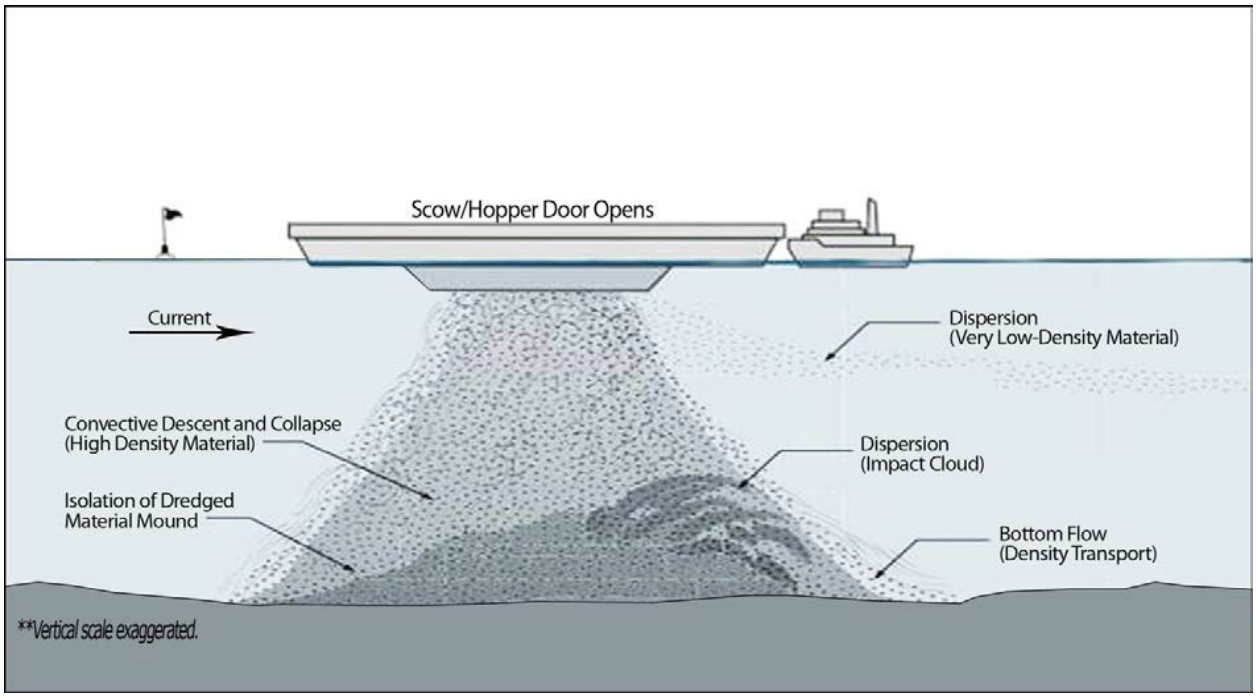

Figure 4 – Aquatic Placement of Dredged Material

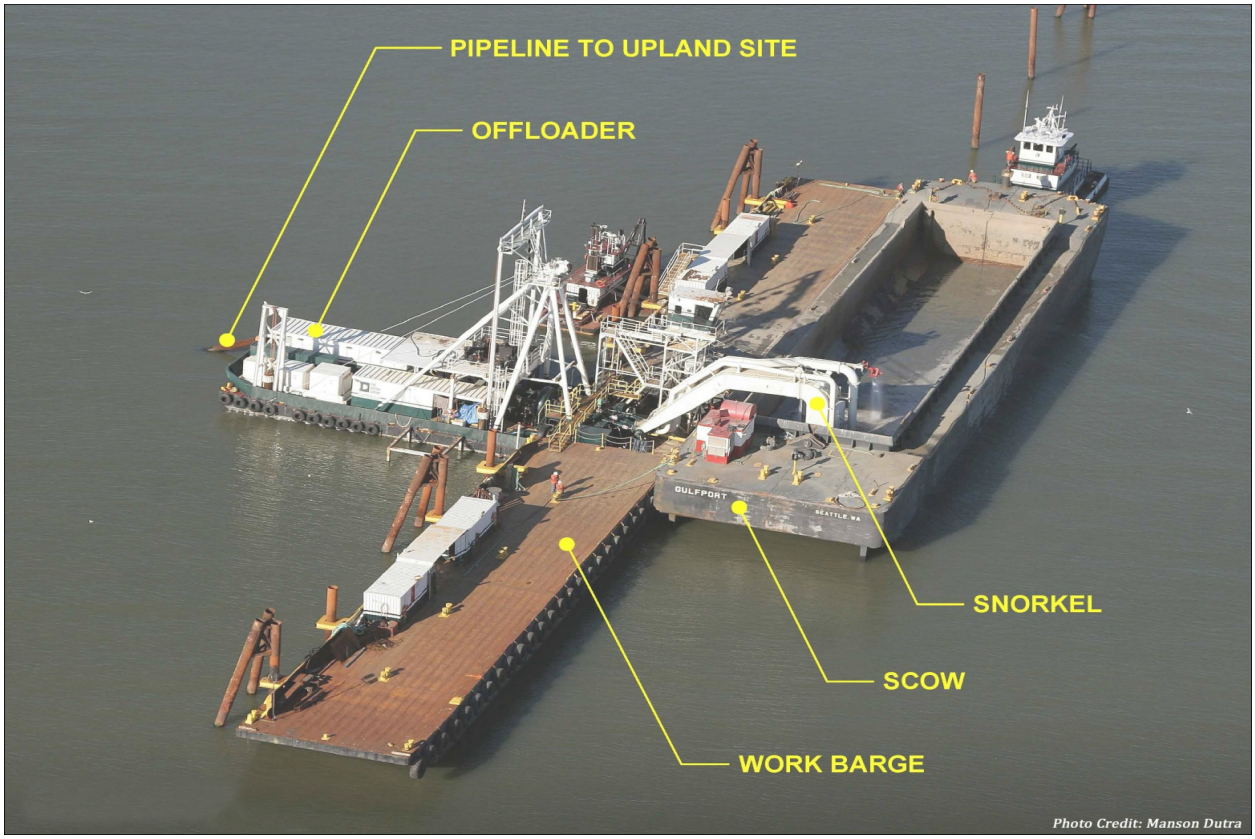

Figure 5 - Liberty Offloader during Typical Offloading at Montezuma Wetlands Restoration Project

2.1.2 Montezuma Wetlands

Montezuma Wetlands Restoration Project (MWRP) is a privately-owned restoration project located on the eastern edge of Suisun Marsh, north of the confluence of the Sacramento and San Joaquin Rivers near the town of Collinsville, in Solano County. In the early 1900s, the site was diked, drained, and used for agriculture. Since the site was diked, the land has subsided up to 10 feet. Once completed, Montezuma Wetlands is expected to restore 1,820 acres of tidal, seasonal, and managed wetlands (Collins and Grosso 2006). Approximately 17.5 million cubic yards of dredged material are needed to raise site elevations. As of August 2017, approximately 4 million cy of dredged material have been placed at Montezuma Wetlands, contributing to the restoration of over 350 acres of wetlands (https://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/dredging.html). The site can accept both cover and foundation material. Foundation material is allowed only in the deepest portions of the site and must be covered with at least 3 feet of clean cover material.

A detailed description of the restoration activities and associated impacts to special status species and critical habitat are fully described in the Montezuma Wetland Restoration Project's biological opinions (USFWS file numbers 1-1-99-F-12; 1-1-02-F-0175 and 1-1-04-F-0270; NMFS file number F-SA-00-6:EAC), which are incorporated into this document by reference.

Based on the above information for Montezuma Wetlands, 9,000 to 11,429 cy of dredged sediment is required to create 1 acre of wetland habitat at the above locations. Using an intermediate value of 10,000 cy per acre of habitat, the approximately 98,500 cy of dredged sediment resulting from the proposed project is expected to create 9.8 acres of wetland habitat due to its beneficial reuse.

2.1.3 Cullinan Ranch Restoration Project

The Cullinan Ranch Restoration Project is located along the northern shoreline of San Pablo Bay near the city of Vallejo in Solano and Napa Counties. The site consists of diked baylands that was used for agriculture until the late 1980s. Following diking and draining the site, much of it lost up to 6 feet of elevation as a result of sediment deposition, soil compaction, and loss of organic matter (USFWS 2010). The USFWS is currently restoring over 1,500 acres of the site to tidal wetlands consistent with the USFWS' recovery plan for salt marsh harvest mouse and California clapper rail. In addition, it is believed that the restored marsh would provide suitable habitat for delta smelt, Central California coastal Steelhead, Central Valley Steelhead, winter-run Chinook Salmon, Central Valley spring-run Chinook Salmon, Green Sturgeon, and western snowy plover (USFWS 2010). The Cullinan Ranch Restoration Project also is expected to provide food and nutrients for aquatic species in the adjacent Napa River Estuary and San Pablo Bay.

