UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404

FEB 2 2016

Refer to NMFS No: WCR-2015-3520

Leslie T. Rogers
Regional Administrator
Federal Transit Administration
201 Mission Street
San Francisco, California 94105-1839

Re: Endangered Species Act Section 7(a)(2) Biological Opinion for the San Francisco Bay Area Water Emergency Transportation Authority's (WETA) Central Bay Operations and Maintenance Facility Project, Reinitiation of Consultation

Dear Mr. Rogers:

Thank you for your letter of September 3, 2015, requesting reinitiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq.*), for the Water Emergency Transportation Authority's (WETA) proposed Central Bay Operations and Maintenance Facility Project in the City of Alameda, California. The Federal Transit Administration (FTA) proposes to provide financial assistance for construction of this project. FTA is requesting reinitiation of consultation to address several proposed changes to the project. Since the completion of the October 31, 2012, biological opinion issued by NMFS (NMFS Tracking No. 2011/05520), WETA has modified the proposed project to include use of larger diameter piles, reduced the total number of supporting piles, expanded the facility's area of overwater structure, and added the construction of a harbor seal haul-out facility. The enclosed biological opinion replaces the original biological opinion of October 31, 2012.

The enclosed biological opinion is based on our review of the proposed project, including the proposed project modifications, and describes NMFS's analysis of potential effects on threatened southern distinct population segment (DPS) of North American green sturgeon (*Acipenser medirostris*), threatened Central California Coast (CCC) steelhead (*Oncorhynchus mykiss*), and designated critical habitat in accordance with section 7 of the ESA.

In the enclosed biological opinion, NMFS concludes that the project is not likely to jeopardize the continued existence of southern Distinct Population Segment (DPS) of North American green sturgeon, nor is the project likely to result in the destruction or adverse modification of critical habitat for southern DPS green sturgeon. However, NMFS anticipates take of southern DPS

green sturgeon in the form of injury or death caused by impact hammer pile driving. An incidental take statement with non-discretionary terms and conditions is included with the enclosed biological opinion. NMFS has also found that the proposed project is not likely to adversely affect threatened Central California Coast (CCC) steelhead or its critical habitat. Regarding Essential Fish Habitat (EFH) consultation under the Magnuson-Stevens Fishery Conservation and Management Act, the project changes did not warrant a reinitiation of the original EFH consultation. Therefore, the original EFH consultation from October 31, 2012 is still valid as are the associated EFH Conservation Recommendations (NMFS Tracking No. SWR-2011-5520).

Please direct questions regarding this letter to Autumn Cleave, North-Central Coast Office in Santa Rosa, California at (707) 575-6056, or via e-mail at autumn.cleave@noaa.gov.

Sincerely,

for

William W. Stelle, Jr.
Regional Administrator

Enclosure

cc: Alex Smith, FTA, San Francisco, California
Mike Gougherty, WETA, San Francisco California
Copy to ARN File #151422SWR2011SR00553
Copy to Chron File

Endangered Species Act Section (ESA) 7(a)(2) Biological Opinion

Water Emergency Transportation Authority's Central Bay Operations and Maintenance Facility Project

NMFS Consultation Number: WCR-2015-3520
Action Agency: Federal Transit Administration

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species or Critical Habitat?*	Is Action Likely To Jeopardize the Species?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Central California Coast steelhead (*Oncorhynchus mykiss*)	Threatened	*No	N/A	N/A
North American Green Sturgeon (*Acipenser medirostris*)	Threatened	Yes	No	No

*Please refer to section 2.10 for the analysis of species or critical habitat that are not likely to be adversely affected.

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By: [signature] for

William W. Stelle, Jr.
Regional Administrator

Date: FEB 2 2016

TABLE OF CONTENTS

LIST OF ACRONYMS

BA	Biological Assessment
BOR	Bureau of Reclamation
CCC	Central California Coast
CDFW	California Department of Fish and Wildlife
cSEL	cumulative sound exposure level
dB	decibel
DMMO	Dredge Material and Management Office
DPS	distinct population segment
DQA	Data Quality Act
DWR	Department of Water Resources
ESA	Endangered Species Act
FHWG	Fisheries Hydroacoustic Working Group
ft	foot
FTA	Federal Transit Administration
GCID	Glenn Colusa Irrigation District
ITS	incidental take statement
MHHW	mean higher high water
MLLW	mean lower low water
m	meter
NMFS	National Marine Fisheries Service
OWS	overwater structure
PAHs	polycyclic aromatic hydrocarbons
PCE	primary constituent element
PSU	practical salinity unit
RBDD	Red Bluff Diversion Dam
RMS	root mean squared
SAR	sediment analysis report
SEL	sound exposure level
SF-DODS	San Francisco Deep Ocean Disposal Site
SPL	sound pressure levels
sq ft	square feet
TL	total length
TSS	total suspended sediment
TTS	temporary threshold shift
WETA	Water Emergency Transportation Authority

1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into section 2 below.

1.1 Background

NOAA's National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 *et seq.*), and implementing regulations at 50 CFR 402. This biological opinion replaces the original biological opinion written October 31 of 2012 (File No. SWR-2011-5520).

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available through NMFS' Public Consultation Tracking System (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts). A complete record of this consultation is on file at the NMFS North-Central Coast Office in Santa Rosa, California.

1.2 Consultation History

Formal consultation with the Federal Transit Administration (FTA) for the Water Emergency Transportation Authority's (WETA) Central Bay Operations and Maintenance Facility Project (Project) was concluded with NMFS issuance of a biological opinion, dated October 31, 2012, in which NMFS concluded that the proposed Project was not likely to jeopardize the continued existence of the Distinct Population Segment (DPS) of threatened Central California Coast (CCC) steelhead (*Oncorhynchus mykiss*) and the southern DPS of North American green sturgeon (*Acipenser medirostris)*, or adversely modify designated critical habitat. However, NMFS anticipated potential injury or mortality of green sturgeon as a result of Project construction and an incidental take statement with non-discretionary terms and conditions was included with the biological opinion.

In a letter dated July 15, 2015, to NMFS, FTA's consultant, Anchor OEA, provided information on several proposed modifications to the Project. By letter dated September 3, 2015, FTA requested reinitiation of formal consultation with NMFS to address the proposed use of larger diameter piles, reduce the total number of supporting piles, and expand the facility's area of overwater structure. Emails were exchanged between NMFS, FTA and WETA from August through November of 2015. On November 25, 2015, WETA provided information regarding the proposed removal of an existing derelict pier used by harbor seals and the construction of a new platform for the haul-out of seals.

1.3 Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). The FTA proposes to provide financial assistance to WETA for construction of the Central Bay Operations and Maintenance Facility at Alameda Point in Alameda, California. The Operations and Maintenance Facility will serve as the Central San Francisco Bay base for WETA's ferry fleet and will also include the Operations Control Center and Emergency Operations Center. The project site is located within the Alameda Naval Air Station Base Realignment and Closure area (now referred to as Alameda Point) in the City of Alameda, Alameda County, California (Figure 1). WETA is the lead planning agency and local public agency for the Project. Construction is scheduled to being in 2016 or 2017. All in-water construction and dredging will be limited to the period between June 15 and November 30.

The project changes proposed by FTA include 24 42-inch diameter steel piles now proposed for installation instead of the 30-inch diameter steel piles as described in the October of 2012 biological opinion. The total number of piles to be installed will decrease from 80 to 54. The original project description had a net reduction in overwater coverage of 4,005 square feet (ft^2). The proposed project modifications will have a net reduction in overwater coverage of 1,620 ft^2. The proposed facility will be located southeast of the intersection of West Hornet Avenue and Ferry Point Road near Pier 3 along the Alameda waterfront in Central San Francisco Bay. The new facility will occupy approximately 0.36 acres of landside space and one acre of waterside space in San Francisco Bay (the Bay). It will provide berthing space for boats, maintenance services (such as fueling, engine oil changes, spare parts storage, and concession supply), and light repair facilities for WETA's Central San Francisco Bay ferry fleet. As WETA's Operations Control Center, the facility will also provide a centralized location for day-to-day management and oversight of services and crews.

"Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02). There are no interdependent or interrelated actions associated with the proposed action.

Landside Project Elements and Construction Activities

The proposed landside portion of the Project includes a four-story, approximately 25,000 square foot building. The building will provide maintenance functions and storage for vessel spare parts and as office and meeting space for WETA staff, crew facilities, and concession support. Landside facilities will also include four below grade vaults for diesel fuel. Each tank will be able to store up to 12,000 gallons. The fuel tanks will be National Fire Protection Association-approved and installed in buried concrete. For safety the vaults will be equipped with vapor and liquid detection systems as well as a fire suppression system. Systems will be provided to recover liquid from the vaults.

Stormwater runoff from the site will be collected with a new system of onsite catch basins and pipes. Site runoff will be treated by oil-water separators and treatment vaults prior to connecting to an existing 12-inch storm drain.

Landside construction activities consist of site preparation, demolition, ground improvement, building construction, and utility installation. Construction equipment will include backhoes, excavators, haul trucks, track-mounted drilling rigs, wheeled hydraulic crane, and delivery and support trucks.

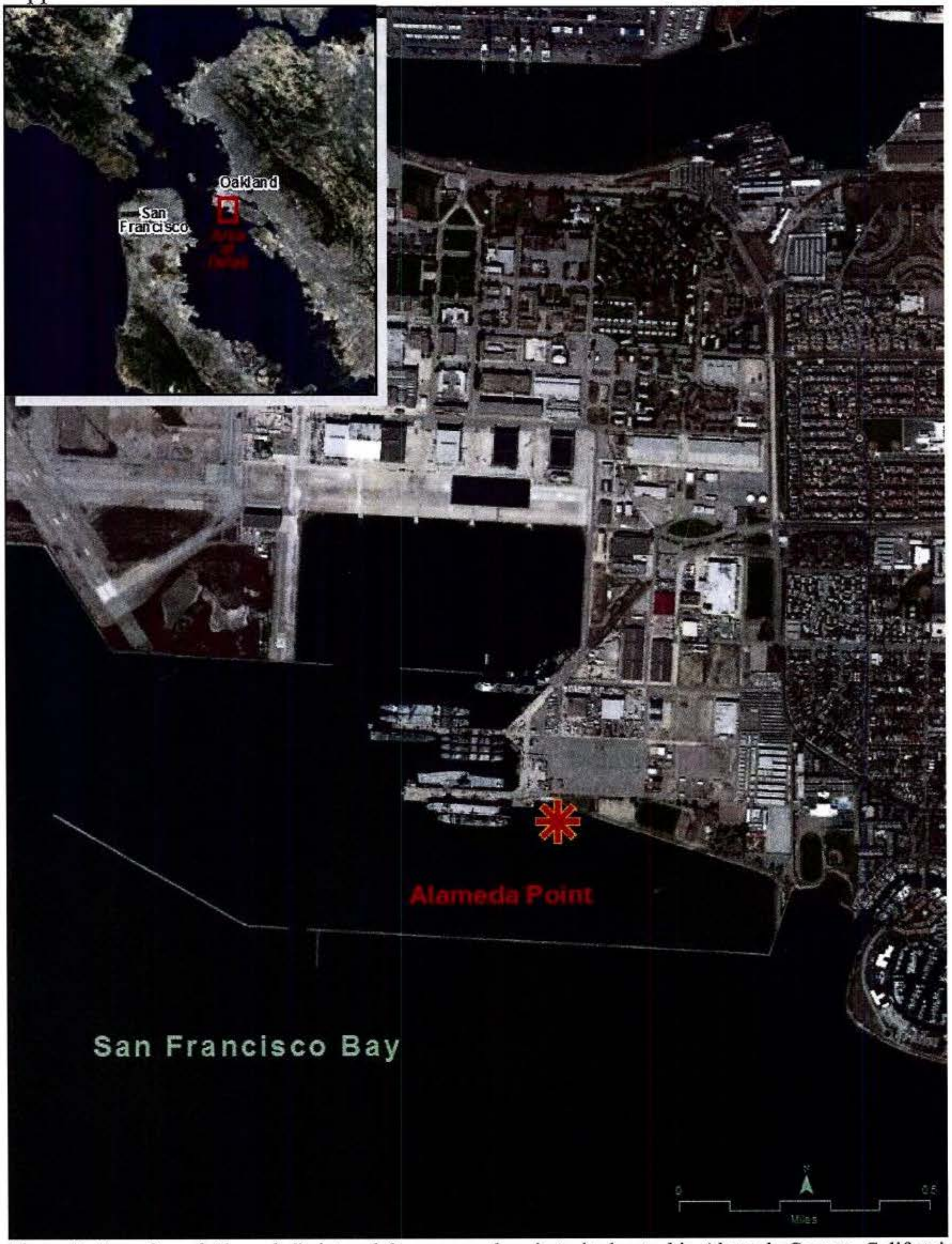

Figure 1. Location of Alameda Point and the proposed project site located in Alameda County, California.

Waterside Project Elements and Construction Activities

The waterside facilities consist of berthing slips for up to 11 passenger ferries, associated gangway structures, and a replacement harbor seal haul-out dock. The berthing slips will

provide mooring for the safe docking and holding of vessels. Berthing slips will be supplied by fresh water, sanitary sewer, electricity, diesel fuel, waste pump-out and fire suppression. Although no regular passenger loading and off-loading is anticipated at this site, berths would be capable of loading and unloading passengers in the event of an emergency. An on-shore davit[1] will be constructed for the transfer of equipment between shore and water, movement of spill response equipment, and transfer of small boats to the water in the event of an emergency. An existing deteriorated seawall will be replaced with a new concrete secant-pile seawall.
Prior to construction of the berthing facility, the remaining portions of a small recreational marina will be removed. In the mid-1950's the Navy constructed a small-boat floating marina on this site for use by residents at the former Alameda Naval Air Station. Following the closure of the Navy base, the marina's building was demolished. The Project will remove all remaining portions of the floating marina, which is 20,200 sq ft of overwater structure (OWS), and 35 existing concrete piles.

Demolition of the remnant recreational marina and construction of the new marine facilities will be performed with support and material barges, work boats, a barge-mounted pile driver, a wheeled crane, a support boat, and an occasional tug. Both an impact hammer and vibratory hammer will be used to remove existing piles and install new piles.

