UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

Refer to NMFS No: WCRO-2019-00143

September 9, 2019

William Guthrie
Chief, California Delta Section Regulatory Division
Sacramento District
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response, and Fish and Wildlife Coordination Act Recommendations for the AMPORTS Antioch Berth Rehabilitation Project in Contra Costa County, California.

Dear Mr. Guthrie:

Thank you for your letter of February 28, 2019, requesting initiation of consultation with the National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA, 16 U.S.C. 1531 et seq.) for the AMPORTS Antioch Berth Rehabilitation Project (Project).

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA, 16 U.S.C. 1855(b)) for this action. NMFS' review concludes that the Project will adversely affect the EFH of Pacific Coast Salmon, Coastal Pelagic, and Pacific Groundfish in the action area and therefore provides Conservation Recommendations.

Based on the best available scientific and commercial information, the biological opinion (BO) concludes that the AMPORTS Antioch Berth Rehabilitation Project is not likely to jeopardize the continued existence of the Federally listed endangered Sacramento River (SR) winter-run Chinook salmon evolutionarily significant unit (ESU, *Oncorhynchus tshawytscha*), threatened Central Valley (CV) spring-run Chinook salmon ESU (*O. tshawytscha*), threatened California Central Valley (CCV) steelhead distinct population segment (DPS, (*O. mykiss*)), or the threatened southern DPS (sDPS) of North American green sturgeon (*Acipenser medirostris*), and is not likely to destroy or adversely modify their designated critical habitats. For the above species, NMFS has included an incidental take statement with reasonable and prudent measures and nondiscretionary terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of listed species associated with the Project.

Because the proposed action will modify a stream or other body of water, NMFS also provides recommendations and comments for the purpose of conserving fish and wildlife resources under the Fish and Wildlife Coordination Act [16 U.S.C. 662(a)].

Please contact Page Vick at the California Central Valley Office of NMFS at (916) 930-3728 or via email at page.vick@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Maria Rea

Maria Rea
Assistant Regional Administrator
California Central Valley Office

Enclosure

cc: To the file 151422-WCR2019-SA00504

Electronic copy only:
Mr. Thomas Faughnan, Thomas.J.Faughnan@usace.army.mil
Ms. Chandra Jenkins, Chandra.L.Jenkins@usace.army.mil

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Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response and Fish and Wildlife Coordination Act Recommendations

AMPORTS Antioch Berth Rehabilitation Project

National Marine Fisheries Service ECO Number: WCRO-2019-00143

Action Agency: U.S. Army Corps of Engineers

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*)	Endangered	Yes	No	Yes	No
Central Valley spring-run Chinook salmon (*O. tshawytscha*)	Threatened	Yes	No	Yes	No
California Central Valley steelhead (*O. mykiss*) DPS	Threatened	Yes	No	Yes	No
Southern DPS of North American green sturgeon (*Acipenser medirostris*)	Threatened	Yes	No	Yes	No

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes
Coastal Pelagic	Yes	Yes
Pacific Groundfish	Yes	Yes

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

Issued By:

Maria Rea
Assistant Regional Administrator

Date: September 9, 2019

TABLE OF CONTENTS

LIST OF ACRONYMS

ACID	Anderson Cottonwood Irrigation District
BA	biological assessment
BD	breasting dolphin
BMPs	best management practices
BO	biological opinion
°C	degrees Celsius
CCV	California Central Valley
CDEC	California Data Exchange Center
CDFW	California Department of Fish and Wildlife
cm	centimeter
CV	Central Valley
CVP	Central Valley Project
dB	decibel
Delta	Sacramento-San Joaquin River Delta
DJFMP	Delta Juvenile Fish Monitoring Program
DO	dissolved oxygen
DPS	distinct population segment
DQA	Data Quality Act
EEZ	exclusive economic zone
EFH	essential fish habitat
ESA	Endangered Species Act
ESU	evolutionarily significant unit
°F	degrees Fahrenheit
ft	feet
ft^2	square feet
FMP	fishery management plan
FWCA	Fish and Wildlife Coordination Act
HAPC	habitat area of particular concern
HDPE	high density polyethylene
ITS	incidental take statement
m	meter
MD	mooring dolphin
MLLW	mean lower low water
mm	millimeter
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NMFS	National Marine Fisheries Service
NTU	nephelometric turbidity units
OHWM	ordinary high water mark
PAHs	polycyclic aromatic hydrocarbons
PBFs	physical or biological features
ppt	parts per thousand (unit)
RIBITS	Regulatory In-lieu Fee and Bank Information Tracking System
RMS	root-mean-square
RoRo	roll-on roll-off

LIST OF ACRONYMS CONTINUED

RWQCB	regional water quality control board
sDPS	southern distinct population segment
SEL	sound exposure level
SJRRP	San Joaquin River Restoration Program
SR	Sacramento River
SWP	State Water Project
TL	transmission loss
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
WEAP	worker environmental awareness program
yd^3	cubic yards
YOY	young-of-the-year

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3 below.