In 2014, regulatory permits were revised to increase the volume of dredged sediment authorized for placement in support of tidal marsh habitat restoration at Cullinan Ranch (DMMO 2015). Specifically, the amount was increased from 450,000 cy to restore 50 acres to 2.8 million cy to restore 290 acres of the 1,575-acre site to elevations suitable for marsh plain establishment. As of December 2017, approximately 800,000 cy had been placed at Cullinan Ranch (Ducks Unlimited 2017), leaving a remaining capacity of approximately 2 million cy.

A detailed description of the restoration activities and associated impacts to special status species and critical habitat are fully described in the Cullinan Ranch Restoration Project's biological

opinion (Intra-Service section 7 consultation number SFB-1010-01), which is incorporated into this document by reference.

2.1.4 Antioch Dunes National Wildlife Refuge

The Antioch Dunes National Wildlife Refuge (ADNWR) is an approximately 55-acre refuge managed by USFWS that consists of two parcels separated by a Georgia-Pacific Gypsum Plant and a Pacific Gas & Electric utility easement. The refuge was founded in 1980 and is located along the shoreline of the San Joaquin River in Antioch, California. The western parcel, the 41-acre Stamm Unit, is the only unit proposed to receive dredge sediment for this project. The ADNWR is located about 12 miles east of MOTCO.

The site is surrounded by industry including a gypsum plant to the east, a former shipyard to the west, a former wastewater treatment facility which now functions as a municipal landfill, and a set of railroad tracks to the south. A total of three Federally-listed species: the Contra Costa Wallflower (*Erysimum capitatum ssp. angustatum*), the Antioch Dunes Evening Primrose (*Oenothera deltoides ssp. howellii*), and the Lange's Metalmark Butterfly (*Apodemia mormo langei*), have been identified at ADNWR.

As part of the Comprehensive Conservation Plan (CCP) for the ADNWR, dune restoration is one of the primary objectives for habitat restoration (USFWS 2002). Beginning in 1991, the USFWS has imported sand to the ADNWR in order to create additional habitat. The CCP specifies identifying potential sources of clean sand, specifically from the Stockton DWSC, and importing the sand for habitat restoration. Due to the sandy substratum in the areas surrounding Antioch Dunes, the shoaling that typically occurs in this section of the San Joaquin River is sand. In 2013, the Port of Stockton and the USFWS at Antioch Dunes partnered with the Corps to begin restoration efforts using dredged material. The beneficial reuse of dredged material allows the recreation of sand dunes, the natural habitat of the Contra Costa wallflower, the Antioch Dunes evening primrose, and Lange's metalmark butterfly. Continued use of this DMPS as a site for the beneficial reuse of dredged material will eventually allow natural restructuring of the sand dunes, possibly recreating the natural function and habitat value of the ADNWR. This site was used as a DMPS in 2013, 2015, and is planned to be used in 2019.

2.1.5 SF-9 Carquinez Strait Placement Site

The SF-9 placement site is a 1,000-foot by 2,000-foot rectangle, approximately 10 to 55 feet deep, 0.9 miles west of the entrance to Mare Island Strait in eastern San Pablo Bay in Solano County (Figure 1). Disposal is limited to 1.0 million cubic yards (cy) of dredged material per month and a maximum of 3.0 million cy per year during wet or above-normal water flow years; and 2.0 million cy per year during all other years.

2.1.5.1 SF-16 Suisun Bay Placement Site

The SF-16 placement site is a single-user, in-Bay, unconfined disposal site reserved for sand dredged from the Suisun Channel and New York Slough projects only. SF-16 is a 500-foot by 11,200-foot rectangle adjacent to the northern side of Suisun Bay Channel, approximately 1 mile upstream of the Interstate 680 Bridge (Figure 1). The depth at this site is approximately 30 feet MLLW. Currently, the site is authorized to receive 200,000 cy of dredged sand per year.

Figure 6 - Modified Offloader Currently Offloading Dredged Material at Cullinan Ranch (Dutchman Slough)

2.2 Future Operations and Maintenance Activities

Local water velocities appear to slow sediment deposition therefore, MOTCO currently expects to dredge every 2 years when necessary to maintain navigability starting in 2020, and continuing through 2030. Maintenance dredging includes dredging up to 2 feet of overdepth.

2.3 Military Ocean Terminal Pier Modernization

The Department of the Army (DOA) requested formal consultation for the modernization and repair of Piers 2 and 3 at the Military Ocean Terminal Concord (MOTCO) on October 28, 2013 (NMFS 2014; USFWS 2015; DOA 2015, 2016). Major activities included demolition of pier 2, replacement of the existing pier pilings, temporary knockdown dredging around the pilings, and repairs of piers 2 and 3. Formal ESA consultation was completed in February 2015. Subsequent re-design reduced the effects associated with replacement of the pilings from the proposed action (DOA 2016). No dredging was conducted during pier modernization.

3.0 Consultation History

On July 16, 2019 a species list was requested and received from USFWS for this project. This project would follow the best management practices (BMPs) and reasonable and prudent measures (RPMs) of the Long Term Management Strategy (LTMS) for the Placement of Dredge Material in the San Francisco Bay Region (USFWS 1999). This project would follow the BMPs and RPMs of the LTMS (2015a,b).

On September 18, 2019 the USFWS and NMFS participated on a conference call with MOTCO and USACE to discuss the content in the forthcoming BA(s). The conversation focused on clearly describing the proposed dredging action at MOTCO.

4.0 Environmental Baseline and General Effects of the Proposed Action

This section discusses the existing environmental conditions and aspects of the proposed project that could impact the existing conditions either directly or indirectly. This section is limited to only those impacts that may adversely affect special status species or critical habitat, and further discusses the general impact mechanisms of the project which would be similar for all special status species and habitat analyzed herein. For specific impacts on special status species, refer to Sections 5.0 (USFWS-managed species),. The resources and potential impacts included in this analysis are listed below:

- Direct impacts through dredging and dredged material transportation. These impacts could range from injury or death of special status fishes or changes in their behavior, to adverse effects on critical habitat and essential fish habitat.
- Direct and indirect impacts to water quality resulting from turbidity and suspended sediment, release of constituents of concern, and salinity intrusion.
- Direct and indirect impacts resulting from hydrodynamic noise.

4.1 Impacts Associated with Dredging and Dredged Material Transportation

Special status fishes have the potential to be directly injured by construction equipment, including through contact with the dredge clamshell bucket or contact with the tug and scows. In addition, fish may become entrained in prop wash from tugs or other shallow-draft skiff vessels transporting crew and equipment. The most likely cause of injury would be from the clamshell bucket falling through the water column or entrainment in tug prop wash.

While individual fish have the potential to be struck or entrained by clamshell bucket as if falls through water column to the bottom, the falling bucket would generate a pressure wave around it that would force small fish away from the falling bucket. As a result of the pressure wave, mechanical clamshell dredging has a very low risk of entraining fishes (USACE DOER 1998). As such, the use of a clamshell dredge minimizes the risk of fish entrainment for all fishes.

Special status fish also have the potential to be entrained in tug prop wash. The project proposes to use two 1800 hp tugs to transport scows to and from the beneficial use sites, and up to three 1,000 hp tugs to maneuver the clamshell dredges. The smaller tugs would remain in the vicinity of the dredge area; whereas the larger tugs would move between the dredge areas and the placement sites. The dredges would draft between 10 and 18 feet MLLW. While operating, the tugs would create propeller wash as they move through the water. Propeller wash is a pressure disturbance that results in a system of diverging and transverse waves. As the propeller spins, it generates a turbulent, continuous stream of fast moving water (AMOG Consulting 2010). Fish entrained in propeller wash may become disoriented or injured.