A deteriorating dock that is currently being used as a harbor seal haul-out will be removed and replaced. The new dock will be made of wood, plastic or concrete. Before the new haul-out dock is secured with four permanent 12-inch diameter concrete or wood piles, the dock will be temporarily deployed with boat anchors near the existing wooden haul-out dock. The new dock will then be moved incrementally to its final location at least 250 meters east from the existing dock and 100 meters from shore. After the new haul-out dock is secured the existing wooden dock will be removed. Deployment of the new dock will occur in January of 2016. The four 12-inch wood or concrete piles will be installed and the existing dock will be removed between August 1 and November 30 of 2016. Either an impact hammer or vibratory hammer will be used to install the new piles. There will be no increase in overwater coverage in the action area because the new haul-out dock will match the size of the existing deteriorated dock.

Berthing Floats and Gangways

The berthing facility will include a system of ramps and platforms for access between the gangway and vessel doors, and for access to the floating dock for line handling and servicing of vessels. The berthing floats will consist of compartmented concrete pontoons approximately 135 feet by 12 feet in dimension. Berths will be equipped with fenders and mooring fittings for safe docking and holding of vessels. Gangways will be aluminum structures approximately 90 feet long by 8 feet wide. Walking surfaces will be grated for light penetration.

A gangway landing approximately 20 feet by 40 feet will be constructed with concrete and located mid-length along the new seawall (see seawall description below). The landing will provide support for the gangway to the berthing floats and also contain a small storage area. Four 24-inch diameter steel piles will be installed by impact hammer to support the gangway landing. To construct the gangway landing water-tight forms will be installed on the piles and

[1] A davit is a crane-like device used to suspend or lower equipment.

casting of the concrete landing will be performed in isolation from the waters of San Francisco Bay.

The new construction will be comprised of a total of 18,600 sq ft. of OWS. This will have a net reduction in OWS of 1,620 sq ft.

Pile Driving

Up to 50 new steel piles will be installed for construction of the gangway landing, berthing floats, and gangways. Steel piles will be installed by an impact hammer and a vibratory hammer will be used when feasible. A protective coating comprised of an inert material that does not leach into the aquatic environment may be added to the steel piles. An additional, four 12-inch diameter concrete or wood piles will be installed for the replacement of the harbor seal haul-out dock. If wooden piles are used for the seal haul-out dock, they will not be creosote-treated. Either an impact hammer or vibratory hammer will be used to install the four 12-inch diameter piles. Table 1 presents a summary of the piles anticipated to be installed for the marine facilities (the installation method may include use of a vibratory hammer). Pile driving will occur between June 15 and November 30. Pile driving will occur up to 3 hours per day for up to 12 days.

Table 1. Summary of piles that will be installed.

Pile Diameter (inches)	Pile Type	Number of Piles	Installation Method	Attenuation Device
24	Steel	18	Impact hammer	Bubble curtain
42	Steel	24	Impact hammer	Bubble curtain
36	Steel	8	Impact hammer	Bubble curtain
12	Wood or concrete	4	Impact hammer or vibratory hammer	None

Seawall

An existing 160-foot long concrete seawall along the shoreline of the site delineates the landside portion of the site from the waterside portion. The existing seawall is approximately 8 feet high, tilted and cracked. The toe of the wall is located 1 to 2 feet above mean higher high water (MHHW). Rip rap and broken concrete span the area between the seawall and the waters of San Francisco Bay. Removal of the existing seawall will be performed with a land-based backhoe and pneumatic hammer. Removal is expected to occur over 2 to 5 days and generate approximately 60-90 cubic yards of rubble. All concrete rubble will be hauled off-site for processing as recycled aggregate material. A combination of temporary catchments and the precise demolition methods will be used to prevent debris from falling in the water.

The seawall will be replaced with a new concrete secant-pile wall. The new seawall will also be built above MHHW along 230 feet of shoreline and to a height of 8.5 feet. The new seawall will overlap with the footprint of the existing seawall and extend an additional 70 feet to the east. The contractor will use temporary catchments to prevent debris from falling in the water and prevent uncured concrete from contacting the waters of San Francisco Bay.

Dredging

Dredging is required to achieve the navigable parameters of the vessels and berths at the project site. The Project proposes to dredge the berthing area to a depth of 12 feet mean lower low water (MLLW) and an additional 2 feet of depth will be removed for an over-depth allowance. Dredging is anticipated to remove approximately 47,100 cubic yards of material (26,700 cubic yards to -12 feet and an additional 20,400 cubic feet for the -2 feet of over-depth allowance) from a 5.5 acre area. Dredging will occur over a 90-day period with a 10-cubic yard bucket clamshell dredge and a scow barge. The Dredged Material Management Office (DMMO) has reviewed the results of sediment tests from the Project's proposed dredge site and determined materials are suitable for disposal at the San Francisco Deep Ocean Disposal Site (SF-DODS) or placement as wetland cover at a wetland beneficial re-use site.

WETA reports sedimentation rates in the area are low and there is insufficient data to predict future dredging needs. Therefore, future maintenance dredging needs are unknown at this time. Best estimates by WETA predict future maintenance dredging could occur at a frequency of once every 5 to 10 years, and approximately 1 foot of sediment would be removed over the entire 13.5-acre vessel operating area (approximately 22,000 cubic yards of material). Future dredging would be performed with a clamshell dredge working 10-12 hours per day. Dredging will be restricted to the period between July 31 and November 30. Dredged materials from future dredging operations will be disposed at SF-DODS or a wetland beneficial re-use site.

Operations and Maintenance

The vessel types held at the facility will include small crew boats and ferry vessels. The facility would typically operate from 5 a.m. to 11 p.m. every day. On any given day up to 58 employees will be on the premises. Employees will include maintenance crew, supervisor, WETA manager, concessionaire, Operations Control Center staff, Emergency Operations Center staff, and ferry crewmembers.

Upwards of 11 ferries will transit the berthing facility four times each day (departure in the morning, arrival mid-day, departure mid-day, and arrival at the end of day). This is the maximum number of ferries and transits because not all ferries would make the mid-day return.

Avoidance and Minimization Measures

(1) All in-water construction and dredging will be limited to the period between June 15 and November 30.

(2) A Stormwater Pollution Prevention Plan (SWPPP) will be prepared and include best management practices to address the potential discharge of pollutants and ensure the proper handling of materials.

(2) A Spill Prevention, Control and Countermeasures (SPCC) Plan will be prepared and specify restrictions and procedures for fuel storage location, fueling activities, and equipment maintenance.

(4) Monitoring of turbidity will be performed during dredging at a distance of approximately 500 feet. If turbidity levels exceed San Francisco Bay Basin Plan Standards then operational controls or silt curtains may be used.

(5) A 500-foot access corridor has been established to protect wildlife along the shoreline at the adjacent Alameda National Wildlife Refuge. All construction, maintenance, and ferry vessels will utilize this access corridor and adhere to a maximum 5 mile per hour speed limit.

(6) All piles will be steel and driving will be done with an impact hammer and a bubble curtain will be used to attenuate sound levels. Underwater sound levels will be monitored and results will be used real-time to maximize the effectiveness of the bubble curtain. A hydroacoustic monitoring plan will be prepared and submitted to NMFS for review and approval prior to the initiation of construction.

(7) Following the completion of dredging, WETA will conduct "z-layer" sediment sampling to assess conditions on the newly exposed Bay bottom. If sediments contain bioaccumulative contaminants above certain thresholds, like that specified in the Project's biological assessment (BA), further actions will be pursued to prevent exposure to aquatic organisms.

1.4 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The proposed project's action area is located in Central San Francisco Bay, Alameda County, California. The action area extends from the open waters of Central San Francisco Bay to upland habitats. The landside portion of the action area consists of approximately 15,500 square feet (0.36 acre) area within the former Alameda Naval Air Station. The waterside portion of the action area consists of approximately one acre of waterside space in Central San Francisco Bay where the new facility will be constructed, a 13.5-acre nearshore area to be dredged, and the 6.5-square nautical mile disposal site that is approximately 50 miles offshore from the City of San Francisco in the Pacific Ocean. The San Francisco Bay portion of the action area includes areas that will be affected by noise and turbidity during construction, dredging, and future operations. The area in San Francisco Bay that will be subjected to sound levels that could result in the injury or mortality of listed fish (*i.e.,* in excess of 206 decibel (dB) peak sound pressure level for any single strike and/or accumulated sound exposure level of 187 dB referenced to one micropascal) is a radial distance of 900 feet, or an area of 109 acres.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, Federal agencies must ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides an opinion stating how the agency's actions would affect listed species and their critical habitat. If incidental take is expected, section 7(b)(4) requires NMFS to provide an incidental take statement (ITS) that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures and terms and conditions to minimize such impacts.

2.1 Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of a listed species," which is "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

The adverse modification analysis considers the impacts of the Federal action on the conservation value of designated critical habitat. This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.[2]

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Identify the rangewide status of the species and critical habitat likely to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.
- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors to assess the risk that the proposed action poses to species and critical habitat.
- Reach jeopardy and adverse modification conclusions.

[2] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

- If necessary, define a reasonable and prudent alternative to the proposed action.

For critical habitat, NMFS determines the range-wide status of critical habitat by examining the condition of its physical or biological features (also called "primary constituent elements" or PCEs) - which were identified when critical habitat was designated. Species and critical habitat status are discussed in section 2.2 of this biological opinion.

To conduct the assessment, NMFS examined an extensive amount of information from a variety of sources. Detailed background information on the biology and status of critical habitat has been published in a number of documents including peer reviewed scientific journals, primary reference materials, and governmental and non-governmental reports. Additional information regarding the effects of the project's actions on the listed species in question, their anticipated response to these actions, and the environmental consequences of the actions as a whole was formulated from the aforementioned resources, and from the 2011 Biological Assessment and Essential Fish Habitat Assessment San Francisco Bay Area Water Emergency Transportation Authority Central Bay Operations and Maintenance Facility Project document. The updated project description sent with the reinitiation letter was also used as a resource. Information was also provided in email messages and telephone conversations between August and October of 2015. For information that has been taken directly from published, citable documents, those citations have been referenced in the text and listed at the end of this document.

2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential physical and biological features that help to form that conservation value.

2.2.1 Species Description, Life History, and Status

This opinion analyzes the effects of the federal action on the southern DPS of green sturgeon and their designated critical habitat.

2.2.1.1 Green Sturgeon General Life History

Green sturgeon is an anadromous, long-lived, and bottom-oriented fish species in the family Acipenseridae. Sturgeon have skeletons composed mostly of cartilage and lack scales, instead possessing five rows of characteristic bony plates on their body called "scutes." On the underside of their flattened snouts are sensory barbels and a siphon-shaped, protrusible, toothless mouth. Large adults may exceed 2 meters in length and 100 kilograms in weight (Moyle 1976).

Based on genetic analyses and spawning site fidelity, NMFS determined that North American green sturgeon are comprised of at least two DPSs: a northern DPS consisting of populations originating from coastal watersheds northward of and including the Eel River ("northern DPS green sturgeon"), with spawning confirmed in the Klamath and Rogue river systems; and a southern DPS consisting of populations originating from coastal watersheds south of the Eel River ("southern DPS green sturgeon"), with spawning confirmed in the Sacramento River system (Adams *et al.* 2002).

Green sturgeon is the most marine-oriented species of sturgeon (Moyle 2002). Along the West Coast of North America, they range in nearshore waters from Mexico to the Bering Sea (Adams *et al.* 2002), with a general tendency to head north after their out-migration from freshwater (Lindley *et al.* 2011). While in the ocean, archival tagging indicates that green sturgeon occur in waters between 0 and 200 meters depth, but spend most of their time in waters between 20–80 meters and temperatures of 9.5–16.0°C (Nelson *et al.* 2010; Huff *et al.* 2011). Subadult and adult green sturgeon move between coastal waters and estuaries (Lindley *et al.* 2008; Lindley *et al.* 2011), but relatively little is known about how green sturgeon use these habitats. Lindley *et al.* (2011) reported multiple rivers and estuaries are visited by aggregations of green sturgeon in summer months, and larger estuaries (*e.g.*, San Francisco Bay) appear to be particularly important habitat. During the winter months, green sturgeon generally reside in the coastal ocean. Areas north of Vancouver Island are favored overwintering areas, with Queen Charlotte Sound and Hecate Strait likely destinations based on detections of acoustically-tagged green sturgeon (Lindley *et al.* 2008; Nelson *et al.* 2010).

Based on genetic analysis, Israel *et al.* (2009) reported that almost all green sturgeon collected in the San Francisco Bay system were southern DPS. This is corroborated by tagging and tracking studies which found that no green sturgeon tagged in the Klamath or Rogue rivers (*i.e.*, Northern DPS) have yet been detected in San Francisco Bay (Lindley *et al.* 2011). However, green sturgeon inhabiting coastal waters adjacent to San Francisco Bay include northern DPS green sturgeon.

Adult southern DPS green sturgeon spawn in the Sacramento River watershed during the spring and early summer months (Moyle *et al.* 1995). Eggs are laid in turbulent areas on the river bottom and settle into the interstitial spaces between cobble and gravel (Adams *et al.* 2007). Like salmonids, green sturgeon require cool water temperatures for egg and larval development, with optimal temperatures ranging from 11 to 17°C (Van Eenennaam *et al.* 2005). Eggs hatch after 6–8 days, and larval feeding begins 10–15 days post-hatch. Larvae grow into juveniles typically after a minimum of 45 days (post-hatch) when fish have reached 60–80 mm total length (TL) and have migrated downstream. Juveniles spend their first few years in the Delta and San Francisco estuary before entering the marine environment as subadults. Juvenile green sturgeon salvaged at the State and Federal water export facilities in the southern Delta are generally between 200 mm and 400 mm TL (Adams *et al.* 2002), which suggests southern DPS green sturgeon spend several months to a year rearing in freshwater before entering the Delta and San Francisco estuary. Laboratory studies conducted by Allen and Cech (2007) indicated juveniles approximately 6 month old were tolerant of saltwater, but approximately 1.5-year old green sturgeon appeared more capable of successful osmoregulation in salt water.

Subadult green sturgeon spend several years at sea before reaching reproductive maturity and returning to freshwater to spawn for the first time (Nakamoto *et al.* 1995). Little data are available regarding the size and age-at-maturity for the southern DPS green sturgeon, but it is likely similar to that of the northern DPS. Male and female green sturgeon differ in age-at-maturity. Males can mature as young as 14 years and female green sturgeon mature as early as age 16 (Van Eenennaam *et al.* 2006). Adult green sturgeon are believed to spawn every 2 to 5 years. Recent telemetry studies by Heublein *et al.* (2009) indicate adults typically enter San Francisco Bay from the ocean and begin their upstream spawning migration between late February and early May. These adults on their way to spawning areas in the upper Sacramento River typically migrate rapidly through the estuary toward their upstream spawning sites. Preliminary results from tagged adult sturgeon suggest travel time from the Golden Gate to Rio Vista in the Delta is generally 1-2 weeks. Post-spawning, Heublein *et al.* (2009) reported tagged southern DPS green sturgeon displayed two outmigration strategies; outmigration from Sacramento River prior to September 1 and outmigration during the onset of fall/winter stream flow increases. The transit time for post-spawning adults through the San Francisco estuary appears to be very similar to their upstream migration (*i.e.*, 1-2 weeks).