1.1 Background

NOAA's National Marine Fisheries Service (NMFS) prepared the biological opinion (BO) and incidental take statement (ITS) 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.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600.

Because the proposed action would modify a stream or other body of water, NMFS also provides recommendations and comments for the purpose of conserving fish and wildlife resources, and enabling the Federal agency to give equal consideration with other project purposes, as required under the Fish and Wildlife Coordination Act (FWCA) (16 U.S.C. 661 et seq.).

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 (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). A complete record of this consultation is on file at NMFS California Central Valley Office.

1.2 Consultation History

On February 28, 2019, NMFS received a letter and accompanying biological assessment (BA) from the U.S. Army Corps of Engineers (USACE) requesting initiation of section 7 consultation for the AMPORTS Berth Rehabilitation in Contra Costa County, California.

On March 15, 2019, NMFS issued an insufficiency letter to the USACE, requesting additional information in regard to construction details, effects analysis, and project descriptions that were not contained in the BA.

On March 27, 2019, NMFS received additional information from the USACE and WRA Consultants in response to the insufficiency letter addressing each outstanding item. In addition, the USACE requested a phone call with NMFS and WRA Consultants to discuss BA insufficiencies.

On March 28, 2019, NMFS, the USACE, and WRA Consultants discussed the document provided to NMFS on March 27.

On April 29, 2019, NMFS received an updated, complete BA from the USACE and WRA Consultants.

On May 2, 2019, NMFS notified the USACE that consultation was initiated.

1.3 Proposed Federal 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 USACE proposes to issue to AMPORTS, the applicant, a Clean Water Act section 404 permit to implement the Antioch Berth Rehabilitation Project (Project). AMPORTS is proposing a structural upgrade to the existing wharf by replacing existing creosote-treated timber breasting and mooring dolphins, associated connected walkways, and a roll-on roll-off (RoRo) ramp, which would connect the wharf to the shoreline. Project work would be conducted within the general footprint of the existing wharf facility. The purpose of the Project is to convert the former Gaylord Paper facility pulp berth to a RoRo berth in order to accommodate vessels that would deliver and transfer cargo from the property to offsite locations. The wharf is currently in an inoperable state and has not serviced vessels for several years. The unsafe structural condition of the wharf has led to general disuse until the financial means have come available to undergo upgrades and rehabilitation. Project activities include both in-water work (*i.e.*, pile removal and pile driving) and over-water work (*i.e.*, dock demolition, new dolphin and walkway construction, and timber repairs) described in more detail below.

The Project is located offshore along the San Joaquin River at 2301 Wilbur Avenue, in an unincorporated area of Contra Costa County, approximately 1.5 miles west of the Senator John A. Nejedly Bridge (Antioch Bridge), and east of Suisun Bay (Figure 1). The existing wharf is situated approximately 60 feet north of the south shoreline and south of West Island. Industrial and commercial facilities are located immediately to the west, east and south of the Project Area. The Sardis Unit of the Antioch Dunes National Wildlife Refuge is located approximately 1,400 feet (0.26 mile) west of the Project site.

Construction would take approximately five months to complete, and in-water work, which includes pile driving, would occur between July 1 and November 30 for concrete piles and August 1 to November 30 for steel piles. The in-water work would take approximately 8 to 14 weeks to complete. Construction work on structures raised above the water may occur outside of this in-water work window. All work would occur between 7:00am and 6:00pm on weekdays and between 9:00am and 5:00pm on weekends and holidays.