4.2 Habitat Alteration

The proposed project area provides habitat for a wide variety of aquatic species, including species associated with the benthos (e.g., annelids, mollusks, and crustaceans); phytoplankton and zooplankton; common fish species; special status fish species; invasive aquatic plants, fish, and invertebrates; and marine mammals. Aquatic habitats include tidal marsh and tidal mudflats; intertidal, shallow sub-tidal, and deep sub-tidal habitats; managed wetlands; rocky intertidal and subtidal; and open bay waters. Much of the land adjacent to Suisun Bay, the Carquinez Strait, San Pablo Bay, and San Francisco Bay is developed. Suisun Bay is adjacent to

Suisun Marsh and other wetland areas, as well as some developed shorelines. The habitat types around the Bay and Delta often blend with one another and with nearby upland habitats in transition zones called ecotones. Species found in these areas often occur in more than one habitat type (USACE 2014a).

The proposed project would remove several feet of accumulated sediment the MOTCO Piers Access area. The total project area of 38 acres is the maximum area that would be disturbed. Removal of benthos may temporarily reduce the food supply for special status fish species that are benthic predators, such as Green Sturgeon. Benthic recolonization of the dredged area may take months or years (Oliver et al. 1977). Dredging of accumulated sediment would not decrease the area of shallow water habitat in the project area.

4.3 Water and Sediment Quality

The project has the potential to affect water and sediment quality by temporarily increasing suspended sediment during dredging, which also can result in releases of constituents of concern; salinity intrusion; and changing the sediment quality of the channel bed following dredging. Salinity intrusion especially could affect the quantity and quality of habitat available for fishes which depend on a particular range of salinity as suitable habitat; of particular concern is Delta Smelt. These potential impacts to water and sediment quality are discussed in greater detail below.

4.3.1 Sediment Sampling and Testing

The Inland Testing Manual (ITM), Ocean Testing Manual, and the Upland Testing Manual specify the sampling and testing requirements for dredged material based upon the potential placement site. Some upland sites may have additional requirements beyond those specified in the three manuals.

The DMMO is a forum used by project proponents and the regulatory agencies to ensure sampling and testing programs meet water quality standards and that dredged material is placed in sites that are appropriate for the type and quality of the material to be dredged. The Sampling and Analysis Plan (SAP) describes the process for compositing, analyzing and reviewing sediment results for Federal maintenance dredging projects (see example USACE 2014b). The SAP for MOTCO dredging describes how material should be collected, shipped, stored, handled, and tested for certain physical, chemical, and biological analyses. The SAP would be updated in 2019 prior to sampling toward the end of the calendar year.

In accordance with the ITM, when the material to be dredged is greater than 80 percent sand and is in a high-energy environment, it is assumed to be clean and exempt from further testing. Sediment directly in front of MOTCO Piers 2, 3 and 4, and Barge Pier is <80% sand. The sediment was previously tested in 2014 in accordance with a DMMO reviewed Sediment SAP (USACE 2014c). Sampling would be implemented in 2019 to provide current sediment data for identifying appropriate disposal sites in the permitting compliance (EA).

A comparison of DMMO criteria and bioaccumulation tissue concentration results indicate that bioaccumulation of PAHs, PCBs, pesticides and metals is not anticipated (USACE 2014c). Additional z-layer samples are not likely required in the proposed dredging area following dredging. Using NOAA sediment quality guidelines, significant adverse effects are not expected. The NOAA Enterprise Risk Management (ERM) criteria is considered the most appropriate comparison value and with the exception of nickel, which was further evaluated, no

values exceed the available ERM. Results show elevated levels of metals and polycyclic aromatic hydrocarbons as expected. However, the results of the toxicity and bioaccumulation bioassays indicate that significant adverse effects are not anticipated for vertebrate and invertebrate receptors (USACE 2014). Deionized Water Waste Extraction Test results do not exceed the Soluble Threshold Limit Concentration criteria. Therefore, material placement is not expected to impact groundwater via infiltration, or impact surface water due to stormwater discharge (USACE 2014). Waste Extraction Test results indicate that further evaluation or monitoring for chemical constituents is not necessary because effluent concentrations are similar to site water (background) concentrations. Discharge into Suisun Bay is not likely to cause adverse impacts to water quality or ecological receptors regardless of dredging methodology (USACE 2014).

Based on grain size results alone, the anticipated dredge materials from Suisun Bay Channel and New York Slough were suitable for in-Bay disposal at the Suisun Bay Disposal Site (SF-16). In addition, the Grain Size results were greater 80 percent sand in a high energy environment is considered to be clean sand suitable for aquatic placement.

Dredged materials from Suisun Bay Channel and New York Slough have historically been comprised predominantly of sand with low levels of metals and butyltins and very low or non-detect levels of polyaromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs), which excludes these dredged materials from further chemical and biological analyses.

Sampling and testing for the Suisun Bay Channel is on a 5-year cycle, with the next episode scheduled for 2019. USACE would implement sediment sampling in the MOTCO project area using the updated SAP.

4.3.2 Turbidity and Suspended Sediment

The proposed action could produce increased suspended sediments and turbidity in the action area from clamshell dredging operations and placement of spoils at the disposal site. Background turbidity in the estuary is naturally high, with total suspended solids (TSS) levels varying from 10 mg/L to more than 100 mg/L (Robinson and Greenfield 2011). However, sediment plumes would be generated from excess sediment and other material entrained (e.g. air bubbles) being discharged back into the water during dredging. Plumes typically have an increased suspended sediment concentration, thus elevated turbidity. The degree of sediment re-suspension depends on the material, size and composition the sediment being re-suspended. Plume size, concentration, and duration of the plume depend on environmental and operational specific factors. During dredging, sediments may become suspended because of the clamshell bucket's impact to the bottom, material washing from the top and side of the bucket as it passes through the water column, sediment spillage as it breaks the water surface, spillage of material during barge loading, and intentional overflow in an attempt to increase the barge's effective load which is only permissible for material that is 80 percent or more sand.

Turbidity plumes were measured during clamshell dredging in the Oakland Harbor and Richmond Inner Harbor, located in Central San Francisco Bay, and Redwood City Harbor, located in the South San Francisco Bay in 2016 and 2017. Sediment in these channels ranges from very fine silt to sandy-silt. The purpose of the turbidity monitoring was to determine if dredging and/or overflowing of scows exceeded the turbidity requirements in the project's water quality certification. The water quality certification requires that increased turbidity be less than 50 NTU or no greater than 10 percent if the baseline NTU is greater than 50 at the point of

compliance (i.e., 500 feet downstream of dredging). Ambient turbidity was measured 200 feet up current from dredging, in areas that were not affected by the turbidity plume. The turbidity plumes were measured at 200 feet down current from the dredge (referred to as the early warning location) and 500 feet down current from the dredge (referred to as the point of compliance). For each location, turbidity was measured near the surface (approximately 2 feet below the surface), mid-depth, and near the bottom (approximately 2 feet above the bed). Turbidity was measured when the scow was overflowing (decanting) and when the scow was not overflowing, and also represented the range of tides in the region. Measurements were taken every 10 minutes at each location. Exceedances of the water quality turbidity standards occurred periodically for all channels, with most exceedances occurring in the Richmond Inner Harbor, where sediment is very fine-grained.

Exposure to excessive suspended sediment concentrations could lead to physiological stresses such as clogged gills, eroded gill and epithelial tissues, impaired foraging activity and feeding success, and altered movement and migration patterns of juvenile and adult fish (Clarke and Wilber 2000; Minello *et.* al.1987; Newcombe and Jensen 1996; Newcombe and MacDonald 1991). Exposure of fish to elevated suspended sediment concentrations could result in behavioral avoidance and exclusion from otherwise suitable habitat, disrupt movement and migration patterns, reduce feeding rates and growth, result in sublethal and lethal physiological stress, habitat degradation, or delayed hatching; and, under severe circumstances, could result in mortality (Newcombe and Jensen 1996; Clarke and Wilber 2000). The response of fish to suspended sediments varies among species and life stages as a function of suspended particle size, particle shape, water velocities, suspended sediment concentrations, water temperature, depressed dissolved oxygen concentrations, contaminants, and exposure duration (O'Connor 1991; Sherk 1971; Newcombe and Jensen 1996). Short-duration exposure to elevated suspended sediment concentration associated could result in sublethal effects; however, potential exposure and dosage of suspended sediment concentrations drops exponentially from the source of the plume.

4.3.3 Exposure to Constituents of Concern and Bioaccumulation

Sediment sampling was conducted and analysed for the MOTCO Pier renovation (USACE 2014c). These analyses indicate there are unlikely to be constituents of concern in the sediments to be dredged. USACE proposes to conduct confirmatory sediment sampling and analysis during fall 2019 to the depths proposed for this project, plus the required overdepth, prior to dredging. Confirmatory testing would verify that the sediments are suitable for placement at Montezuma Wetlands, and SF- Cullinan Ranch, and DODS.