During the summer and fall, an unknown proportion of the population of non-spawning adults and subadults enter the San Francisco estuary from the ocean for periods ranging from a few days to 6 months (Lindley *et al.* 2011). Some fish are detected only near the Golden Gate, while others move as far inland as Rio Vista in the Delta. The remainder of the population appear to enter bays and estuaries farther north from Humboldt Bay, California to Grays Harbor, Washington (Lindley *et al.* 2011).

Green sturgeon feed on benthic invertebrates and fish (Adams *et al.* 2002). Radtke (1966) analyzed stomach contents of juvenile green sturgeon captured in the Sacramento-San Joaquin Delta and found the majority of their diet was benthic invertebrates, such as mysid shrimp and amphipods (Corophium spp). Dumbauld *et al.* (2008) reported that immature green sturgeon found in Willapa Bay, Grays Harbor, and the Columbia River Estuary, fed on a diet consisting primarily of benthic prey and fish common to these estuaries (ghost shrimp, crab, and crangonid shrimp), with burrowing thalassinid shrimp representing a significant proportion of the sturgeon diet. Dumbauld *et al.* (2008) observed feeding pits (depressions in the substrate believed to be formed when green sturgeon feed) in soft-bottom intertidal areas where green sturgeon are believed to spend a substantial amount foraging.

2.2.1.2 Status of Southern DPS Green Sturgeon and Critical Habitat

To date, little population-level data have been collected for green sturgeon. In particular, there are no published abundance estimates for either northern DPS or southern DPS green sturgeon in any of the natal rivers based on survey data. As a result, efforts to estimate green sturgeon population size have had to rely on sub-optimal data with known potential biases. Available abundance information comes mainly from four sources: 1) incidental captures in the California Department of Fish and Wildlife (CDFW) white sturgeon monitoring program; 2) fish monitoring efforts associated with two diversion facilities on the upper Sacramento River; 3) fish salvage operations at the water export facilities on the Sacramento-San Joaquin Delta; and 4) dual frequency sonar identification in spawning areas of the upper Sacramento River. These data are insufficient in a variety of ways (short time series, non-target species, etc.) and do not support more than a qualitative evaluation of changes in green sturgeon abundance.

CDFW's white sturgeon monitoring program incidentally captures southern DPS green sturgeon. Trammel nets are used to capture white sturgeon and CDFW utilizes a multiple-census or Peterson mark-recapture method to estimate the size of subadult and adult sturgeon population (https://www.dfg.ca.gov/fish/Resources/Sturgeon/). By comparing ratios of white sturgeon to green sturgeon captures, estimates of southern DPS green sturgeon abundance can be calculated. Estimated abundance of green sturgeon between 1954 and 2001 ranged from 175 fish to more than 8,000 per year and averaged 1,509 fish per year. Unfortunately, there are many biases and errors associated with these data, and CDFW does not consider these estimates reliable. For larval and juvenile green sturgeon in the upper Sacramento River, information is available from salmon monitoring efforts at the Red Bluff Diversion Dam (RBDD) and the Glenn-Colusa Irrigation District (GCID). Incidental capture of larval and juvenile green sturgeon at the RBDD and GCID have ranged between 0 and 2,068 green sturgeon per year (Adams *et al.* 2002). Genetic data collected from these larval green sturgeon suggest that the number of adult green sturgeon spawning in the upper Sacramento River remained roughly constant between 2002 and 2006 in river reaches above RBDD (Israel and May 2010). In 2011, rotary screw traps operating in the Upper Sacramento River at RBDD captured 3,700 larval green sturgeon which represents the highest catch on record in 16 years of sampling (Poytress *et al.* 2011).

Juvenile green sturgeon are collected at water export facilities operated by the California Department of Water Resources (DWR) and the Federal Bureau of Reclamation (BOR) in the Sacramento-San Joaquin Delta. Fish collection records have been maintained by DWR from 1968 to present and by BOR from 1980 to present. The average number of southern DPS green sturgeon taken per year at the DWR facility prior to 1986 was 732; from 1986 to 2001, the average per year was 47 (70 FR 17386). For the BOR facility, the average number prior to 1986 was 889; from 1986 to 2001 the average was 32 (70 FR 17386). Direct capture in the salvage operations at these facilities is a small component of the overall effect of water export facilities on southern DPS green sturgeon; entrained juvenile green sturgeon are exposed to potential high levels of predation by non-native predators, disruption in migratory behavior, and poor habitat quality. Delta water exports have increased substantially since the 1970s and it is likely that this has contributed to negative trends in the abundance of migratory fish that utilize the Delta, including the southern DPS green sturgeon.

During the spring and summer spawning period, researchers with University of California Davis have utilized dual-frequency identification sonar (*i.e.*, DIDSON) to enumerate adult green sturgeon in the upper Sacramento River. These surveys estimated 175 to 250 sturgeon (±50) in the mainstem Sacramento River during the 2010 and 2011 spawning seasons. However, it is important to note that this estimate may include some white sturgeon, and movements of individuals in and out of the survey area confound these estimates. Given these uncertainties, caution must be taken in using these estimates to infer the spawning run size for the Sacramento River, until further analyses are completed.

The most recent status review update concluded the southern DPS green sturgeon is likely to become endangered in the foreseeable future due to the substantial loss of spawning habitat, the concentration of a single spawning population in one section of the Sacramento River, and multiple other risks to the species such as stream flow management, degraded water quality, and introduced species (NMFS 2005). Based on this information, the southern DPS green sturgeon was listed as threatened on April 7, 2006 (71 FR 17757).

Critical habitat was designated for the southern DPS of green sturgeon on October 9, 2009 (74 FR 52300). Critical habitat includes coastal marine waters within 60 fathoms depth from Monterey Bay, California to Cape Flattery, Washington, and includes the Strait of Juan de Fuca to its United States boundary. Designated critical habitat also includes the Sacramento River, lower Feather River, lower Yuba River, Sacramento-San Joaquin Delta, Suisun Bay, San Pablo Bay, and San Francisco Bay in California. PCEs of designated critical habitat in estuarine areas are food resources, water flow, water quality, migration corridor, depth, and sediment quality. In freshwater riverine systems, PCEs of green sturgeon critical habitat are food resources, substrate type or size, water flow, water quality, migratory corridor, depth, and sediment quality. In nearshore coastal marine areas, PCEs are migratory corridor, water quality, and food resources.

The current condition of critical habitat for the southern DPS of green sturgeon is degraded over its historical conditions. It does not provide the full extent of conservation values necessary for the recovery of the species, particularly in the upstream riverine habitat of the Sacramento River. In the Sacramento River, migration corridor and water flow PCEs have been impacted by human actions, substantially altering the historical river characteristics in which the southern DPS of green sturgeon evolved. In addition, the Delta may have a particularly strong impact on the survival and recruitment of juvenile green sturgeon due to their protracted rearing time in brackish and estuarine waters.

2.2.2 Factors Responsible for Green Sturgeon Stock Declines

NMFS cites many reasons (primarily anthropogenic) for the decline of southern DPS green sturgeon (Adams *et al*. 2002; NMFS 2005). The foremost reason for the decline in these anadromous populations is the degradation and/or destruction of freshwater and estuarine habitat. Additional factors contributing to the decline of these populations include: commercial and recreational harvest, artificial propagation, natural stochastic events, marine mammal predation, reduced marine-derived nutrient transport, ocean conditions, and global climate change.

2.2.2.1 Habitat Degradation and Destruction

The best scientific information presently available demonstrates a multitude of factors, past and present, have contributed to the decline of green sturgeon by reducing and degrading habitat by adversely affecting essential habitat features. Most of this habitat loss and degradation has resulted from anthropogenic watershed disturbances (Adams *et al.* 2002) and lagoon management (Smith 1990).

2.2.2.2 Commercial and Recreational Harvest

Until recently, commercial and recreational harvest of southern DPS green sturgeon was allowed under State and Federal law. The majority of these fisheries have been closed (NMFS 2005). In addition, the confounding effects of habitat deterioration, drought, and poor ocean conditions make it difficult to assess the degree to which recreational and commercial harvest have contributed to the overall decline of green sturgeon in West Coast rivers.

2.2.2.3 Natural Stochastic Events

Natural events such as droughts, landslides, floods, and other catastrophes have adversely affected sturgeon populations throughout their evolutionary history. The effects of these events are exacerbated by anthropogenic changes to watersheds such as logging, roads, and water diversions. These anthropogenic changes have limited the ability of sturgeon to rebound from natural stochastic events and depressed populations to critically low levels.

2.2.2.4 Global Climate Change

Another factor affecting the rangewide status of southern DPS green sturgeon and their critical habitat at large is climate change. Impacts from global climate change are already occurring in California. For example, average annual air temperatures, heat extremes, and sea level have all increased in California over the last century (Kadir *et al.* 2013). Snow melt from the Sierra Nevada has declined (Kadir *et al.* 2013). However, total annual precipitation amounts have shown no discernable change (Kadir *et al.* 2013). Green sturgeon may have already experienced some detrimental impacts from climate change. NMFS believes the impacts to date are likely fairly minor because natural, and local, climate factors likely still drive most of the climatic conditions sturgeon experience, and many of these factors have much less influence on sturgeon abundance and distribution than human disturbance across the landscape.

In the San Francisco Bay region, warm temperatures generally occur in July and August, but as climate change takes hold, the occurrences of these events will likely begin in June and could continue to occur in September (Cayan *et al.* 2012). Interior portions of San Francisco Bay are projected to experience a threefold increase in the frequency of hot daytime and nighttime temperatures (heat waves) from the historical period (Cayan *et al.* 2012). Climate simulation models also project that the San Francisco region will maintain its Mediterranean climate regime, but experience a higher degree of variability of annual precipitation during the next 50 years and years that are drier than the historical annual average during the middle and end of the twenty-first century. The greatest reduction in precipitation is projected to occur in March and April, with the core winter months remaining relatively unchanged (Cayan *et al.* 2012).

For Northern California, most models project heavier and warmer precipitation. Extreme wet and dry periods are projected, increasing the risk of both flooding and droughts (DWR 2013). Estimates show that snowmelt contribution to runoff in the Delta may decrease by about 20 percent per decade over the next century (Cloern *et al.* 2011). Many of these changes are likely to further degrade southern DPS green sturgeon habitat by, for example, reducing streamflows during the summer and raising summer water temperatures. Estuaries may also experience changes that are detrimental. Estuarine productivity is likely to change based on changes in freshwater flows, nutrient cycling, and sediment amounts (Scavia *et al.* 2002; Ruggiero *et al.* 2010). Cloern *et al.* (2011) estimated that the salinity in San Francisco Bay could increase by 0.30-0.45 practical salinity unit (psu) per decade due to the confounding effects of decreasing freshwater inflow and sea level rise. In short time frames, climate conditions not caused by the human addition of carbon dioxide to the atmosphere are more likely to predominate (Cox and Stephenson 2007; Santer *et al.* 2011).

2.3 Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

2.3.1 Action Area Overview

The action area consists of two locations: one within Central San Francisco Bay; the other is the offshore dredge material disposal site (SF-DODS) in the Pacific Ocean. San Francisco Bay is the largest estuary on the west coast of North America. Located about halfway up the California coast from the Mexican border, it is the natural exit point of 40 percent of California's freshwater outflow. The climate is Mediterranean; most precipitation falls in winter and spring as rain throughout the Central Valley and as snow in the Sierra Nevada and Cascades. The freshwater outflow pattern is seasonal; highest outflow occurs in winter and spring. Current and wave patterns in the action area are largely generated by the tides interacting with the bottom and shoreline configurations. It also receives inputs from stormwater runoff, and wastewater from municipal and industrial sources that vary in volume depending on the location and seasonal weather patterns. SF-DODs is a 6.5-square nautical mile area located approximately 50 miles offshore from the City of San Francisco in the Pacific Ocean.

The San Francisco Bay portion of the action area consists of densely developed Alameda waterfront areas and nearshore estuarine areas adjacent to former Alameda Naval Air Station. Water depths at construction and dredging sites range from less than 5 feet to 40 feet at MLLW. The transition zone between the upland areas to the subtidal zone primarily consists of rock rip rap, concrete rubble, and an existing deteriorated seawall. The majority of benthic aquatic habitats within the project area are soft mud and/or clay sediments. The abundant invertebrate community is characterized by a diverse array of polychaetes (Thompson *et al.* 2007). Some hard bottom habitat is present along the shoreline and seawall. Currently no eelgrass is present at the site. For disposal of dredged materials, SF-DODS is located in open ocean waters approximately 50 miles offshore from the Golden Gate in the Pacific Ocean. Ocean waters at SF-DODS are approximately 10,000 feet deep and site contains strong currents.

2.3.2 Status of Species and Critical Habitat in Action Area

2.3.2.1 Green Sturgeon

Green sturgeon are iteroparous[3], and adults pass through San Francisco Bay including the action area during spawning and post-spawning migrations. Pre-spawn green sturgeon enter San

[3] They have multiple reproductive cycles over their lifetime.

Francisco Bay between late February and early May, as they migrate to spawning grounds in the Sacramento River (Heublein *et al.* 2009). Post-spawning adults may be present in the Suisun Bay after spawning in the Sacramento River in the spring and early summer for months prior to emigrating into the ocean. Juvenile green sturgeon move into the Delta and San Francisco estuary early in their juvenile life history, where they may remain for 2-3 years before migrating to the ocean (Allen and Cech 2007; Kelly *et al.* 2007). Subadult and non-spawning adult green sturgeon utilize both ocean and estuarine environments for rearing and foraging. Due to these life-history characteristics, juvenile, subadult and adult green sturgeon may be present in the action area year-round.

Little is known about green sturgeon distribution and abundance in the Bay, and what influences their movements (Kelly *et al.* 2007). Tracking of green sturgeon movements in the Bay indicate that subadults typically remain in shallower depths (less than 30 feet) and show no preference for temperature, salinity, dissolved oxygen, or light levels (Kelly *et al.* 2007). Observations also suggest that there are two main types of movements of subadult green sturgeon: directional and non-directional (Kelly *et al.* 2007). Tracking data suggests that directional movements typically occur near the surface of the water, while non-directional movements were associated with the bottom at depths up to 42 feet, indicating foraging behavior (Kelly *et al.* 2007) since green sturgeon are known to feed on benthic invertebrates and fish (Adams *et al.* 2002). Within San Francisco Bay, including this project's action area, sturgeon are likely foraging on benthic prey and fish commonly found in muddy, soft-bottom habitats.