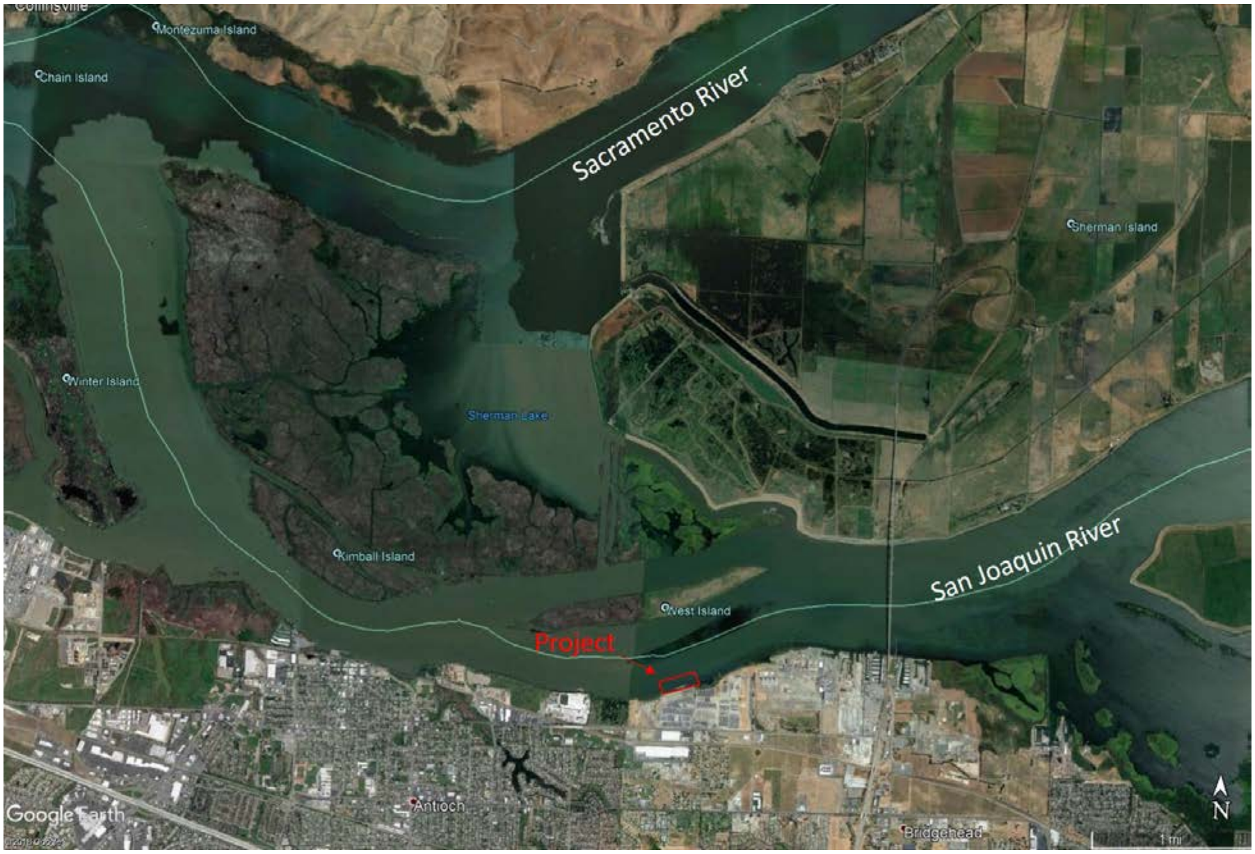

Figure 1. Map of Project Area (Source: Google Earth)

1.3.1 Description of Proposed Action

Proposed upgrades to the AMPORTS wharf include the removal of timber breasting and mooring dolphins, decking and framing piles, and east pier pile clusters comprised of a total of 128 12- and 15-inch diameter creosote-treated timber piles. The creosote-treated piles would be disposed of at an upland facility (not yet named). These piles would be replaced by five new breasting dolphins (BD-1 through BD-5) and one new mooring dolphin (MD-5) along with connecting walkways (Figure 2). The five new breasting dolphins would consist of one 72-inch steel pile equipped with an energy-absorbing fender. New breasting dolphin caps will be precast on land, then placed on top of the steel piles in-water. The new mooring dolphin would consist of one 72-inch steel pile. A new stern ramp and walkway would consist of 47 24-inch octagonal concrete piles. The stern ramp fender system would consist of 29 13-inch high density polyethylene (HDPE) piles. The Project would have a net increase of 377 cubic yards (yd^3) added in-water volume and a net increase of 9,228 square feet (ft^2) of over-water surface area (Table 1).