4.3.4 Noise

Underwater sound pressure waves can harass and harm fish species (Reyff 2003, Abbott and Bing-Sawyer 2002, Caltrans 2001, Langmuir and Lively 2001, Stotz and Colby 2001). As the pressure wave passes through a fish, the swim bladder is rapidly squeezed due to the high pressure, and then rapidly expanded as the under pressure component of the wave passes through the fish. This can cause effects including: rupture of the swim bladder, rupture capillaries, internal hemorrhage, neurological stress, and auditory damage. Extreme sound waves can cause instantaneous death, latent death within minutes after exposure, or can occur several days later. Increase in sound waves can also result in reduced fitness of fish, making it susceptible to predation, disease, starvation, or ability to complete its life cycle.

The proposed action is expected to cause increased underwater sound pressures waves. The noise from a clamshell dredge is punctuated by its entry into the water, contact with bottom substrate and the closing of the jaws of the clamshell. There are also periods of quiet between the events when the clamshell enters the water. In 2001, the U.S. Army Engineer Research and Development Center prepared an analysis of increased sound pressure level (SPLs) produced by clamshell dredging in Cook Inlet, Alaska. In that analysis, the most extreme peak SPLs (dB rms) was produced by the dredge bucket striking the bottom in mixed coarse sand and/or gravel. The increase in sound measured at a 150 meter distance to the dredge plant source, produced peak SPLs (dB rms) of 124.0 dB, or 50.8 dB above peak ambient conditions. Ambient noise conditions, in the action area during the proposed work window, are comprised primarily of commercial ship traffic, wind and wave turbulence, and hydrodynamic noise associated with variable tidal flow condition. The ambient noise conditions in the action area are expected to be similar to that of Cook Inlet Alaska, ergo the peak SPLs at 150 meters are expected to be higher than ambient.

To quantify the level of sound expected to cause harassment and harm, the Fisheries Hydroacoustic Working Group has established interim criteria for evaluating underwater noise impacts from pile driving on fish. These criteria are defined in the document entitled *Agreement in Principal for Interim Criteria for Injury to Fish from Pile Driving Activities* (Fisheries Hydroacoustic Working Group 2008). This agreement identifies a peak sound pressure level (SPLs) of 206 decibels (dB) and an accumulated sound exposure level of 187 dB as thresholds for injury to fish ≥ 2 grams. For fish less than 2 grams, the accumulated sound exposure level threshold is reduced to 183 dB. Although there has been no formal agreement on a behavioral threshold, National Marine Fisheries Service (NMFS) uses 150 dB-root mean square (rms) as the threshold for adverse behavioral effects (NMFS 2009b). The proposed project is expected to produce peak SPLs of 124.0 db as determined in the Cook Inlet study, which is below all of the thresholds described above. Therefore, the noise from the proposed project is not expected to adversely affect listed species greater than 150 m from the clamshell dredge plant. Effects on fish closer than 150 m are unclear, but likely to involve behavioral avoidance of the area.

5.0 USFWS Endangered Species Act Resources

This section presents the impacts assessment for threatened and endangered species, as well as critical habitat managed by the USFWS. An official USFWS-species list was generated from the USFWS's IPaC website on July 16, 2019. The species list identified 17 threatened and endangered species, including one mammal, two birds, two reptiles, two amphibians, one fish, four insects, three crustaceans, and two plants. Critical habitats was identified for the delta smelt (*Hypomesus transpacificus*). Delta smelt critical habitat occurs in the proposed project area. In addition, this analysis considers the potential effects of the proposed project on the candidate species longfin smelt (*Spirinchus thaleichthys*). Should longfin smelt be listed prior to or during construction of the proposed project, MOTCO would request a conference opinion, pursuant to 50 C.F.R § 402.10.

Species identified in the official USFWS list are provided in Table 4, along with a brief analysis of whether the species or critical habitat is in the action area and could be affected by the proposed action. A detailed analysis of the potential effects on the project's effects on threatened and endangered species and critical habitat that has the potential to be affected is also provide herein.

Table 4: Special Status Species and Critical Habitat Included on the USFWS Official Species List (July 16, 2019)						
Common Name	**Scientific Name**	**Status**	**Designated Critical Habitat**	**Critical Habitat in the Action Area**	**Habitat Requirements**	**Effects Determination**
Mammals						
Saltmarsh harvest mouse [(a)]	*Reihrodontomys raveiventris*	FE, SE	No	na	Endemic to salt and brackish marshes of the San Francisco Bay area. They predominately utilize areas of dense pickleweed stands; however, to a lesser extent, they are known to forage and find shelter in saltgrass and other vegetated areas found in salt and brackish marshes.	ESA consultation for upland beneficial use sites is already completed.
Birds						
California clapper rail [(a)]	*Rallus longirostris obsoletus*	FE, SE	No	na	Prefers intertidal zones and sloughs of salt and brackish marshes dominated by pickleweed, Pacific cord grass, gumplant, saltgrass (*Distichlis spicta*), jaumea and adjacent upland refugia.	ESA consultation for upland beneficial use sites is already completed.
California least tern [(a)]	*Sterna antillarum browni*	FE, SE	No	na	California least tern inhabit coastal areas from the San Francisco Bay area south to Baja, California. They nest on open beach free of vegetation and migrate south in the fall (USFWS 2006). In the Bay Area, the LTMS has developed work windows from the Berkeley Marina to south of the Highway Bridge; however, these areas our outside of the project area.	No effect. Habitat not present in the action area; therefore, individuals will not be present.
Reptiles						
Alameda whipsnake	*Masticophis lateralis euryxanthus*	FT, ST	Yes	No	Alameda whipsnake typically inhabit chaparral and coastal sage scrub communities. Rock outcrops, rock crevices and mammal burrows are important habitat features. Its current range includes the inner coast range of California, primarily in most of them in Contra Costa and Alameda counties.	No effect. Habitat not present in the action area; therefore, individuals will not be present.
Giant garter snake	*Thamophis gigas*	FT, ST	No	na	The giant garter snake is endemic to wetlands of the Sacramento-San Joaquin Valley. Specifically, they inhabit marshes, sloughs, ponds, small lakes, low gradient streams, and other waterways (e.g., drainage ditches, rice fields, agricultural canals; 58 FR 54053).	No effect. Habitat not present in the action area; therefore, individuals will not be present.
Amphibians						
California red-legged frog	*Rana draytonii*	FT	Yes	No	California red-legged frogs inhabit aquatic, riparian, and upland habitat for forage, shelter, cover, and non-dispersal movements (75 FR 12,816).	No effect. Habitat not present in the action area; therefore, individuals will not be present
California tiger salamander	*Ambystoma californiense*	FT, CH, ST	Yes	No	They inhabit subterranean refugia, especially burrows of ground squirrels, and breed in shallow wetlands or ponds. Migrations between breeding grounds and upland habitats generally occur at night during periods of sustained rainfall. During breeding migrations, individuals can be found under rocks, logs, or other objects (69 FR 47,212).	No effect. Habitat not present in the action area; therefore, individuals will not be present
Fishes						
Delta Smelt	*Hypomesus transpacificus*	FT, SE	Yes	Yes	Inhabits estuarine and delta waters	May affect, not likely to adversely affect; see additional analysis in narrative below
Delta Smelt Critical Habitat	*Hypomesus transpacificus*	FT, SE	Yes	Yes	Inhabits estuarine and delta waters	May affect, not likely to adversely affect or modify critical habitat.