Green sturgeon are not expected to be present at SF-DODS. SF-DODS is not suitable for green sturgeon due to the great water depth and lack of foraging habitat.

2.3.2.2 Green Sturgeon Critical Habitat

The project's action area is designated as critical habitat for the southern DPS of green sturgeon. PCEs of designated critical habitat in the action area include food resources, water flow, water quality, mitigation corridor, depth, and sediment quality. The current condition of critical habitat in the action area is degraded over its historical conditions. Habitat degradation is primarily due to altered and diminished freshwater inflow, loss and reduced access to tidal marsh habitat, non-native invasive species, and a long history of industrial and military development along the Alameda Point.

2.3.3 Factors Affecting the Species Environment in the Action Area

Profound alterations to the environment of the greater San Francisco Bay estuary began with the discovery of gold in the middle of the 19th century. Dam construction, water diversion, hydraulic mining, and the diking and filling of tidal marshes soon followed, launching the San Francisco Bay area into an era of rapid urban development and coincidental habitat degradation. There are efforts currently underway to restore the habitat in the Bay, as is noted by the restoration that occurred at the South Bay Salt Ponds. There have also been alterations to the biological community as a result of human activities, including hatchery practices and the introduction of non-native species.

The land bordering the action area has been highly modified by urban development along the Alameda shoreline and the adjacent Port of Oakland. Alameda contains commercial and high density residential development and high use streets. The hydrology of the action area is modified as a result. The terrestrial portions of the action area receive water from direct precipitation, which flows into storm drains and into combined stormwater and sewage treatment system. Water and sediment quality within the action area is affected by stormwater runoff, industrial activities, and other urban influences.

2.3.4 Previous Section 7 Consultations and Section 10 Permits in the Action Area

No formal or informal consultations pursuant to section 7 of the ESA have been previously conducted by NMFS within the San Francisco Bay portion of the action area. For the SF-DODS portion of the action area, NMFS has completed a programmatic consultation with the U.S. Army Corps of Engineers of the Long Term Management Strategy of Disposal of Dredged Materials in the San Francisco Bay Region (LTMS). The LTMS programmatic consultation resulted in the issuance of a biological opinion on July 9, 2015, to the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency. The consultation and biological opinion included the disposal of dredged material at SF-DODS. The July 9, 2015, biological opinion concluded the LTMS program was not likely to jeopardize the continued existence of listed fish species under the jurisdiction of NMFS, or adversely modify or destroy designated critical habitat.

Research and enhancement projects resulting from NMFS' Section 10(a)(1)(A) research and enhancement permits and section 4(d) limits or exceptions could potentially occur in the Central San Francisco Bay watershed. Salmonid and sturgeon monitoring approved under these programs includes juvenile and adult net surveys and tagging studies. In general, these activities are closely monitored and require measures to minimize take during the research activities. Through fall of 2012, no research or enhancement activities have occurred in the Central San Francisco Bay.

2.4 Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

In this biological opinion, our approach to determine the effects of the action was based on institutional knowledge and a review of the ecological literature and other relevant materials. We used this information to gauge the likely effects of the proposed project via an exposure and response framework that focuses on the stressors (physical, chemical, or biotic), directly or indirectly caused by the proposed action, to which southern DPS green sturgeon are likely to be exposed. Next, we evaluate the likely response of the above listed fish to these stressors in terms of changes to survival, growth, and reproduction, and changes to the ability of PCEs or physical and biological features to support the value of critical habitat in the action area. PCEs, and physical and biological features, include sites essential to support one or more life stages of the species. These sites for migration, spawning, and rearing in turn contain physical and biological features that are essential to the conservation of the species. Where data to quantitatively determine the effects of the proposed action on listed fish and their critical habitat were limited or not available, our assessment of effects focused mostly on qualitative identification of likely stressors and responses.

Construction activities associated with the proposed project are expected to temporarily affect threatened green sturgeon through elevated levels of underwater sound during pile driving and degradation of water quality during construction and dredging. When completed, the operation of ferry boats to and from the new facility may affect threatened green sturgeon through temporary increases in turbidity and noise disturbance.

NMFS does not anticipate any adverse effects to listed species or critical habitat from the on-land portion of the proposed Project, because the Project will implement measures (*i.e.*, proper storage and handling of fuels and other contaminants, accidental spill plan, and storm water management plan) that prevent the runoff and discharge of pollutants from landside activities to the waters of San Francisco Bay.

2.4.1 Effects of Construction Activities on Listed Species and Critical Habitat

Construction activities by the proposed project consist of demolition of remaining structures at the on-site marina, construction of berthing floats and gangways, replacement of a harbor seal haul-out dock, replacement of a concrete seawall, and construction of a gangway landing. These activities will likely result in temporary impacts to water quality and elevated underwater sound levels during pile driving. The potential effects of in-water construction are presented below.

2.4.1.1 Overview of Pile Driving Impacts

Green sturgeon may be affected by exposure to high underwater sound pressure levels (SPLs) produced during pile driving. Fish may be injured or killed when exposed to high levels of underwater sound, especially those generated by impulsive sound sources such as pile driving with impact hammers. Pathologies of fish associated with very high sound level exposure and drastic changes in pressure are collectively known as *barotraumas*. These include hemorrhage and rupture of blood vessels and internal organs, including the swim bladder and kidneys. Death can be instantaneous, occur within minutes after exposure, or occur several days later. Fish can also die when exposed to lower, continuous sound pressure levels if exposed for longer periods of time. Hastings (1995) found death rates of 50 percent and 56 percent for gouramis (*Trichogaster sp.*) when exposed for two hours or less to continuous sounds at 192 dB root mean squared (RMS) (re: 1 μPa) at 400 Hz and 198 dB (re: 1 μPa) at 150 Hz, respectively, and 25 percent for goldfish (*Carassius auratus*) when exposed to sounds of 204 dB (re: 1 μPa) at 250 Hz[4]. Hastings (1995) also reported that acoustic "stunning," a potentially lethal effect resulting

[4] Pressures will not be added to each metric for the remainder of the section: dB peak has a pressure of 1 μPa, dB sound exposure level (SEL) has a pressure of 1 $\mu Pa^2 \cdot sec$, RMS dB has a pressure of 1 μPa.

in a physiological shutdown of body functions, immobilized gourami within eight to thirty minutes of exposure to these sound levels.

Hearing loss in fishes can also occur from exposure to high intensity sounds. These sounds can over-stimulate the auditory system of fishes and may result in temporary threshold shifts (TTS). TTS is considered a non-injurious temporary reduction in hearing sensitivity. Physical ear injury may also occur for fish exposed to high levels or continuous sound, manifested as a loss of hair cells, located on the epithelium of the inner ear (Hastings and Popper 2005). These hair cells are capable of sustaining injury or damage that may result in a temporary decrease in hearing sensitivity. However, this type of noise-induced hearing loss in fishes is generally considered recoverable, as fish possess the ability to regenerate damaged hair cells (Lombarte *et al.* 1993; Smith *et al.* 2006). Permanent hearing loss has not been documented in fish. Even if threshold shifts in hearing do not occur, loud sounds can mask the ability of fish to hear their environment. This effect from loud sound exposure is referred to as acoustic or auditory masking. Masking generally results from an unwanted or unimportant sound impeding a fish's ability to hear sounds of interest.

Underwater sound exposures have also been shown to alter the behavior of fishes (see review by Hastings and Popper 2005). The observed behavioral changes include startle responses and increases in stress hormones. Exposure to pile driving sound pressure levels may also result in "agitation" of fishes indicated by a change in swimming behavior detected by Shin (1995) or "alarm" detected by Fewtrell (2003). Other potential changes include reduced predator awareness and reduced feeding. The potential for adverse behavioral effects will depend on a number of factors, including the sensitivity to sound, the type and duration of the sound, as well as life stages of fish that are present in the areas affected by underwater sound produced during pile driving. The startle response in fishes is a quick burst of swimming that may be involved in avoidance of predators (Popper and Fay 1997). A fish that exhibits a startle response may not necessarily be injured, but it is exhibiting behavior that suggests it perceives a stimulus indicating potential danger in its immediate environment. However, fish do not exhibit a startle response every time they experience a strong hydroacoustic stimulus.

In order to assess the potential effects to fish exposed to pile driving sound, a coalition of federal and state resource and transportation agencies along the West Coast, the Fisheries Hydroacoustic Working Group (FHWG), used data from a variety of sound sources and species to establish interim acoustic criteria for the onset of injury to fishes from impact pile driving exposure (FHWG 2008). Most historical research has used peak pressure to evaluate the effects on fishes from underwater sound. Current research, however, suggests that sound exposure level (SEL), a measure of the total sound energy expressed as the time-integrated, sound pressure squared, is the most relevant metric for evaluating the effects of sound on fishes. An advantage of the SEL metric is that the acoustic energy can be accumulated across multiple events and expressed as the cumulative SEL (cSEL). Therefore, a dual metric criteria was established by the FHWG and includes a threshold for peak pressure (206 dB) and cSEL (187 dB for fishes 2 grams or larger and 183 dB for fishes smaller than 2 grams). Injury would be expected if either threshold is exceeded. There is uncertainty as to the behavioral response of fish to underwater sound produced when driving piles in or near water. Until new information indicates otherwise, NMFS believes a 150 dB root-mean-square pressure (RMS) threshold for behavioral responses for green sturgeon is appropriate.

2.4.1.2 Project Specific Considerations

Several site-specific conditions should be considered when conducting an assessment of the potential effects of pile driving associated with construction projects. Effects on an individual fish during pile driving are dependent on variables such as environmental conditions at the project site, specific construction techniques, and the construction schedule. A dual metric criteria of 206 dB peak SPL for any single strike and a cSEL of 187 dB are currently used by NMFS as thresholds to correlate physical injury to fish greater than 2 grams in size from underwater sound produced during the installation of piles with impact hammers. Green sturgeon that may be present within the action area of this project are significantly greater than 2 grams in size.

Different types of piles (*e.g.*, wood, steel, concrete) result in different levels of underwater noise. For the proposed project, steel piles will be driven with an impact hammer. In the updated Compendium of Pile Driving Sound Data (Illingworth and Rodkin 2007, 2012), the most recent pile driving case studies are compiled in order to provide information regarding the underwater sound pressure levels generated with the installation of different pile and hammer types. Several pile driving case studies conducted within the San Francisco Bay region using steel piles are included in the compendium and steel piles driven by an impact hammer tend to cause the highest elevated underwater sound levels.

Water depth at the pile driving site will also influence the rate of sound attenuation. In deep water areas high sound pressure waves are likely to travel further out into the Bay. Within shallow water, the rate of attenuation is expected to be much higher, reducing the expected area of adverse effects as compared to deeper water. Pile driving for the proposed project will occur in water depths ranging from approximately less than 5 feet MLLW to 40 feet at MLLW. Additionally, as distance from the pile increases, sound attenuation reduces sound pressure levels and the potential harmful effects to fish also decreases.

For the Central Bay Operations and Maintenance Facility, WETA proposes to use a bubble curtain to attenuate underwater sound levels during installation of all steel piles. Based on the use of a bubble curtain and pile sizes proposed for this Project, the assessment of acoustic impacts presented in this biological opinion assumes an estimated reduction of 10 dB in sound pressure. Although reductions as high as 20 dB have been measured, as a general rule, sound reductions of greater than 10 dB with attenuation systems cannot be reliably predicted (ICF Jones and Stokes and Illingworth and Rodkin, Inc. 2009).

The timing and duration of pile driving influences the level of potential impact on fish. Some species of fish occur seasonally in Central San Francisco Bay and in-water construction activities can be scheduled to avoid periods when the target fish species is mostly likely to be present. The duration of pile driving also influences the level of risk to fish. If pile driving extends continuously for hours or days, the chance of encounters with fish in the vicinity increases, accordingly. If pile driving is occurring near shore at low tide then fewer large fish are likely to be present due to shallow water depths.

For the proposed project pile driving with an impact hammer will occur over a period of up to 12 days. Per day pile driving is expected to occur for 2 to 3 hours. The installation of these piles will occur between June 15 and November 30.

2.4.1.3 Assessment of Pile Driving Effects at WETA Central Bay Operations and Maintenance Facility

For the purposes of this analysis we have used the maximum distances peak SPLs and accumulated SELs could travel as a reasonable worst case scenario. The project description does not indicate the days on which the 42-inch piles will be driven. Nor does it preclude the driving of 42-inch piles immediately preceding or following the driving of smaller piles on the same day. Therefore, even though Table 2 (below) indicates that peak SPLs of 206 dB associated with smaller piles should be 3 feet or less and accumulated SELs should be 262 feet or less, our effects analysis assumes that all 42, 30, 24, and 12-inch steel piles will have a 13-foot 206 dB peak range and a 900-foot 187 dB accumulated SEL range.

Table 2. Sound levels associated with impact hammer pile driving and use of bubble curtain.

Pile type and size	Max single strike peak at 33 feet (10 m)	Accumulated SEL at 33 feet (10 m)	Single strike RMS at 33 feet (10 m)	Distance (feet) to 206 dB peak	Distance (ft) to 187 dB accumulated SEL/day	Distance (feet) to 150 dB RMS
42-inch steel	200 dB	209 dB	185 dB	13 feet	900 feet	7,067 feet
30-inch steel	195 dB	207 dB	180 dB	7 feet	660 feet	3,281 feet
24-inch steel	193 dB	201 dB	179 dB	3 feet	262 feet	2,815 feet

Although the spreadsheet utilized by NMFS can predict sound pressure levels at a distance of less than 33 feet (*i.e.*, 10 meters) from a pile, hydroacoustic measurements in the field generally cannot be made this close to a pile. Near-field effects of sound waves, on-site equipment, the air bubble curtain, and safety typically don't allow for hydroacoustic monitoring to be performed within a few feet of a pile. At this close range, NMFS believes it is unlikely that exceedance of the 206 dB peak single strike threshold by the Project will result in the injury or mortality of green sturgeon and the basis for this finding is presented below.