Table 4: Special Status Species and Critical Habitat Included on the USFWS Official Species List (July 16, 2019)

Common Name	Scientific Name	Status	Designated Critical Habitat	Critical Habitat in the Action Area	Habitat Requirements	Effects Determination
Longfin smelt	*Spirinchus thaleichthys*	FC, SE	No	na		Likely to adversely affect; see additional analysis in narrative below
Insects						
Callippee silverspot butterfly	*Speyeria callippe*	FE	Proposed	No		No effect. Habitat not present in the action area; therefore, individuals will not be present
Delta green ground beetle	*Elaphurs viridis*	FT	Yes	No		No effect. Habitat not present in the action area; therefore, individuals will not be present
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	FT	Yes	No	Valley elderberry longhorn beetle is associated with the valley elderberry (*Sambucus*) bush during its entire life cycle; the beetles feed on *Sambucus* leaves and use the plant stems that are greater than or equal to one inch in diameter for larval development and pupation.	No effect. Habitat not present in the action area; therefore, individuals will not be present.
Crustaceans						
California freshwater shrimp	*Syncaris pacifica*	FE, SE	No	na		No effect. Habitat not present in the action area; therefore, individuals will not be present.
Vernal pool fairy shrimp	*Branchinecta lynchi*	FT	Yes	No		No effect. Habitat not present in the action area; therefore, individuals will not be present.
Vernal pool tadpole shrimp	*Lepidurus packardi*	FE	Yes	No		No effect. Habitat not present in the action area; therefore, individuals will not be present.
Plants						
Antioch Dunes evening-primrose	*Oenothera deltoides ssp. howellii*	FE	Yes	No		No effect. Habitat not present in the action area; therefore, individuals will not be present
Soft Bird's-beak	*Cordylanthus mollis ssp. mollis*	FE	No	na		No effect. Habitat not present in the action area; therefore, individuals will not be present

FT: Federal threatened
FE: Federal endangered
FC: Federal candidate
SE: State endangered
ST: State threatened

(a) Species may be present in the upland beneficial use sites. Placing dredged material at these sites may affect, and is likely to adversely affect these species, should individuals stray from protected areas into dredged material placement cells. However, the projects have already undergone ESA consultation and have biological opinions and incidental take statements. Therefore, this project does not analyze the potential impacts of placing material at the permitted upland beneficial sites.

5.1 Special Status Species and Critical Habitat in the Action Area

This section discusses the listing status, distribution, life history and biology, habitat, stressors, and status of special status species in the action area. It also discusses critical habitat in the action area, including primary constituent elements of each critical habitat in the action area. This section focuses only on USFWS-managed special status species and critical habitat that may be affected by the proposed action.

5.1.1 Delta Smelt (*Hypomesus transpacificus*) (FT) (CH) (SE)

The Delta Smelt is a euryhaline species endemic to the San Francisco Bay and Sacramento-San Joaquin River Delta. It is a small, slender fish that reaches approximately 2 to 3 inches in length (Figure 14). It is a relatively short-lived species that is nearly translucent with a blue sheen on the sides of their bodies. It is one of seven species of smelt native to California. Its range is confined to the fresh and low salinity waters of the Delta and Suisun Bay, but periods of high outflow may move fish westward into San Pablo Bay.

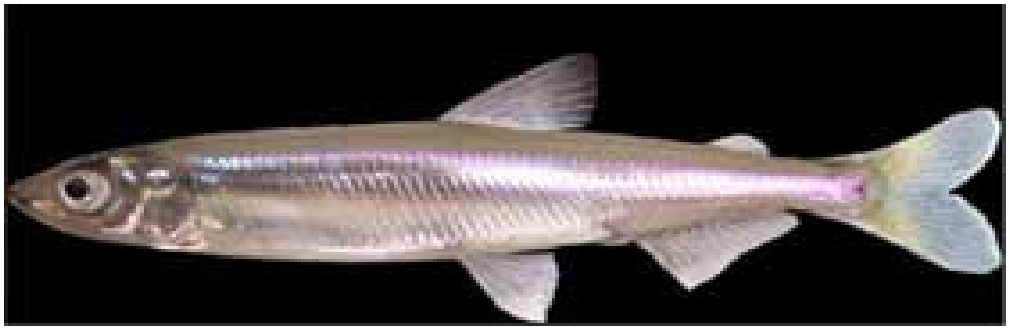

Figure 7 -Delta smelt (*Hypomesus transpacificus*)

5.1.1.1 Listing Status and Range

The USFWS listed the Delta Smelt as threatened on March 5, 1993 (58 FR 12854), and designated critical habitat for this species on December 19, 1994 (59 FR 65256). On April 7, 2010, the USFWS submitted a 12-month petition finding to reclassify the Delta Smelt as endangered. They found that reclassification is warranted, but precluded by other higher priority listing actions (75 FR 17667).

Delta smelt are endemic to the Sacramento–San Joaquin Delta and utilize areas as far upstream as Verona in the Sacramento River, and Mossdale in the San Joaquin River. They occur downstream to San Pablo Bay, in Contra Costa, Sacramento, San Joaquin, Solano, and Yolo Counties, California (73 FR 74674).

5.1.1.2 Life Cycle and Habitat Use

Delta smelt are pelagic fish that are weakly anadromous. They complete most of their 1-year life cycle in the low salinity zone (LSZ)—salinities ranging from about 0.5 to 6 parts per thousand (ppt) (Kimmerer et al. 1998; Moyle 2002), but can inhabit a range of salinities from completely fresh water to 14 ppt. They migrate to fresher water to spawn in the late winter through early spring.

Generally, Delta Smelt are found along the freshwater edge of the mixing zone (The Bay Institute 2007). Other than Delta Smelt eggs, all life stages are pelagic—found in the water column—and are not associated with the shoreline.

In early winter, between December and April, adults migrate to freshwater to spawn. It is thought that upstream migration is triggered by abrupt changes in flow and turbidity associated with the first flush of freshwater. Spawning occurs during the late winter and spring in waters with temperatures ranging from 12 to 18 °Celsius (°C); however, spawning may occur in temperatures up to 22 °C. Although not documented in the wild, it is assumed that spawning takes place in shallow sloughs and channel edge waters over sand and cobble. Females produce approximately 1,200 to 2,600 eggs. Most Delta Smelt die after spawning; however, some individuals live to spawn one more year (59 FR 65256; 75 FR 17667; 73 FR 74674).

Eggs are negatively buoyant and adhesive, sinking to the bottom and attaching to hard substrates, such as sand particles, cobble, rocks, tree roots, and submerged branches. Eggs incubate for 10 to 14 days before hatching in water temperatures ranging from 15 to 17 °C (75 FR 17667; 73 FR 74674). Generally, hatching success is low in higher temperatures.

Larvae are most abundant between April and May. Recently hatched larvae are buoyant and swim actively near the surface of the water. As larvae continue to develop, they become semi-buoyant and sink in the water column (75 FR 17667). Studies indicate that larvae exhibit reverse vertical migration, they use the upper portions of the water column during the day and randomly disperse at night (Lenny Grimaldo (ICF), et al. unpublished data) or move to deeper water (Bennett et. al. 2002 and Hobbs et al. 2006, as cited in Grimaldo et al. unpublished data). Larvae gradually move to rearing grounds downstream in the LSZ, around 0.2 practical salinity units (psu)—known as the X2. They reside in shallow, open waters ranging from 2 to 7 parts per thousand (ppt). Swim bladders began to form 60 to 70 days post-hatching and around 70 days; at this point, most Delta Smelt are no longer larvae (73 FR 74674).

Young Delta Smelt rear in the LSZ from late spring through fall (April through July), reaching adult size by early fall. They reach sexual maturity in the fall (September through October) and begin gradual upstream migration to spawning grounds in early winter.

Delta smelt are visual feeders, feeding on zooplankton and small copepods (Moyle 2002), planktonic crustaceans and, to a lesser extent, insect larvae (58 FR 12863; 73 FR 74674). The ability to find and select prey is enhanced by turbidity.

Larval Delta Smelt begin to feed 5 to 6 days post-hatch. Feeding may be triggered by turbidity, in areas with high densities of prey. Larvae are visual feeders that may feed during the day in the upper portion of the water column (Lenny Grimaldo (ICF), et al. unpublished data). Larvae generally feed on larval stages of copepods, including *Eurytemora affinis*, *Pseudodiaptomus forbesi,* and members of the Cyclopidae family (58 FR 12854). To a lesser extent, larvae also feed on the introduced copepods, *Limnithona tetraspina* and *Acartiella sinenisi* (75 FR 17667).

Juvenile Delta Smelt feed on copepods (*Pseudodiaptomus forbesi* and *E. affinis*), cladocerans, amphipods, and insect larvae. Historically, the main prey included larval stages of *E. affinis* and the mysid *Neomysis mercedis*. Adults also consume opossum shrimp *(Neomysis mercedid*), *Daphnia spp.*, and *Bosmina spp.* seasonally (58 FR 12854).

5.1.1.3 Threats

Delta smelt populations are threatened by several factors, many of which are compounding, and some that are not fully understood. Threats include entrainment in water diversions, habitat degradation, changes in abundance and composition of prey, contamination, and, to a lesser degree, predation and competition (59 FR 65256).

One of the biggest threats to Delta Smelt are the large Banks and Jones water export facilities (pumping facilities) located in the south Delta near Tracy (73 FR 74674; 75 FR 17667). The Jones facility is part of the Central Valley Project (CVP), operated by the United States Bureau of Reclamation, and the Banks facility is part of the Department of Water Resources' State Water Project (SWP). The pumping facilities convey water from the northern portion of the state to farms and municipalities in the southern parts of the state. Water exports can directly entrain Delta Smelt in the Central and South Delta by creating reverse flows—changing the flow of rivers and sloughs from towards the San Francisco Bay to the pumping facilities—and has also affected the Delta hydrology and ecology in several ways. Smelt are at higher risk when the flows in the Old and Middle Rivers become more negative (73 FR 74674).

Entrainment of adult Delta Smelt in the pumping facilities predominantly occurs during their upstream migration to spawning grounds between December and April in the central and south Delta (73 FR 74674). It appears that adults are more susceptible to entrainment during drier years or when exports are higher (73 FR 74674). Hydraulic dredging has also been shown to entrain and take Delta Smelt, albeit in much smaller numbers.

Alteration of habitat is another threat to Delta Smelt (Nobriga et al. 2008; Sommer and Mejia 2013). They utilize low salinity zone habitat from spring through early winter. Factors that alter the position of the LSZ, moving it farther east into the delta, may adversely affect Delta Smelt habitat. Water diversions in the Delta, especially at the pumping facilities, and reduced upstream water releases have reduced delta outflow significantly, which has resulted in salinity intrusion into the fresher waters of the Delta. Salinity intrusion has moved the LSZ habitat further into the Delta, which is thought to constrict habitat, concentrating Delta Smelt in a smaller area (75 FR 17667). When the LSZ is further west, especially when in Suisun Bay, juvenile and adult Delta Smelt are more widely dispersed and have access to shallow water and marsh habitat, which may have higher zooplankton productivity than when shifted east (59 FR 65256; 73 FR 74674).

Loss of and changes to Delta Smelt prey community has also stressed this species. Historically, the predominant prey of Delta Smelt included the copepod *Eurytemora affinis* and the mysid *Neomysis mercedis* (Moyle et al. 1992). These prey resources were replaced by Pseudodiaptomus forbesi and Limnoithona tetraspina, which is now the major prey of Delta Smelt (Baxter et al. 2008; Bouley and Kimmerer 2006). It is believed that these species provide inferior nutritional value to Delta Smelt, compared to the historically preferred species.

Non-native submerged aquatic vegetation may also alter habitat components required for Delta Smelt to complete their life cycle. Introduced *Egeria densa,* among other species, grows rapidly in many parts of the Delta, reduces turbidity, and could reduce spawning habitat in intertidal shoals and beaches (73 FR 74674). Additionally, Delta Smelt cannot prey as effectively on the significant constituents of the benthos that have been displaced by non-native species.

5.1.1.4 Status in the Action Area

Delta smelt juveniles and adults typically are present in the action area in April through December. Juveniles begin their downstream migration to rear in the Suisun Bay region where they mature and then slowly begin their upstream migration to spawning grounds in late fall/early winter. Over the past 15 years, the Delta Smelt population has declined rapidly and reached record low numbers in the last few years. The most recent estimated population abundance from 2017 is extremely low (USFWS 2018), despite being 200% higher than the estimated abundance for 2016 (i.e., 48,000 compared to 16,000 adults). The 2017 estimate is 92% lower than the highest recorded abundance (i.e., 600,000 adults).

Furthermore, it was announced in January 2018 that only two Delta Smelt were collected in 4 months of Fall Midwater Trawl surveys (September-December 2017), the lowest number ever recorded (Hobbs and Moyle 2018). The 2018 population estimate based the on Spring Kodiak Trawl surveys in January and February 2018 (USFWS 2018) was extremely low.

Because Delta Smelt no longer can be reliably detected using the historical survey methods above (Wilcox 2017), the Enhanced Delta Smelt Monitoring (EDSM) program recently began. Delta smelt abundance estimates from this new program varied greatly from week to week in 2017, but greatly declined in July 2017 and remained low (Hobbs and Moyle 2018). Overall, the extremely low abundance, in concert with being an annual species, makes Delta Smelt extremely vulnerable to stressors and that could lead to possible extinction (Hobbs et al. 2017).

5.1.2 Delta Smelt Critical Habitat

Delta smelt critical habitat was designated on December 19, 1994 (59 FR 65256). Critical habitat for this species includes: all submerged lands below the ordinary high water and the entire water column bounded by and including the Suisun Bay (including Grizzly and Honker Bays); Good Year, Suisun, Cutoff, First Mallard, and Montezuma Sloughs; and the water contained within the Sacramento–San Joaquin Delta in Contra Costa, Sacramento, San Joaquin, Solano, and Yolo counties, California.

PCEs essential to the conservation of Delta Smelt include physical habitat, water, river flow, and salinity concentrations that are required to maintain Delta Smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration (59 FR 65256). Potential effects of the proposed project on these PCEs are further discussed below.

PCE #1: *Physical habitat for spawning* - Adult Delta Smelt seek shallow, fresh, or slightly brackish backwater sloughs and edge-waters for spawning. These areas must have clean water and substrates that allow the attachment of eggs. Delta smelt broadcast spawn over sandy or cobble substrate; eggs are negatively buoyant and sink to the bottom where they attach to the substrate. The rest of the Delta Smelt's life cycle is spent in open pelagic waters. Areas identified as important spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore Sloughs and the Sacramento River in the Delta, and the Suisun Marsh. Clamshell dredging and in-bay placement of the dredged material would occur in the open, deepwater areas of San Pablo Bay or Suisun Bay and so would not adversely affect physical habitat for spawning. Dredged material that is used for beneficial re-use at Montezuma Wetlands could increase the physical habitat for spawning.

PCE #2: Suitable water quality for all life stages –Adult Delta Smelt migrating to spawning grounds require low-salinity freshwater habitat with sandy substrate for spawning (USFWS

2008). Eggs require water with low concentrations of constituents of concerns and temperatures ranging from 14 to 17 °C to ensure successful hatching (59 FR 65256). Newly hatched larvae require intertidal freshwater in the LSZ, approximately 5 to 20 kilometers upstream of the X2 (see PCE 4, salinity) with temperatures ranging between 10 to 20 °C to develop. As larvae grow, they move to open pelagic waters and move farther towards the X2. Larvae also require high turbidities to elicit feeding responses and adequate prey. Juveniles require open pelagic waters with temperatures less than 24 °C and a preference for waters with high turbidities (Secchi disk depths < 0.5 meters) (USFWS 2008) and adequate prey (59 FR 65256). Testing at MOTCO for Pier renovations and the Suisan Bay indicates the sediment to be dredged contains low levels of constituents of concern, and is suitable for placement in-bay or as cover sediment in beneficial reuse (USFWS 1998). Clamshell dredging is expected to increase suspended sediment in the water column in the immediate area surrounding the equipment. However, the sediment plumes caused by these activities are expected to be temporary and localized. Specifically, they are expected to dissipate over several hours and be relatively small compared to the overall size of Suisun Bay and the delta.

PCE #3: River flow – Adequate river flow, both inflow and outflow from the Delta, influence the movement of migrating adults, larvae and juveniles. It is required for elicit upstream adult spawning migration, as adults are attracted to pulses of freshwater that are cooler and more turbid (USFWS 2008). River flows also transport larvae and juveniles downstream to LSZ rearing habitats (59 FR 65256). In addition, river flow greatly influences the extent and location of X2 and the LSZ, which is the primary habitat for Delta Smelt, and the vulnerability of Delta Smelt entrainment into pumping facilities (59 FR 65256; USFWS 2008). The proposed project would not permanently divert any water out of Suisun Bay, and hence would not affect river flow. The third PCE is rearing habitat. This PCE is closely linked to the position of the X2 and the protection of shallow water estuarine habitat. Rearing habitat includes waters extending eastward from Carquinez Strait, including Suisun Bay, Grizzly Bay, Honker Bay, Montezuma Slough and its tributary sloughs, up the Sacramento River to its confluence with Three Mile Slough, and south along the San Joaquin River including Big Break. The entire action area is within the rearing habitat PCE. Rearing Delta Smelt may be affected by the proposed action.

PCE #4: Salinity for rearing – This PCE primarily is related to the position of X2 and the protection of the LSZ. Delta smelt spend most of their life cycle in the LSZ. As such, the salinity PCE for Delta Smelt is defined as the LSZ which ranges from 0.5 to 6 psu. In the San Francisco Bay and Delta region, the LSZ is often defined by the location of X2, or the distance from the Golden Gate Bridge where the 2 psu isohaline is located. As river flow increases, X2 moves downstream into Suisun Bay and the LSZ is thought to increase; conversely, the LSZ is thought to decrease as flows are reduced and X2 moves east (USFWS 2008). Due to the importance of the location of X2 for Delta Smelt, flows in the Old and Middle Rivers are managed during certain times of the year to keep X2 from moving too far inland towards the Delta.