Several factors make it unlikely that sturgeon will be present or injured in the area immediately adjacent to a pile being driven by the Project. First, the placement of an air bubble curtain will occupy 5-10 feet of the radial distance immediately outward from the pile. Air bubble curtains are constructed by the placement of one or more horizontal concentric rings of perforated tubing around the pile. Air is pumped through the tubes and into the rings to emit a curtain of bubbles that encapsulate the pile. To optimize the sound attenuation capability of the curtain the amount of bubbles and thickness of the curtain are maximized by adjusting the flow of compressed air delivered to the perforated tubing. Thus, equipment and the air bubble curtain itself will physically take up 5-10 feet immediately outward of the pile. Secondly, activation of the air bubble curtain immediately prior to the initiation of pile driving is expected to startle fish adjacent to the pile and likely result in a flight response. Additional noise will be created by the air compressors operating the bubble curtain, and boats and barges containing the pile driving equipment and crew will be operating immediately overhead. This noise will likely be perceived by fish as a stimulus indicating potential danger in its immediate environment so sturgeon are not expected to remain in the area directly adjacent to a pile (greater than a 33-foot radial distance from the pile) during driving. Sonalysts (1996) reported a variety of fish species demonstrate an avoidance reaction in the near-field (*i.e.* immediately adjacent to the sound source) to underwater sounds. Sonalysts (1996) did not define "near-field" as a specific distance, but ICF Jones and Stokes and Illingworth and Rodkin Inc. (2009) use 33 feet (10 meters) for near-field effects and to estimate the area of acoustic impact. Thirdly, the short duration of the pile driving actions (up to 3 hours per day for up to 12 days) to install the pilings for the Project will also limit the amount of exposure incurred by green sturgeon in the action area.

Table 2 presents sound levels anticipated to occur during impact hammer driving. The 42-inch diameter steel piles (24 total) are the largest piles to be installed by this Project, and would produce the highest sound levels. The project also proposes to install 36-inch steel piles (8 total) and 24-inch steel piles (18 total) for construction of the new ferry maintenance facility. For the seal haul-out dock, four 12-inch wooden or concrete piles will be installed. All pile driving will occur over a period of days, will be limited to daylight hours, and will not be continuous. Due to the smaller size, elevated underwater sound levels associated with installation of the four 12-inch diameter piles are expected to remain below thresholds that result in the mortality or injury of listed fish.

For the 42-inch, 36-inch and 24-inch diameter piles, NMFS anticipates the extent of SPLs above an accumulated SEL of 187 dB would extend up to a radial distance of approximately 900 feet from the pile driving activities. Since the proposed Project is located adjacent to a seawall, sound will mainly travel outwards into Central San Francisco Bay. For the largest piles (*i.e.* 42-inch diameter) the area of effect will encompass a relatively small area adjacent to the Alameda shoreline. For the purposes of this analysis, the zone of potential injury or mortality to threatened green sturgeon is the area in which fish could experience a range of barotraumas, including the damage to the inner ear, eyes, blood, nervous system, kidney, and liver. These injuries have the potential to result in the mortality of an individual fish either immediately or later in time.

Beyond the range of physical injury, extending out to the 150 dB RMS distance, NMFS estimates fish may demonstrate temporary abnormal behavior indicative of stress or exhibit a startle response. As described previously, a fish that exhibits a startle response may not be injured, but it is exhibiting behavior that suggests it perceives a stimulus indicating potential danger in its immediate environment, and startle responses are likely to extinguish after a few pile strikes, or diminish as fish leave the area. Shin (1995) described the behavioral response of snakehead (*Channa argus*) to the noise of pile driving as "agitation" and these fish exhibited a change in swimming behavior. Fewtrell (2003) described the behavioral response of finfish to seismic survey noise as "alarm". Feist *et al.* (1992) reported juvenile salmon schools in Puget Sound were fewer in areas subjected to pile driving and likely avoiding the area of elevated sound. Given the water conditions in the action area and in light of anticipated behavior (to leave the area of higher sound pressures for an area with lower sound pressures), NMFS expects most green sturgeon to react to the sound produced by pile driving by swimming away from the action area. Adequate water depths and the open water area of Central San Francisco Bay adjacent to the action area will provide startled fish sufficient area to escape and elevated sound levels should not result in significant effects on these individuals. Areas adjacent to the Project's action area provide habitat of similar or higher quality and provide adequate carrying capacity to support individual sturgeon that are temporarily displaced during the 12-day period of pile driving.

Depending on the time of year, green sturgeon may be commonly found within San Pablo Bay as indicated by the results of acoustic tag monitoring conducted by the California Fish Tagging Consortium. However, tagging studies have shown that few green sturgeon are present in Central (the location of the action area) and South San Francisco Bay when compared to San Pablo Bay (Hearn *et al.* 2010). Tagging studies also show that fewer sturgeon are present in San Francisco Bay during the late summer and fall period and this period directly overlaps with this Project's proposed construction season of June 15 to November 30. To date, tagging studies provide little information on juvenile green sturgeon, but sampling has indicated juveniles mostly occur in small groups in the Bay/Delta region (Adams *et al.* 2002, Hearn *et al.* 2010) and are unlikely to occur in more than small numbers in the action area. Therefore, few sturgeon are anticipated to be presented in the vicinity of the Alameda shoreline and in the action area during pile driving.

Although green sturgeon may be subjected to elevated sound levels during pile driving for construction of the Central Bay Operations and Maintenance Facility, NMFS estimates that only a very small number of threatened southern DPS green sturgeon may be injured or killed by the proposed pile driving because few individuals are likely to be exposed to an accumulated SEL of 187 dB or greater. Few green sturgeon are anticipated to be injured or killed, because green sturgeon abundance is expected to be low in vicinity of the Alameda shoreline during the construction period, the duration of all pile driving by the Project is 12 days total, and the area of physical injury during pile driving is relatively small in comparison to the size of Central San Francisco Bay.

During pile driving, peak SPLs above 206 dB will be limited to an area of 13 feet or less from the piles. As presented above, within this near-field area, equipment associated with the air bubble curtain will encroach on this space and most fish are expected to disperse with the activation of the air bubble curtain prior to the initiation of pile driving. Thus, similar to our analysis in the previous biological opinion, the likelihood of an individual green sturgeon's presence in the area subject to SPLs above 206 dB is very low; the likelihood of injury is proportionate to the low likelihood of presence.

For the zone of accumulated SEL of 187 dB (up to 900 feet from the pile being driven and an area of 109 acres), exposed sturgeon will be unlikely to remain in the same location to experience the full duration of the pile driving (*i.e.*, up to 3 hours per day) due to tidal currents and behavioral movements. Thus, few, if any, sturgeon are expected to remain stationary long enough to accumulate SPLs to levels which cause injury or mortality. Although no data are available to quantify the risk of exposure to the accumulated SEL threshold of 187 dB, NMFS believes that, for the reasons stated herein, the potential risk of injury and mortality to green sturgeon is low. This low risk is slightly higher than that analyzed in the previous biological opinion because the area of accumulated SELs of 187 dB increases from 660 feet from the pile being driven to 900 feet, and the duration of the pile driving activities increases from 10 days to 12 days. Most sturgeon within the action area will be expected to temporarily disperse with this intrusion, or move with tidal currents and behavioral movements. Adjacent areas in Central San Francisco Bay outside the action area provide fish sufficient area with habitat of similar or higher quality to avoid harm from increased sound levels in the action area and provide adequate carrying capacity to support individual sturgeon that are temporarily displaced during the 12-day period of pile driving.

2.4.1.4 Assessment of Effects on Water Quality

Water quality in the action area may be degraded during construction activities. Disturbance of soft bottom sediments during the removal of piles at the remnant recreational marina, installation of new piles, and dredging are likely to result in temporary increased levels of turbidity.

Turbidity

High levels of turbidity may affect fish by disrupting normal feeding behavior, reducing growth rates, increasing stress levels, and reducing respiratory functions (Benfield and Minello 1996; Nightingale and Simenstad 2001). There is little direct information available to assess the effects of turbidity in San Francisco Bay estuary on juvenile or adult green sturgeon. However, this benthic species is well adapted to living in estuaries with a fine sediment bottom and is tolerant of high levels of turbidity, because they forage for prey organisms in bottom sediments.

As piles, including the larger piles now proposed, are driven and removed from the Bay floor, fine-grain sediments such as the clay and silt material found in and along the Alameda waterfront will be disturbed and generate increased levels of turbidity in the adjacent water column. The extent of turbidity plumes resulting from Project construction will depend on the tide, currents, and wind conditions during these activities. NMFS expects that the elevated levels of turbidity due to pile removal and installation will be minor and localized due to the type of work performed by the Project. These areas of turbidity are expected to rapidly disperse from the project area with tidal circulation, as strong currents are present within Central San Francisco Bay.

During clamshell dredging, sediments may become suspended in the water column by the 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 (Nightingale and Simenstead 2001). Clamshell dredges remove bottom sediment through the direct application of mechanical force to dislodge and excavate the material with little loss of sediment. With this technique, the dredged material ascends rapidly through the water column. However, if not properly maintained or operated, clamshell dredges may generate significant concentrations of suspended sediment throughout the water column. Also, dredging in areas with fine sediments are likely to have greater turbidity impacts than dredging in areas with coarse sediments (Sabol *et al.* 2005). This is because finer grain sediments (silts and clays) are more readily suspended and settle out slower than course sediments, such as sand and gravel.

A study characterizing the spatial extent of turbidity plumes during dredging operations in Oakland Harbor found that a mechanical dredge (closed bucket) generated elevated levels of suspended sediments and turbidity. Ambient Total Suspended Sediment (TSS) concentrations were typically less than 50 mg/l. While exact plume trajectories were dynamic, turbidity levels above ambient were detected up to 1,200 feet both up- and down-current from the source. But in general, significantly elevated TSS concentrations greater than 225 mg/l were detected up to 750 feet from the source (MEC Analytical Instruments, Inc. 2004).

Elevated levels of turbidity from the Project's dredging activities along the Alameda shoreline are expected to result in similar levels as those described above for the Oakland Harbor because water current conditions and equipment are similar. The durations of such turbidity plumes will largely depend upon the currents at the site. Central San Francisco Bay is the deepest sub-embayment in the San Francisco Bay estuary, and has the strongest tidal currents within the estuary (Chin *et al.* 2010). Due to the location of the action area, currents are expected to be strong and dissipate turbidity plumes within hours, if not faster. Thus, NMFS anticipates green sturgeon to be exposed to turbidity plumes within approximately 750 radial feet from dredge sites for short durations.

Threatened green sturgeon in the estuary commonly encounter areas of increased turbidity due to storm runoff events, wind and wave action, and benthic foraging activities of other aquatic organisms. Fish generally react by avoiding areas of high turbidity and return when concentrations of suspended solids are lower. The minor and localized areas of turbidity associated with the Project's in-water construction activities are not expected to result in harm or injury, or behavioral responses that impair migration, foraging, or make green sturgeon more susceptible to predation. If sturgeon temporarily relocate from areas of increased turbidity, areas are available in Central San Francisco Bay adjacent to the work sites which offer habitat of equal or better value for displaced individuals. Adjacent habitat areas also provide adequate carrying capacity to support individual sturgeon that are temporarily displaced during the Project's construction activities.

Contaminants

As described above in the Environmental Baseline, water and sediment quality within the action area is affected by stormwater runoff, industrial activities, and other urban influences. Results from testing of sediments within the vicinity of the action area show that sediments along the Alameda shoreline contain elevated concentrations of mercury and PCBs, however bioaccumulation levels are minor (Pacific EcoRisk 2012).

During the installation and removal of piles, including the larger piles now proposed, bottom sediments will be suspended and contaminants may be released to the water column. However, based on the project description (including the type of activities conducted, the work span, and equipment used) the suspended plumes of sediment and potential contaminants released during construction are expected to be localized and short-term. Any minor and localized elevations in contaminants which might result from those suspended plumes should be quickly diluted by tidal circulation to levels that are unlikely to adversely affect listed green sturgeon.

Dredging can cause contaminated sediments to be suspended in the water column and re-deposited to areas where they become bio-available to listed fish after dredging is completed. Contaminated sediments re-suspended during dredging are expected to follow the same patterns as those described above for turbidity and extend approximately 750 feet from the proposed dredge site. Contaminated sediment released during dredging and deposited in areas outside the dredge footprint will be diluted as they travel through the water column.

Sediment to be removed by dredging was analyzed for contaminant concentrations and to determine the suitability for disposal at SF-DODS or beneficial re-use at wetland sites. The sediments were subjected to full Inland Testing Manual testing, as per DMMO guidelines, to characterize these sediments and a Sample Analyses Report (SAR) was prepared (Pacific EcoRisk 2012) describing the results of testing. The sediments were characterized using three types of analyses: 1) analyzing all sediments for conventional and chemical parameters; 2) analyzing all sediments for benthic and water column toxicity; and 3) if the results of conventional and chemical parameter tests show that contaminants of concern exceed pre-determined thresholds, the sediments were analyzed to determine whether those contaminants have the potential to bioaccumulate in test organisms.

The SAR presents the results of the conventional and chemical analyses with comparisons to two reference sources: Bay ambient sediment concentrations (SFRWQCB 1998) and the SF-DODs reference site database. In summary, the key findings by Pacific EcoRisk (2012) from the conventional and chemical analyses were mercury and PCBs exceeded the reference thresholds. Therefore, mercury and total PCBs were subjected to further evaluation for bioaccumulation. The benthic toxicity test results for all composite sediment samples indicated that mercury and PCBs were not biologically available to cause toxicity in the 10-day sediment tests. Comparison of bioaccumulation test tissue mercury and PCB concentrations to the SF-DODS database indicated that tissue mercury levels were below the SF-DODS reference site. Based on these results, all of the sediments were considered suitable for placement at SF-DODS or placement at a wetland beneficial re-use site. SF-DODS is located approximately 50 miles offshore from the Golden Gate Bridge in the Pacific Ocean with water depths of approximately 10,000 feet. If the Project utilizes SF-DODS for disposal, materials will be diluted to levels which significantly reduce the potential for bioaccumulation of contaminants in marine organisms. Additionally, green sturgeon are unlikely to be found in the vicinity of SF-DODS because this species is typically found on the continental shelf in ocean waters less than 500 feet deep. If the Project utilizes a wetland re-use beneficial site for disposal, materials will be placed within an area contained by levees and isolated from the waters of San Francisco Bay. Disposal of dredged materials at wetland re-use sites will have no effect on listed fish or water quality in San Francisco Bay. For these reasons, adverse effects associated with disposal of dredged materials are not anticipated.