Not only does X2 influence the amount of habitat available, it may also influence the quality of habitat available (USFWS 2008). When X2 is farther downstream in the Suisun Bay region, it is thought that the habitat quality increases because Delta Smelt have access to shallow waters and wetlands in Suisun and Grizzly bays, which could provide additional food resources. They would have to compete less for food resources, be less prone to potential predation, and be less

constricted and able to disperse farther. As previously mentioned, they also would be less prone to entrainment in pumping facilities.

5.2 Environmental Baseline

The San Francisco Bay and the Sacramento-San Joaquin River Delta cover approximately 738,000 acres with upwards of 50 islands, hundreds of miles of waterways, and over 1,000 miles of levees. Loss of aquatic habitat by development of the Delta began in the 1850s with the construction of levees and the draining of the islands for agriculture. Also during this decade, hydraulic mining in the Sacramento and San Joaquin River basins began to affect sediment transport and water circulation in the estuary. Shallow water habitat was transformed by the construction of the Sacramento Deep Water Ship Channel and the San Francisco Bay to Stockton Ship Channels. Extensive pumping for agriculture, and the construction and operation of the SWP and CVP exporting water from the Delta, has altered flows and made Delta smelt subject to entrainment by these facilities.

Introduced species, in particular the Asian clam (Corbula amurensis), is believed to have affected the prey base of the Delta smelt by consuming phytoplankton and the smaller life stages of the smelt's preferred food, the copepod Eurytemora affinis. Three introduced copepods, Sinocalanus doerrii, Pseudodiaptomus forbesi, and P. marinus, appear to compete with E. affinis and offer a less desirable food option for the smelt. Industrial and agricultural chemicals found in the waterways have been shown to be toxic to several species of fish found in the Delta, but the effects of these substances on Delta smelt are not well understood. The introduced Japanese smelt (wagasaki) (Hypomesus nipponensis) may displace the Delta smelt or adversely affect its genotype by hybridization.

Summer Townet Survey

The Summer Townet Survey (TNS) was originally intended to provide fishery managers with an abundance index for young striped bass (Morone saxatilis). The first survey was in 1959, and over the years has provided abundance data on other fish species in the approximate 40 millimeter (mm) size range. The 1995 Biological Opinion for the SWP and the CVP mandated this survey for the Delta smelt.

The TNS (six 4-day episodes) takes place in northeastern San Pablo Bay and the Delta. Sampling begins in mid-June and continues every other week until mid-August. Sampling Stations 501 and 504 are located directly north of MOTCO, near Roe Island and east of Pier 4 respectively. In 2016, the catch per unit effort at 501 and 504 was 0 (similar results from 2014-2015). The 2018 TNS catch per unit effort was 0.0 (2016). In general, Delta smelt do not appear in proximity to the MOTCO dredging areas. The TNS data indicate that aside from Grizzly Bay, the lower Sacramento River, and the Deepwater Ship Channel, the distribution of Delta smelt is highly variable, as is the risk of entrainment.

Spring Kodiak Trawl Survey

The Spring Kodiak Trawl Survey (SKT) was started in 2002. The SKT determines the relative abundance and distribution of spawning Delta smelt. The survey results are used by State and Federal resource agencies to assess the risk of entrainment for smelt by the CVP and SWP. Five surveys per year are conducted from January to May. For Delta smelt, the results are reported by spawning condition and gender. In 2016, 286 smelt were captured (males 4.5%, females 7%,

indeterminate 88.5%). One Delta smelt (indeterminate) was sampled at Station 504 (survey #12). The 2018 SKT index was 2.1.

5.3 Potential Effects of the Proposed Action on ESA-Protected Resources

The proposed action has the potential to cause adverse effects to Delta Smelt through crushing or hitting individuals with dredge equipment, entrainment in dredging equipment, exposure to increased hydroacoustic noise, increased turbidity and suspended sediment, exposure to constituents of concern, changes to physical habitat, and salinity intrusion (i.e., movement of the LSZ and X2 farther upstream). Most effects would be short-lived (i.e., occur during or shortly after actively dredging) and similar to those that occur during maintenance dredging. The project proposes to reduce the potential for adverse effects associated with actively dredging by working within the Delta Smelt work windows, utilizing a clamshell dredge, and otherwise following the best management practices specified by the LTMS.

5.3.1 Direct Contact with Dredging Equipment and Entrainment

Delta smelt have the potential to be directly injured by dredging equipment. The most likely cause of injury would be from the clamshell bucket falling through the water column until reaching the substrate. However, as mechanical equipment travels through the water column, it generates a pressure wave around it which would likely force small fish away from the falling bucket. General disturbance from barges, dredging crew and tugs is expected to disturb any delta smelt in the surrounding area and likely cause the fish to exhibit a startle response, followed by escapement from the area.

Very limited data exist regarding potential entrainment effects of clamshell dredging on small fish such as delta smelt (see USACE DOER 1998). The entrainment of aquatic organisms may be possible with a mechanical clamshell dredge. As the bucket of a mechanical clamshell dredge collects material from the bottom, aquatic organisms can be physically collected within the water and sediment material. However, mechanical clamshell dredging is considered to have a very low risk of fish entrainment, and for large fish typically the lowest of all dredge types (Reine and Clarke 1998). As mentioned previously, general disturbance from barges, dredging crew and tugs is expected to cause any delta smelt in the surrounding area to leave. It is expected that direct contact with dredge equipment or entrainment would be minimal because delta smelt would likely avoid dredging activities.

5.3.2 Noise

The scientific knowledge of the effects of dredge generated noise and sound waves on fishes is limited and varies depending on the species. Severe noise effects on fish can include rupture of the swim bladder, internal hemorrhage, neurological stress, and auditory damage. Studies on the effects of noise on anadromous Pacific coast fishes are primarily related to pile driving activities. The Fisheries Hydroacoustic Working Group has established interim criteria for noise impacts from pile driving on fishes (FHWG 2008). A peak sound pressure level of 206 dB is considered injurious to fishes. An accumulated sound pressure level of 187 dB for fishes that are more than 2 grams, and 183 dB for fishes below that weight are considered to cause injury. Although there is no formal agreement on a “behavioral” threshold, the NMFS uses 150 dB-root mean square as the threshold for adverse behavioral effects (NMFS 2009).

The impact of sound on fish and other species also depends on the ambient sound levels. The Suisun Bay Channel has a high level of deep draft and shallow draft vessel traffic. These vessels

access ports and harbors along the Carquinez Strait and Contra Costa County waterfront, and continue to the Delta. At certain times, locations, and distances from the dredge plant, dredging activities may not be perceptible relative to the ambient noise conditions.

Clamshell dredges produce a repetitive sequence of sounds generated by winches, bucket impact with the substrate, closing and opening of the bucket, and sounds associated with dumping the dredged material into a scow. The sounds are repeated with each bucket load and are stopped when dredging ceases. The most intense sounds are produced during the bucket's impact with the substrate; however, depending on the substrate being dredged, the sound intensity differs. Typically, softer material generates softer sounds and harder, more compact substrate generates louder sounds. Peak sound pressures levels measured during mechanical dredging have been recorded at 124 decibels (dB) from 490 feet (150 meters) away (Dickerson et al. 2001). Noise generated from clamshell dredging is typically lower than sounds levels that adversely affect marine species, and is expected to be below specified threshold levels. However, noise from the bucket hitting the bottom or from the dredge plant could elicit avoidance behavior by delta smelt.

5.3.3 Increased Suspended Sediment

There would be a localized increase in suspended sediment during dredging. This would be minimal and short lived because much of the sediment has a high sand content (USACE 2017) and sand falls quickly through the water column and settles on the bottom of the bay. The range of temporary turbidity increases is expected to be within a 200 foot radius from dredging operations and disposal area, and is expected to last less than 20 minutes (USACE 1976; USACE et al. 1998; Anchor 2003). The behavioral avoidance response of Delta Smelt is expected to substantially reduce or eliminate the risk of exposure the farther they are from the plume source. Additionally, dredging activities are generally centered within the navigation channel, outside of the intertidal areas associated with the Delta Smelt's shallow water habitat minimizing the potential for adverse effects.