Upon completion, dredging will create a newly exposed surface layer on the Bay floor at depths of -12 to -14 feet. This surface, which was previously buried in sediment, may contain high levels of contaminants which become available for uptake by aquatic organisms. NMFS utilized the results of SAR to assess the potential for contaminants in the sediment to be exposed following dredging. Z-layer test results indicate the post-dredge mudline on the Bay floor will contain better (*i.e.*, cleaner) sediment quality than the existing mudline, due to the removal of contaminated sediments by dredging operations (Pacific EcoRisk 2012). In addition, new sediment is expected to settle in the dredge area and cover the existing sediments quickly. These newly deposited sediments will likely consist of contaminant concentrations near Bay ambient conditions and thus, pose no increase in contaminant risk to green sturgeon.

2.4.1.5 Assessment of Effects of Entrainment

Dredging has the potential to entrain fish and other aquatic organisms in the clamshell dredge. Entrainment occurs when organisms are trapped during the uptake of sediments and water by mechanical dredging machinery. Benthic infauna are particularly vulnerable to being entrained by dredging uptake, but mobile epibenthic and demersal organisms such as burrowing shrimp, crabs, and fish may also be susceptible to entrainment under some conditions. Green sturgeon may come in contact with the clamshell bucket of the mechanical dredge. Due to the short duration that mechanical dredging equipment is in contact with the bottom, and the relatively small size of the footprint of substrate affected by each dredge bucket, the likelihood of a green sturgeon being entrained is very low. The clamshell bucket is relatively small (10 cubic yards) and dredging will be conducted in areas less than 14 feet MLLW. In this shallow water, dredging activities are expected to startle green sturgeon and fish will disperse from the immediately vicinity. Sturgeon that react behaviorally to dredging operations will have areas of adequate water depths and the open water in Central San Francisco Bay adjacent to work sites. Thus, startled fish will have sufficient area to escape disturbance by dredging and should not experience adverse effects.

2.4.1.6 Assessment of Effects of Construction of the Seawall

The toe of the existing and new seawall is located 1-2 feet above MHHW; thus all project demolition and construction activities associated with the seawall are designed to occur outside of the waters of San Francisco Bay.

Although demolition activities will occur above the water line, debris could be a source of water pollution that affects fish by depleting the water of dissolved oxygen as the wastes decompose, or by introducing toxic materials to the aquatic habitat. The Project proposes to prevent unwanted materials from entering San Francisco Bay through the use of temporary catchments. In addition, the Project will have a spill contingency plan and supplies on site in case of any hazardous discharges. These proposed containment measures are expected to effectively prevent construction debris from becoming a source of water pollution. With regard to water quality, NMFS expects no effects from seawall demolition on green sturgeon.

Construction of the new concrete seawall will also occur along the upper portion of the shoreline and above the waters of San Francisco Bay. This area is above the MLLW and work methods have been developed to avoid personnel and equipment from entering the waters of San Francisco Bay. As with demolition of the existing seawall, construction of the new seawall will implement sediment control and debris containment measures to prevent materials from entering the waters of the Bay. With the implementation of proposed containment measures, construction of the seawall is not expected to impact water quality or disturb fish in the vicinity.

The new seawall structure will be approximately 230 feet in length and extend approximately 70 feet to east further than the existing seawall. The construction of an additional 70 feet of concrete seawall has the potential to reduce the value of shoreline habitat for listed fish by creating a vertical shoreline/water interface and eliminating natural substrate that support aquatic plants and intertidal organisms. Under current conditions the 70-foot long shoreline area to be modified by the new seawall is primarily comprised of rock rip rap. Since new seawall will be located 1-2 feet above MHHW the existing rock rip rap below MHHW will remain in place. The area at which the new seawall will be placed is wetted only during extreme high water events and does not provide habitat value for green sturgeon. In general, the shoreline within the action area is greatly disturbed by rock rip rap, bulkheads, piers, and Alameda Point is reported to be predominately built of land created by placing fill in the Bay (Baseline Environmental Consulting 2012). Considering the current condition of the shoreline in the action area and that the new seawall will be constructed above MHHW, the proposed replacement seawall is not expected to degrade existing habitat values or result in adverse effects to designated critical habitat for the southern DPS of green sturgeon.

2.4.1.7 Assessment of Effects of Future Operations

Long-term facility operations such as refueling, fluid leakage, and equipment maintenance at Alameda Point pose some risk of contamination of aquatic habitat and subsequent injury or death to threatened green sturgeon. Oils and similar substances from ferry maintenance activities can contain a wide variety of polynuclear aromatic hydrocarbons (PAHs), and metals. Both can result in adverse impacts to listed fish. Some of the effects that metals can have on fish are: immobilization and impaired locomotion, reduced growth, reduced reproduction, genetic damage, tumors and lesions, developmental abnormalities, behavior changes (avoidance), and impairment of olfactory and brain functions (Eisler 2000).

To address any potential for the release of toxic substances into the waters of San Francisco Bay, the Project will prepare and implement a Spill Prevention, Control and Countermeasures (SPCC) Plan. The SPCC Plan will specify restrictions and procedures for fuel storage location, fueling activities, and equipment maintenance. In addition, the Project will prepare a Stormwater Pollution Prevention Plan to protect water quality during construction. The SWPPP will include measures to collect and contain the discharge of pollutants from construction sites. Post-construction, stormwater runoff from the site will be collected with a new system of onsite catch basins and pipes. Site run-off will be treated by oil-water separators and treatment vaults prior to connecting to an existing 12-inch storm drain. Due to these measures, NMFS expects that the potential for release of toxic substances as a result of future operations is improbable and is, therefore, unlikely to adversely affect fish.

The new maintenance facility will contain berths for passenger ferry vessels during maintenance and mooring. Ferry boats traveling to and from the berths are expected to disturb bottom sediments and generate increased levels of turbidity in the water column. Noise associated with ferry boat traffic may startle fish. Although there is no water quality or sound data to quantify these levels, observations from similar ferry boat operations in Vallejo, Larkspur, Sausalito and other, similar locations around the San Francisco Bay indicate these impacts will be minor, localized, and limited to short periods of time during the arrival and departure of the ferry boats.

With 11 ferries transiting the berthing facility up to four times each day (departure in the morning, arrival mid-day, departure mid-day, and arrival at the end of day), the total number of future ferry boat arrivals and departures at the Central Bay Operations and Maintenance Facility is expected to range from 30 to 44 trips per day. Increased levels of turbidity associated with ferry boat arrivals and departures are expected to last for a matter of a few minutes during each trip. Under the scenario of 30 to 44 trips per day, cumulative disturbance over a day is expected to range between one and three hours. These short-term increases in turbidity are expected to rapidly return to background levels with tidal circulation. Fish startled by elevated noise levels will have adequate opportunity to avoid boat traffic in adjacent open-water areas in Central San Francisco Bay.

Increased boat traffic in the area could facilitate the spread of the non-native Asian kelp *Undaria pinnatifida*. The invasive kelp is a native of the Western Pacific (*e.g.*, Japan, Korea), is quick-growing and opportunistic, and can quickly become established on ship hulls, moorings, ropes, and docks. Invasive kelp negatively impacts native species by outcompeting native vegetation for space and light. *Undaria* has been documented in California since 2000. In 2009, it was documented in the San Francisco Marina and at several locations along the City of San Francisco waterfront. Ferry traffic associated with this Project may increase the potential spread; however, its potential effect on threatened green sturgeon and its critical habitat is not expected to be significant because the action area does not currently support eelgrass or other species of submerged vegetation. Overall, the effects of ferry boat traffic at the site on the aforementioned listed species and designated critical habitat are expected to be improbable or negligible.

2.4.1.8 Assessment of Effects on Critical Habitat

The action area is designated as critical habitat for southern DPS green sturgeon and project implementation is anticipated to impact designated critical habitat. Construction activities are expected to temporarily alter water quality and foraging habitat for green sturgeon designated critical habitat. Completion of the project will benefit designated critical habitat by eliminating 1,620 sq ft of existing overwater structure that is currently shading aquatic habitat in the action area.

Water Quality

The effects of project construction activities on water quality are discussed above in section 2.4.1.4, Assessment of Effects on Water Quality, of this biological opinion and also apply to designated critical habitat in the action area. As described above, the effects of the proposed project may result in increased levels of turbidity and the suspension of sediment-associated contaminants. The impacts on water quality from turbidity and contaminants are not expected to degrade PCEs of green sturgeon because the duration of potential contaminant exposure and elevated turbidity is short-term, minor, and localized.

Completion of project construction is expected to benefit designated critical habitat over the long-term by removal of 1,620 sq ft of existing overwater structure (OWS).

Disturbance of the Benthic Community

The installation and removal of pilings will disturb bottom sediments and the associated benthic community in the project's action area. This disturbance may remove prey organisms for green sturgeon. Once construction activities are completed, these impacts to the benthic community are expected to extend over a period of up to 3 years based on recovery rates for benthic disturbance in the scientific literature (Oliver *et al.* 1977; Watling *et al.* 2001). During the short-term construction activities the amount of forage for green sturgeon may be impaired in the action area.

Information on juvenile green sturgeon foraging behavior and their prey organisms in the Bay is limited. Dumbauld *et al.* (2008) reported green sturgeon prey on demersal fish (*e.g.*, sand lance) and benthic invertebrates in estuaries of Washington and Oregon. Radtke (1966) analyzed stomach contents of juvenile green sturgeon captured in the Sacramento-San Joaquin Delta and found the majority of their diet was benthic invertebrates, such as mysid shrimp and amphipods.

Proposed dredging activities in the berthing area of the facility may adversely affect benthic infauna at the site by directly removing or burying these organisms (Newell *et al.* 1998, Van der Veer *et al*. 1985). There is little information available to quantify the level of potential benthic infauna entrainment during dredging, although it is known to occur. A reduction in benthic organisms at the dredge site could lead to an overall reduction in the quality of sturgeon foraging habitat in the action area. Upon the completion of a dredging episode, benthic organisms will recolonize the site over time. Rates of recovery listed in the literature range from several months to several years for estuarine muds (Currie and Parry 1996; McCauley *et al*. 1976; Oliver *et al.* 1977; Tuck *et a*l.1998; Watling *et al.* 2001). Oliver *et al.* (1977) reported recolonization can take up to 3 years in areas of strong current and up 10 years in areas of low current. Collie *et al.* (2000) reported some aquatic invertebrates re-colonize areas within a few months of a disturbance activity. Although temporary, forage resources for fish that feed on the benthos are expected to be reduced during this recovery period. Based on site conditions in the action area, NMFS will assume full recovery of prey resources within the direct footprint of the dredged area activities will require at least 1 year. Due to the small size of the dredge site (approximately 5.5 acres for the initial episode and up to 13.5 acres for future maintenance) and the large amount of alternative forage sites that are located nearby, the temporary reduction in forage species at these sites are not expected to result in the reduced fitness of individual sturgeon and NMFS does not expect the temporary reduction of benthic prey in the action area will prevent sturgeon from finding suitable forage at the quantities and quality necessary for normal behavior (*e.g.*, maintenance, growth, reproduction). Given the small portion of the action area disturbed, the likely availability of forage elsewhere in the action area, and the recovery of the benthic community after disturbance, impacts to prey resource availability due to project construction are expected to be negligible.

Introduction of Invasive Species

Increased boat traffic in the area could facilitate the spread of the non-native Asian kelp Un*daria pinnatifida*. The invasive kelp is a native of the Western Pacific (*e.g.*, Japan, Korea), is quick-growing and opportunistic, and can quickly become established on ship hulls, moorings, ropes, and docks. Invasive kelp negatively impacts native species by outcompeting native vegetation for space and light. *Undaria* has been documented in California since 2000. In 2009, it was documented in the San Francisco Marina and at several locations along the City of San Francisco waterfront. Ferry traffic associated with this Project may increase the potential spread; however, its potential effect on green sturgeon critical habitat is not expected to be significant because the action area does not currently support eelgrass or other species of submerged vegetation. Overall, the effects of ferry boat traffic at the site on designated critical habitat are expected to be negligible.

Overwater Shading

Overwater structures, such as docks and piers, result in shading of water column and benthic habitats. Shading is known to have the potential to reduce growth of submerged aquatic vegetation, decrease primary productivity, alter predator-prey interactions, change invertebrate assemblages, and reduce the density of benthic invertebrates (Glasby 1999; Helfman 1981; Struck *et al.* 2004; Stutes *et al.* 2006) all of which may lead to an overall reduction in the quality of fish habitat.

For construction of the Central Bay Operations and Maintenance Facility, the Project will remove the remnants of a former recreational marina which includes approximately 20,220 sq ft of overwater structure in the action area. The new facility will now include 18,600 sq ft of new overwater structure, an increase from what NMFS analyzed previously. Thus, upon completion, the Project will result in the net removal of approximately 1,620 sq ft of overwater structure in the action area. However, some additional shading will occur periodically from vessels moored for servicing and layover. To minimize the effects of shading by the new facility, walking surfaces will be grated for light penetration. The replacement haul-out dock will have the same footprint as the existing dock and will not increase overwater shading. The net removal of overwater structure will allow light penetration to areas previously shaded and these sites will have the opportunity to re-colonize with submerged vegetation and benthic organisms. In consideration of the net reduction of overwater structure in the action area and the light transmission that will be provided by grated walkways, the effects of shading on submerged benthic areas by the new facility are expected to have negligible effects on critical habitat in the action area.

2.5 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). 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 ESA.

NMFS does not anticipate any cumulative effects in the action area other than those ongoing actions already described in the Environmental Baseline above, and resulting from climate change. Given current baseline conditions and trends, NMFS does not expect to see significant improvement in habitat conditions in the near future due to existing land and water development in San Francisco Bay. In the long term, climate change may produce temperature and precipitation changes that may adversely affect green sturgeon habitat in the action area.

Productivity in the San Francisco Bay is likely to change based on changes in freshwater flows, nutrient cycling, and sediment amounts (Scavia *et al.* 2002). Many of these changes may place further stress on green sturgeon populations.

2.6 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (section 2.5), taking into account the status of the species and critical habitat (section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species.

Southern DPS green sturgeon have experienced serious declines in abundance and long-term population trends that suggest a negative growth rate. Human-induced factors have reduced populations and degraded habitat, which in turn has reduced the population's resilience to natural events, such as droughts, floods, and variable ocean conditions. Global climate change presents another real threat to the long-term persistence of the population, especially when combined with the current depressed population status and human caused impacts. Within the project's action area in Central San Francisco Bay, the effects of shoreline development, industrialization, and urbanization are evident. As a result, forage species that green sturgeon depend on have been reduced throughout the San Francisco Bay Estuary.

During construction and dredging, water quality in the action area may be degraded through the disturbance of bottom sediments. Turbidity effects associated with construction activities will likely result in minor and temporary changes to fish behavior, and are not expected to adversely affect green sturgeon. NMFS does not anticipate any adverse effects to listed species or critical habitat from the on-land portion of the proposed Project, because the applicant will implement measures during construction and post-construction that prevent the runoff and discharge of pollutants from landside activities to the waters of San Francisco Bay.

Dredging may result in higher levels of turbidity for longer periods of time than other in-water activities. The Project proposes to use a mechanical (clamshell) dredge for dredging between July 31 and November 30. Few green sturgeon are expected to be present at or in close proximity to the dredge site during dredging activities. Anticipated turbidity levels are not expected to result in harm or injury, or behavioral responses that impair migration, foraging, or make green sturgeon more susceptible to predation. No adverse effects are anticipated at the potential dredge disposal sites because the wetland restoration re-use sites are isolated from the waters of San Francisco Bay by levees and the SF-DODS is located in the open ocean, approximately 50 miles off-shore with water depths of 10,000 feet. At SF-DODS, threatened green sturgeon are unlikely to be present because this species is typically found on the continental shelf in ocean waters less than 500 feet deep. Post-dredging, the newly exposed Bay floor surface is expected to contain lower levels of contaminants in the sediments when compared to pre-dredge sediment levels.

Threatened green sturgeon may be adversely affected by elevated underwater sound levels during the driving of large steel piles with an impact hammer. Peak SPLs above 206 dB from a single strike will be limited to the area immediately adjacent to the pile (3 feet and up to 13 feet from the pile). It is unlikely individual fish will occur within this close in proximately during construction activities since equipment will likely startle fish away from the pile driving sites before pile driving initiates and a bubble curtain will likely prevent fish from being located within 13 feet of the piles. However, accumulated SELs may result in injury or death to green sturgeon if individuals remain within a distance of 900 feet from the piles being driven. NMFS expects the number of green sturgeon exposed to this effect to be small because the duration of pile driving is short (up to 12 days), the area of effect is small (109 acres), and the abundance of green sturgeon in the action area expected to be low. In addition, exposed sturgeon would be unlikely to remain in the same location to experience the full duration of the pile driving due to tidal currents and behavioral movements. Behavioral effects during pile driving may extend up to 7,067 feet. This noise may discourage green sturgeon from utilizing the action area during construction, but this area represents a small portion of the Central San Francisco Bay and these habitat areas will become available again once the 12 days of pile driving is completed.

Upon completion, the new facility will contain berths for passenger ferry vessels during maintenance and mooring. With 11 ferries transiting the berthing facility up to four times each day, water quality may be degraded and fish startled by this disturbance. Increased levels of turbidity and fish disturbance associated with ferry boat arrivals and departures are expected to last for a matter of a few minutes during each trip, and the effects of this boat traffic are expected to be negligible.

The action area is designated critical habitat for southern DPS green sturgeon. Critical habitat is expected to be impacted through temporary degradation of water quality and temporary impacts to foraging habitat. Water quality may be degraded through increased turbidity and suspension of sediment-borne contaminants. Foraging and migratory habitat will be temporarily affected during project activities through elevated SPLs, physical disturbance of benthic habitat, and the associated impacts to food resources. Once the pile driving is complete, temporary impacts from elevated SPLs will cease. Temporary impacts from the very small areas of benthic habitat disturbed by the removal and placement of piles will recover in 1-3 years. Removal of the remnant marina and construction of the new berthing facility will result in the elimination of approximately 1,620 sq ft of overwater structures. This removal of structure will allow light penetration to areas previously shaded and these sites will have the opportunity to re-colonize with submerged vegetation and benthic organisms.

Based on the above, a small number of juvenile, sub-adult, and adult green sturgeon are expected to be adversely affected by the Project's proposed pile driving activities. However, it is unlikely that the small potential loss of individuals as a result of the Project will impact future adult returns, due to the large number of individual green sturgeon unaffected by the Project compared to the small number of green sturgeon likely affected by the Project. Due to the life history strategy of green sturgeon that spawn every 3-5 years over an adult lifespan of as much as 40 years (Moyle 2002), the few individuals injured or killed during pile driving are likely to be replaced in subsequent generations of green sturgeon.

Regarding future climate change effects in the action area, California could be subject to higher average summer air temperatures and lower total precipitation levels. The Sierra Nevada snow pack is likely to decrease by as much as 70 to 90 percent by the end of this century under the highest emission scenarios modeled. Reductions in the amount of snowfall and rainfall would reduce stream flow levels in Northern and Central Coastal rivers. Estuaries may also experience changes in productivity due to changes in freshwater flows, nutrient cycling, and sediment amounts. For this Project, construction would be completed within the next 2-3 years and the above effects of climate change will not be detected within that time frame. The short-term effects of project construction will have completely elapsed prior to initiation of climate change effects. Since the effects to listed fish associated with the future operation of the facility are negligible, future climate change effects will not add to the anticipated effects of this Project.

2.7 Conclusion

After reviewing and analyzing the current status of green sturgeon and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' biological opinion that the WETA Central Bay Operations and Maintenance Facility Project is not likely to jeopardize the continued existence of threatened southern DPS green sturgeon or destroy or adversely modify its designated critical habitat.

2.8 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement.

2.8.1 Amount or Extent of Take

In this biological opinion, NMFS determined that incidental take would occur as follows: NMFS anticipates that take of threatened green sturgeon associated with the WETA Central Bay Operations and Maintenance Facility Project in Alameda County, California will be in the form of injury or death caused by impact hammer pile driving.

Due to the relatively small area of potential effect and its location under water with low visibility, NMFS was not able to estimate the specific number of juvenile green sturgeon that may be in the action area during the proposed action. Monitoring or measuring the number of listed fish actually injured or killed by elevated sound levels during pile driving is also not feasible. Observation of injured or killed fish is unlikely because they may not float to the surface or may be carried away by the strong currents in and near the action area into the larger portions of Central San Francisco Bay. Due to the difficulty in quantifying the number of listed green sturgeon affected by pile driving, a surrogate measure of take is necessary to establish a limit to the take exempted by this incidental take statement. For this action, compliance with the expected elevated underwater sound levels during pile driving is the best surrogate measure for incidental take associated with project implementation. Therefore, NMFS will consider the extent of take exceeded if elevated sound levels during pile driving indicates that accumulated sound pressure levels greater than 187 dB SEL extend beyond 900 feet during the installation of any of the piles. This distance represents the maximum area where green sturgeon injury or death is reasonably certain during pile driving for this project.

2.8.2 Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the Southern DPS of green sturgeon or destruction or adverse modification of its critical habitat.

2.8.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of green sturgeon:

1. Ensure construction methods, minimization measures, and monitoring are properly implemented and assist in the evaluation of Project's effects on green sturgeon.

2. Submit reports regarding the construction of the Project and the results of the hydroacoustic monitoring program.

2.8.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the FTA or any applicant must comply with them in order to implement the reasonable and prudent measures (50 CFR 402.14). The FTA or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this incidental take statement (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1:

   a. Prior to the initiation of construction, WETA shall develop and submit to NMFS for review a hydroacoustic monitoring plan that includes underwater sound measurements at various distances and depths from pile driving operations;

b. WETA shall make available to NMFS data from the hydroacoustic monitoring program on a real-time basis (*i.e.*, daily monitoring data should be accessible to NMFS upon request);

c. WETA shall allow any NMFS employee(s) or any other person(s) designated by NMFS, to accompany field personnel to visit the project sites during construction activities described in this opinion;

d. If any sturgeon are found dead or injured during visual observations, the biologist shall contact NMFS biologist Gary Stern by phone immediately at (707) 575-6060 or the NMFS North Central Coast Office at (707) 575-6050. All sturgeon mortalities shall be retained, placed in an appropriately-sized sealable plastic bag, labeled with the date and location of collection, fork length, and be frozen as soon as possible. Frozen samples shall be retained by the biologist until specific instructions are provided by NMFS. The biologist may not transfer biological samples to anyone other than the NMFS North Central Coast Office without obtaining prior written approval from the NMFS North Central Coast Office. Any such transfer will be subject to such conditions as NMFS deems appropriate.

2. The following term and condition implements reasonable and prudent measure 2:

   a. The FTA or WETA shall provide a written report to NMFS by January 15 of the year following construction of the Project. The report shall be submitted to NMFS North Central Coast Office, Attention: Supervisor of the San Francisco Bay Branch, 777 Sonoma Avenue, Room 325, Santa Rosa, California, 95404-6528. The report shall contain, at a minimum, the following information:

      i. **Construction related activities --** The report shall include the dates construction began and was completed; a description of any and all measures taken to minimize effects on ESA-listed fish; and the number of fish killed or injured during the project action.

      ii. **Hydroacoustic monitoring --** The report shall include the a description of the methods used to monitor sound, the dates that hydroacoustic monitoring was conducted; the locations (depths and distance from point of impact) where monitoring was conducted; the total number of pile strikes per pile, total number of strikes per day, the interval between strikes, the peak/SPL, RMS and SEL per strike, and accumulated SEL per day for each hydroacoustic monitor deployed; and the number of fish killed or injured during the pile driving.

2.9 Reinitiation of Consultation

This concludes formal consultation for the WETA Central Bay Operations and Maintenance Facility Project.

As 50 CFR 402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) the amount or extent of incidental taking specified in the incidental take statement is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

2.10 "Not Likely to Adversely Affect" Determinations

NMFS does not anticipate the proposed action will adversely affect:

Central California Coast steelhead (*Oncorhynchus mykiss*) **DPS**
threatened (71 FR 834; January 5, 2006)
critical habitat (70 FR 52488; September 2, 2005).

The effects of the proposed action are reasonably likely to include elevated underwater sound levels during pile driving, temporary degradations to water quality, entrainment, and habitat disturbance as described above. By restricting pile driving activities with an impact hammer to the period between June 15 and November 30 and dredging activities to July 31 and November 30, the project avoids the majority of the migration season of adult and juvenile Central California Coast (CCC) steelhead in San Francisco Bay. Thus, NMFS anticipates CCC steelhead are extremely unlikely to be present in the action area during in-water construction activities and effects of these activities are expected to be discountable for CCC steelhead.

Effects on water quality and resulting impacts on CCC steelhead are similar to effects on green sturgeon described in section 2.4.1.4. Pile removal and other project activities are expected to create temporary increases in turbidity via sediment suspension in the adjacent water column. The extent of turbidity associated with this project is not expected to result in levels that adversely affect CCC steelhead or their critical habitat. If CCC steelhead temporarily relocate from areas of increased turbidity, habitat of similar value is available in San Francisco Bay adjacent to the action area, and other areas in San Francisco Bay offer equal or better habitat value for displaced individuals. NMFS also expects tidal circulation in San Francisco Bay will quickly return any turbidity in the action area to background levels. Therefore, NMFS expects effects of increased levels of turbidity and suspended sediment will be insignificant on CCC steelhead and their critical habitat.

In addition to the creation of relatively small areas of temporary turbidity, the suspension of bottom sediments may also release contaminants to the water column. However, based on the project description (including the type of activities conducted, the work span, and equipment used) the potential release of contaminants during construction is expected to be localized and short-term. Any minor and localized elevations in contaminants which might result from construction activities should be quickly diluted by tidal circulation to levels that are unlikely to adversely affect CCC steelhead or their critical habitat. Also, the project applicants will develop and implement a spill and prevention plan to avoid any impacts of potential contamination from project activities. Therefore, impacts of contamination are expected to be insignificant on CCC steelhead and their critical habitat.

Project activities (removal and installation of piles, dredging) will disturb bottom sediments and the associated benthic community in a small portion of the project's action area. This disturbance may remove prey organisms for CCC steelhead. However, once construction activities are completed, the benthic community in disturbed areas is expected to recover over a few months to a few years based on recovery rates from benthic disturbance in the scientific literature (Oliver *et al.* 1977; Watling *et al.* 2001). Although temporary, forage resources for fish that feed on the benthos are expected to be reduced during this recovery period. Based on site conditions in the action area, NMFS assumes full recovery of prey resources within the direct footprint of the dredged area activities will require at least one year. Because of the small size of disturbed areas (directly adjacent to pilings removed), NMFS expects CCC steelhead will be able to find prey items in nearby areas while the disturbed areas recover. Therefore, effects of disturbance on CCC steelhead their critical habitat are expected to be insignificant.

3. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

3.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is the FTA. Other interested users could include WETA, US Fish and Wildlife Service, San Francisco Bay Conservation and Development Commission, and the State Water Quality Control Board. Individual copies of this opinion were provided to FTA. This opinion will be posted on the Public Consultation Tracking System web site (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts). The format and naming adheres to conventional standards for style.

3.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

3.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook and ESA regulations, 50 CFR 402.01 *et seq.*

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA implementation and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

4. REFERENCES

Adams, P.B., C.B. Grimes, S.T. Lindley, and M.L. Moser. 2002. Status Review for North American Green Sturgeon, *Acipenser medirostris*. National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz, California. 49 pages.

Adams, P.B., C.B. Grimes, J.E. Hightower, S.T. Lindley, M.L. Moser, and M.J. Parsley. 2007. Population status of North American green sturgeon, *Acipenser medirostris*. Environmental Biology of Fishes 79:339-356.

Allen P.J., J.J. Cech, Jr. 2007. Age/size effects on juvenile green sturgeon, *Acipenser medirostris*, oxygen consumption, growth, and osmoregulation in saline environments. Environmental Biology of Fishes 79:211–229.

Baseline Environmental Consulting. 2010. Phase 1 Environmental Site Assessment - Southeast Corner of W. Hornet and Ferry Point Road, Alameda, California. Prepared for the San Francisco Bay Area Water Emergency Transportation Authority, Planning and Development, San Francisco, CA January 2010. (Appendix C in Initial Study/Mitigated Negative Declaration for the Central Bay Operations and Maintenance Facility, March 2011).

Benfield, M.C. and T.J. Minello. 1996. Relative effects of turbidity and light intensity on reactive distance and feeding of an estuarine fish. Environmental Biology of Fish 46(2):211-216.

Cayan, D., M. Tyree, and S. Iacobellis. 2012. Climate Change Scenarios for the San Francisco Region. Prepared for California Energy Commission. Publication number: CEC-500-2012-042. Scripps Institution of Oceanography, University of California, San Diego.

Chin, J.L., Woodrow, D.L., McGann, Mary, Wong, F.L., Fregoso, Theresa, and Jaffe, B.E. 2010. Estuarine sedimentation, sediment character, and foraminiferal distribution in central San Francisco Bay, California: U.S. Geological Survey Open-File Report 2010-1130, 58 pages plus data tables and GIS data.