5.3.4 Habitat Loss

The total acreage of smelt habitat that would be affected in any year is would be less than the 38 acre project area. However, beneficial reuse of dredged sediment is expected to result in the creation or restoration of 9.8 acres of tidal wetland habitat that would benefit smelt.

5.4 San Francisco Bay-Delta Climate Change

The effects of climate change do not act in isolation; they are anticipated to exacerbate existing threats to delta smelt. We considered the potential effects of climate change on the Delta Smelt based on projections derived from various modeling scenarios. A series of publications (Feyrer et al. 2011; Cloern et al. 2011; Brown et al. 2013) have modeled future impacts of climate change in the delta and projected how this would affect Delta Smelt. These models used the B1 and A2 scenarios from the 2007 IPCC report. Each scenario included both a warmer-wetter and warmer-dryer sub scenario. Modeled predictions presented in these publications are based on current baseline conditions (no increased outflow, no breeching of levees) which may or may not change in the future. Temperature increases are likely to lead to a continued rise in sea level, further increasing salinity which would increasingly restrict Delta Smelt's already limited geographic range (Feyrer et al. 2011; Cloern et al. 2011; Brown *et al.* 2013). Higher air temperatures would reduce snowpacks, melt snow earlier in the winter or spring, and increase water temperatures.

These changes would likely alter freshwater flows, possibly shifting and condensing the timing and location of Delta Smelt reproduction (Brown et al. 2013).

Projections indicate that temperature and precipitation changes would diminish snowpack, changing the availability of natural water supplies (Reclamation 2011). Warming may result in more precipitation falling as rain and less storage as snow. This would result in increased rain on snow events and increase winter runoff with an associated decrease in runoff for the remainder of the year (USBR 2011). Sacramento Valley Ecoregion projections include a 27 percent decrease in annual freshwater flows and earlier snowmelts, with increased freshwater flows in January and February but reduced throughout the rest of the year (PRBO Conservation Science 2011). Earlier seasonal warming increases the likelihood of rain-on-snow events, which are associated with mid-winter floods. Smaller snowpacks that melt earlier in the year may result in increased drought frequency and severity (Rieman and Isaak 2010). Thus overall, these changes may lead to increased frequency of flood and drought cycles during the 21st century (USBR 2011).

Sea level rise is likely to increase the frequency and range of saltwater intrusion. Salinity within the northern San Francisco Bay is projected to rise by 4.5 m by the end of the century (Cloern et al. 2011). Elevated salinity levels could push the position of X2 farther up the estuary if outflows were not increased to compensate for it. Fall X2 mean values are projected to increase by a mean of about 7 km to the area of Antioch for a distance of approx. 90 km from the golden gate bridge by 2100 (Brown et al. 2013). This increase in the position of X2 in the fall is expected to result in a decrease in suitable physical habitat (Brown et al. 2013) if current levees and channel structures are maintained. A decrease in spring habitat due to the movement of X2 upstream due to sea level rise is also expected to result from climate change.

We expect warmer estuary temperatures to be yet another significant conservation challenge based on climate change models. Mean annual water temperatures within the upper Sacramento River portion of the Bay-Delta estuary are expected to approach or exceed 14 °C during the second half of this century (Cloern et al. 2011). Warmer water temperatures could reduce Delta Smelt growth, increase Delta Smelt mortality and constrict suitable habitat within the estuary during the summer months. Due to warming temperatures, Delta Smelt are projected to spawn an average of 25 days earlier in the season depending on the location (Brown et al. 2013). Also due to expected temperature increases, total number of high mortality days is expected to increase for all IPCC climate change scenarios (Brown et al. 2013). The number of stress days is expected to be stable or decrease partly because many stress days would become high mortality days. This could lead to Delta Smelt being forced to grow under highly stressful conditions during summer and fall with less time to mature because of advanced spawning (Brown et al. 2013). Growth rates have been shown to slow as water temperatures increase therefore requiring Delta Smelt to consume more food to reach growth rates that are normal at lower water temperatures (Rose et al. 2013a). Delta smelt are already often smaller than they used to be (Sweetnam 1999; Bennett 2005) and expected temperature increases due to climate change would likely further slow growth rates.

At the same time, warmer water would tend to move the spawning season earlier in the year (Brown et al. 2013). That means the fish would have to grow faster still to compensate for that shorter growing season to produce even as many eggs as they do now - and that may already be a serious limitation on their population fecundity (Rose et al. 2013b). Higher temperatures may restrict Delta Smelt distribution into the fall, limiting their presence in Suisun Bay for more than

just salinity reasons and force greater inhabitation of cooler high salinity waters (Brown et al. 2013). Water temperatures are already presently above 20°C for most of the summer in core habitat areas, sometimes even exceeding 25 °C for short periods. The Delta Smelt is currently at the southern limit of the inland distribution of the family *Osmeridae* along the eastern Pacific coast. That indicates that this region is already about as warm as that fish family can handle. Increased temperatures associated with climate change may result in a habitat in the Bay-Delta that is outside of the species ecological tolerance limits.

5.5 Cumulative Effects

Cumulative effects include the effects of future state, Tribal, local, or private actions that are reasonably certain to occur in the area considered in this biological opinion. Future federal actions that are unrelated to the proposed action are not considered in this section, because they require separate consultation pursuant to section 7 of the Act. Adverse effects to delta smelt may result from point and non-point source chemical contaminant discharges within the action area. These contaminants include, but are not limited to ammonia and free ammonium ion, numerous pesticides and herbicides from agricultural activities, and oil and gasoline product discharges into Delta waterways from shipping and boating activities and from urban activities and runoff. Implicated as potential stressors of smelt, these contaminants may adversely affect fish reproductive success and survival rates.

Maintenance dredging that removes an annual average of 6M cy of sediment from shipping channels regularly occurs in San Francisco, San Pablo, and Suisun bays under the auspices of the LTMS (USACE et al. 1998). Disposal sites include in-bay at federal standard placement sites, offshore at SF-DODS, or at beneficial reuse locations typically for wetland restoration. The LTMS includes several avoidance and minimization measures to protect ESA-listed species, such as work windows.

This BA incorporates by reference information on the Long-Term Mangement Strategy (LTMS) contained in the *2015 Maintenance Dredging of the Federal Navigation Channels in the San Francisco Bay Final EA-Finding of No Significant Impact (FONSI) and Environmental Impact Report (EIR)* prepared jointly by USACE and the Regional Water Quality Control Board (RWQCB) (referred to as 2015 Federal Navigation Channels EA/EIR) (USACE 2015). This document analyzed the environmental impacts associated with Programmatic maintenance dredging of Federal navigation projects in San Francisco Bay-Delta.

Potential to dredge the MOTCO project area concurrent with the Suisun Bay Channel dredging would result in a blended dredge material for disposal. In 2014, physical analyses on sediment samples from the three Suisun Bay Channel and New York Slough composite areas confirmed that the anticipated dredge materials are predominantly sand (86 percent) with very low amounts of total organic carbon (TOC) ranging from 0.21 to 0.52 percent (USFWS 2017).

Other future, non-federal actions within the action area that are likely to occur and may adversely affect delta smelt include: the dumping of domestic and industrial garbage that decreases water quality; oil and gas development and production that may affect aquatic habitat and may introduce pollutants into the water; agricultural activities, including burning or removal of vegetation on levees that reduce riparian and wetland habitats that contribute to the quality of habitat used by Delta Smelt; and livestock grazing activities that may degrade or reduce riparian and wetland habitats that contribute to the quantity and quality of habitat used by Delta Smelt.

5.6 Conclusions and Determination of Effects

As discussed above, the proposed action may affect Delta Smelt through direct contact with dredge equipment and entrainment, and through interactions with increased suspended sediment and noise. Use of best management practices, however, would reduce the potential for entrainment or other direct contact with equipment. Noise would be produced; but, it would be similar to ambient noises in the busy navigation channels. Suspended sediment could temporarily affect delta smelt; but this is unlikely because the sediment is composed of sand and sand quickly settles to the bay bottom, rather than remaining suspended in the water column. Further, dredging during the work window would reduce these impacts by simply reducing the likelihood that smelt would encounter adverse conditions caused by the project, and because the work windows are protective of the most sensitive life stages of delta smelt.

Beneficial reuse of dredged sediment would result in the creation or restoration of 9.8 acres of tidal wetland habitat that may be used by smelt. Based on the analysis provided, the project may affect, but is not likely to adversely affect Delta Smelt, and may affect, but not likely to adversely affect or modify critical habitat.

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