Cloern, J. E., N. Knowles, L. R. Brown, D. Cayan, M. D. Dettinger, T. L.Morgan, D. H. Schoellhamer, M. T. Stacey, M. van der Wegen, R. W. Wagner, and A. D. Jassby. 2011. Projected Evolution of California's San Francisco Bay-Delta-River System in a Century of Climate Change. PLoS ONE 6(9):13.

Collie, J.S., S.J. Hall, M.J. Kaiser, and I.R. Poiner. 2000. A quantitative analysis of fishing impacts on shelf-sea benthos. Journal of Animal Ecology 69: 785-798.

Cox, P., and D. Stephenson. 2007. A changing climate for prediction. Science 113:207-208.

Currie, D.R., Parry, G.D. 1996. Effects of scallop dredging on a soft sediment community: a large-scale experimental study. Oceanographic Literature Review 43(12).

DWR. 2013. San Francisco Bay Hydrologic Region. California Water Plan Update 2013. State of California Natural Resource Agency Department of Water Resources, Sacramento, California.

Dumbauld, B. R., D. L. Holden, and O. P. Langness. 2008. Do sturgeon limit burrowing shrimp populations in Pacific Northwest estuaries? Environmental Biology of Fishes 83:283-296.

Eisler, R. 2000. Handbook of chemical risk assessment: health hazards to humans, plants, and animals. Volume 1, Metals. Boca Raton, FL, Lewis Press.

Feist, M.L. Blake E., James J. Anderson and Robert Miyamoto. 1992. Potential impacts of pile driving on juvenile pink (*Oncorhynchus gorbuscha*) and chum (*O. keta*) salmon behavior and distribution. FRI-UW-9603. Fisheries Resources Institute, University of Washington. Seattle.

Fewtrell, J.H. 2003. The response of finfish and marine invertebrates to seismic survey noise. Thesis presented for the degree of Doctor of Philosophy, Curtin University of Technology. Muresk Institute. October 2003, 20 pages.

Fisheries Hydroacoustic Working Group (FHWG). 2008. Agreement in Principle for the Interim Criteria for Injury to Fish from Pile Driving Activities. The Fisheries Hydroacoustic Working Group. June 12, 2008.

Glasby, T. M. 1999. Effects of shading on subtidal epibiotic assemblages. Journal of Experimental Marine Biology and Ecology, 234: 275-290.

Hastings, M. C. 1995. Physical effects of noise on fishes. Proceedings of INTER-NOISE 95. The 1995 International Congress on Noise Control Engineering, Volume II: 979–984.

Hastings, M.C., A.N. Popper. 2005. Effects of sound on fish. Jones and Stokes, Sacramento, CA.

Hearn, A.R., E.D. Chapman, A.P. Klimley, P.E. LaCivita, and W.N. Brostoff. 2010. Salmonid smolt outmigration and distribution in the San Francisco Estuary 2010. Interim Draft Report, University of California Davis and US Army Corp of Engineers. 90 p.

Helfman, G. S. 1981. The advantage to fishes of hovering in shade. Copeia 2: 392-400.

Heublein, J. C., J. T. Kelly, C. E. Crocker, A. P. Klimley, and S. T. Lindley. 2009. Migration of green sturgeon, *Acipenser medirostris*, in the Sacramento River. Environmental Biology of Fishes 84:245–258.

Huff, D.D., S.T. Lindley, P.S. Rankin, and E.A. Mora. 2011. Green sturgeon physical habitat use in the coastal Pacific Ocean. PLOS One 6(9):e25156.

ICF Jones and Stokes and Illingworth and Rodkin Inc. 2009. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish – Final. Prepared for: California Department of Transportation: 298.

Illingworth and Rodkin, Inc. 2007. Compendium of Pile Driving Sound Data. Prepared for the California Department of Transportation, September 27, 2007. Available at: http://www.dot.ca.gov/hq/env/bio/files/pile_driving_snd_comp9_27_07.pdf.

Illingworth and Rodkin, Inc. 2012. Updated Compendium of Pile Driving Sound Data. Prepared for the California Department of Transportation, October, 2012. Available at: http://www.dot.ca.gov/hq/env/bio/files/hydroacstc_compendium.pdf.

Israel, J.A., K.J. Bando, E.C. Anderson, and B. May. 2009. Polyploid microsatellite data reveal stock complexity among estuarine North American green sturgeon (*Acipenser medirostris*). Canadian Journal of Fisheries and Aquatic Sciences 66:1491 – 1504.

Israel, J.A. and B. May. 2010. Indirect genetic estimates of breeding population size in the polyploidy green sturgeon (*Acipenser medirostris*). Molecular Ecology 19:1058-1070.

Kadir, T., L. Mazur, C. Milanes, and K. Randles. 2013. Indicators of Climate Change in California. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment Sacramento, CA.

Kelly, J. T., A. P. Klimley, and C. E. Crocker. 2007. Movements of green sturgeon, *Acipenser medirostris,* in the San Francisco Bay Estuary, California. Environmental Biology of Fishes 79:281-295.

Lindley, S.T., M.L. Moser, D.L. Erickson, M. Belchik, D.W. Welch, E.L. Rechisky, D. Vogel, J.T. Kelly, J.C. Heublein, and A.P. Klimley. 2008. Marine Migration of North American green sturgeon. Transactions of the American Fisheries Society 137:182–194.

Lindley, S.T., D.L. Erickson, M.L. Moser, G. Williams, O.P. Langness, B.W. McCovey Jr., M. Belchik, D. Vogel, J.T. Kelly, J.C. Heublein, and A.P. Klimley. 2011. Electronic tagging of green sturgeon reveals population structure and movement among estuaries. Transactions of the American Fisheries Society 140:108–122.

Lombarte, A., Yan, H.Y., Popper, A.N., Chang, J.C., Platt, C. 1993. Damage and regeneration of hair cell ciliary bundles in a fish ear following treatment with gentamicin. Hearing Research 66:166 – 174.

McCauley, J.E., R.A. Parr, and D.T. Hancock. 1976. Benthic infauna and maintenance dredging: a case study. Water Research 11:233-242.

MEC Analytical Systems, Inc. & U.S. Army Engineer Research and Development Center. 2004. Spatial characterization of suspended sediment plumes during dredging operations through acoustic monitoring. Technical report to the U.S. Army Corps of Engineers, San Francisco District, San Francisco, CA.

Moser, M. L., and S. T. Lindley. 2007. Use of Washington estuaries by subadult and adult green sturgeon. Environmental Biology of Fishes 79:243–253.

Moyle, P.B. 1976. Inland fishes of California: First Edition. University of California Press. Berkeley, Los Angeles and London. 405 pages.

Moyle, P.B., R.M. Yoshiyama, J.E. Williams, E.D. Wikramanayake. 1995. Fish species of special concern in California. Department of Wildlife and Fisheries Biology, UC Davis.

Moyle, P.B. 2002. Inland fishes of California: Second edition. University of California Press, Berkeley and Los Angeles, CA. 502 pages.

Nakamoto, R. J., T. T. Kisanuki, and G. H. Goldsmith. 1995. Age and growth of Klamath River green sturgeon (*Acipenser medirostris*). U.S. Fish and Wildlife Service Project 93-FP-13, Yreka, CA. 20 pages.

Newell, R.C., L.J. Seiderer, and D.R. Hitchcock. 1998. The impact of dredging on biological resources of the sea bed. Oceanography and Marine Biology Annual Review 336:127-178.

Nelson, T.C., P. Doukakis, S.T. Lindley, A.D. Schreier, J.E. Hightower, L.R. Hildebrand, R.E. Whitlock, and M.A.H. Webb. 2010. Modern technologies for an ancient fish: tools to inform management of migratory sturgeon stocks. A report for the Pacific Ocean Shelf Tracking (POST) Project.

Nightingale, B. and C.A. Simenstad, Jr. 2001. Dredging activities: Marine issues. Seattle, WA 98105: Washington State Transportation Center, University of Seattle.

NMFS (National Marine Fisheries Service). 2005. Green sturgeon (*Acipenser medirostris*) status review update. Biological review team- Southwest Fisheries Science Center (NMFS). Santa Cruz, NOAA Fisheries.

NMFS (National Marine Fisheries Service). 2009. The use of treated wood in aquatic environments: Guidelines to West Coast NOAA Fisheries staff for Endangered Species Act and Essential Fish Habitat Consultations in the Alaska, Northwest and Southwest Regions. United States Department of Commerce, National Oceanic and Atmospheric Administration, NOAA Fisheries. 58 pages.

Oliver, J. S., P. N. Slattery, L. W. Hulberg and J. W. Nybakken. 1977. Patterns of succession in benthic infaunal communities following dredging and dredged material disposal in Monterey Bay. U.S. Army Corps of Engineers. Technical Report D-77-27.

Pacific EcoRisk. 2012. Data Report for the Characterization of Port of San Francisco Piers 32-36, 28 South, 14 North and South, and 9 Sediments in Support of the 34th America's Cup: Dredge Materials Sampling and Analysis Results. Prepared for ESA and Port of San Francisco. February 2012. 58 pages.

Popper, A.N. and R. Fay. 1997. Evolution of the ear and hearing: issues and questions. Brain, Behavior and Evolution 50(4):213-221.

Poytress, W.R., J.J. Gruber, and J.P. Van Eenennaam. 2011. 2010 Upper Sacramento River Green Sturgeon Spawning Habitat and Larval Migration Surveys. Annual Report of U.S Fish and Wildlife Service to U.S. Bureau of Reclamation, Red Bluff, CA.

Radtke, L. D. 1966. Distribution of smelt, juvenile sturgeon, and starry flounder in the Sacramento-San Joaquin Delta with observations on food of sturgeon. Pages 115-129 *in*: J. L. Turner and D. W. Kelley, editors. Ecological studies of the Sacramento-San Joaquin Delta Part II: Fishes of the Delta. California Department of Fish and Game Fish Bulletin.

Ruggiero, P., C. A. Brown, P. D. Komar, J. C. Allan, D. A. Reusser, H. Lee, S. S. Rumrill, P. Corcoran, H. Baron, H. Moritz, J. Saarinen. 2010. Impacts of climate change on Oregon's coasts and estuaries. Pages 241-256 *in* K.D. Dellow and P. W. Mote, editors. Oregon Climate Assessment Report. College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, Oregon.

Sabol, B., D. Shafer, and E. Lord. 2005. Dredging effects on Eelgrass (*Zostera marina*) distribution in a New England small boat harbor. Final Report ERDC/EL TR-05-8. U.S. Army Corps of Engineers Research and Development Center, Vicksburg, MS.

San Francisco Regional Water Quality Control Board concentrations (SFRWQCB). 1998. Ambient Concentrations of Toxic Chemicals in San Francisco Bay Sediments: Draft Staff Report. San Francisco Regional Water Quality Control Board Lab, Oakland, CA.

Santer, B.D., C. Mears, C. Doutriaux, P. Caldwell, P.J. Gleckler, T.M.L. Wigley, S. Solomon, N.P. Gillett, D. Ivanova, T.R. Karl, J.R. Lanzante, G.A. Meehl, P.A. Stott, K.E. Talyor, P.W. Thorne, M.F. Wehner, and F.J. Wentz. 2011. Separating signal and noise in atmospheric temperature changes: The importance of timescale. Journal of Geophysical Research 116: D22105.

Scavia, D., J.C. Field, D.F. Boesch, R.W. Buddemeier, V. Burkett, D.R. Cayan, M. Fogarty, M.A. Harwell, R.W. Howarth, C. Mason, D.J. Reed, T.C. Royer, A.H. Sallenger, and J.G. Titus. 2002. Climate Change Impacts on U.S. Coastal and Marine Ecosystems. Estuaries, volume 25(2): 149-164.

Shin, H.O. 1995. Effect of the piling work noise on the behavior of snakehead (*Channa argus*) in the aquafarm. J. Korean Fish. Soc. 28(4):492-502.

Smith, J.J. 1990. The effects of sandbar formation and inflows on aquatic habitat and fish utilization in Pescadero, San Gregorio, Waddell and Pomponio Creek estuary/lagoon systems, 1985-1989. Department of Biological Sciences, San Jose State University, San Jose, California. December 21, 1990.

Smith, M.E., Coffin, A.B., Miller, D.L., Popper, A.N. 2006. Anatomical and functional recovery of the goldfish (*Carassius auratus*) ear following noise exposure. Journal of Experimental Biology 209:4193 – 4202.

Sonalysts. 1996. Acoustic measurements during the Baldwin Bridge Demolition (Final) Report, Appendix B/C. Sonalysts, Inc., Waterford, CT.

Struck, S. D., C. B. Craft, S. W. Broome, M. D. Sanclements and J. N. Sacco. 2004. Effects of bridge shading on estuarine marsh benthic invertebrate community structure and function. Environmental Management, 34: 99-111.

Stutes, A. L., J. Cebrian and A. A. Corcoran. 2006. Effects of nutrient enrichment and shading on sediment primary production and metabolism in eutrophic estuaries. Marine Ecology Progress Series, 312: 29-43.

Thompson, J.K., K. Hieb, K. McGourty, N. Cosentino-Manning, S. Wainwright-De La Cruz, M. Elliot, S. Allen. 2007. Habitat type and associated biological assemblages: soft bottom substrate. In: Schaeffer K., McGourty K., Cosentino-Manning N., eds. Report on the Subtidal Habitats and Associated Biological Taxa in San Francisco Bay. Santa Rosa, CA, US. National Oceanic and Atmospheric Administration, 18-23 (Table 3a), 37-46.

Tuck, I.D., S.J. Hall, and M.R. Robertson. 1998. Effects of physical trawling disturbance in a previously unfished sheltered Scottish sea loch. Marine Ecology-Progress Series, 162: 227-242.

Van der Veer, H., M.J.N. Bergman, and J.J. Beukema. 1985. Dredging activities in the Dutch Wadden Sea effects on macrobenthic infauna. Netherlands Journal for Sea Research

19:183-190.

Van Eenennaam, J.P., J. Linares-Casenave, X. Deng, and S.I. Doroshov. 2005. Effect of incubation temperature on green sturgeon, *Acipenser medirostris*. Environmental Biology of Fishes 72:145-154.

Van Eenennaam, J. P., J. Linares, S. I. Doroshov, D. C. Hillemeier, T. E. Willson, and A.A. Nova. 2006. Reproductive conditions of the Klamath River green sturgeon. Transactions of the American Fisheries Society 135:151-163.

Watling, L., R.H. Findlay, L.M. Lawrence, and D.F. Schick. 2001. Impact of a scallop drag on the sediment chemistry, microbiota, and faunal assemblages of a shallow subtidal marine benthic community. Journal of Sea Research, 46: 309-324.