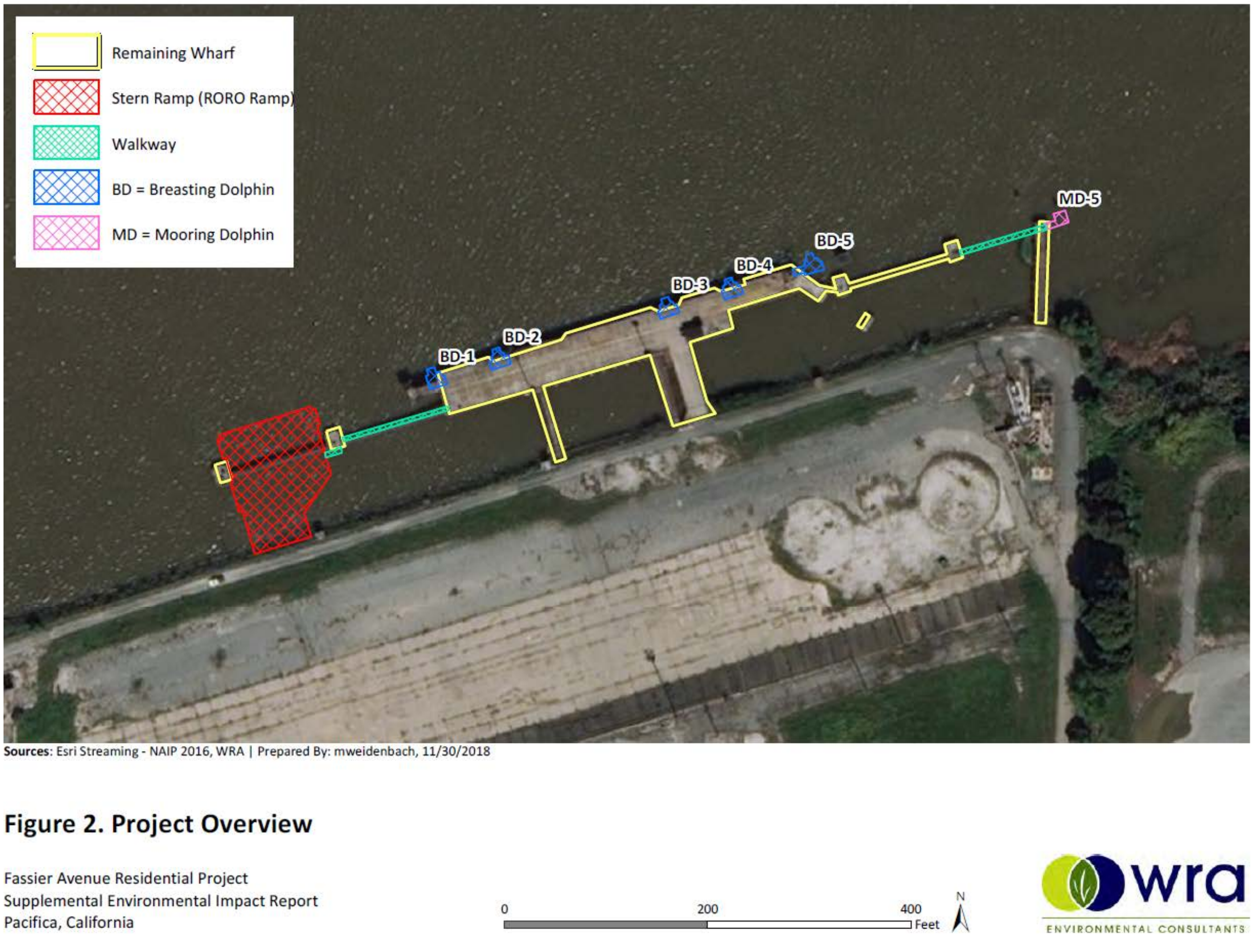

Figure 2. Project Overview (Source: BA)

1.3.1.1 Existing Structure to Remain in Place

The majority of the existing wharf will remain in place, with some small portions demolished and some structural and safety/operational repairs made as described below. An existing, isolated pier located to the east of the main wharf facilities will remain in place to allow operations and maintenance access to and egress from the easternmost mooring dolphins. There are two existing pipeways/timber walkways and an existing concrete ramp that connects the existing wharf facilities to the shoreline; these structures will remain in place to allow wharf access from the landside. These pipeways were previously used for the pulp conveyance, and will be left abandoned in place. Four existing mooring dolphins (MD-1 through MD-4) composed of 55 H-piles will remain in place.

Table 1. Construction Overview (Source: BA)

Structure Type	Solid / Grated Cover	Removed Over-Water Solid Surface Area (ft^2)	Added Over-Water Surface Area (ft^2)
Breasting Dolphins [BD-1, BD-2, BD-3, BD-4, BD-5]	Solid Cover	601	794
Existing Wharf Decking and Framing	Solid Cover	590	--
Stern Ramp and Fender System	Solid Cover	--	10,213
Mooring Dolphin [MD-5]	Solid Cover	--	186
Stairs, walkways	Removed Solid Cover New Grated Cover	1,441	667
	Total	**2,632**	**11,860**
	Summary	**9,228 ft^2 Total Net New Over-Water Cover (Including 667 ft^2 of Grated Cover)**	

1.3.1.2 Structural and Operational Safety Repairs and Improvements

The Project also includes structural and operational safety repairs and improvements to the existing wharf. Concrete spall repairs would involve removing and replacing loose material with new concrete. Existing steel support beams would be repaired by removing surface materials (oil, grease, dirt, etc.) and by coating the steel support beams with new epoxy-based paint. Up to five existing corroded steel piles would be repaired using fiberglass pile sleeve. Corroded portions of piles would be removed, fiberglass pile sleeves would be installed, and a fully contained grout mixture would be injected into the piles sleeves. Existing mooring dolphins (MD-1 through MD-4, composed of 55 H-piles) would have their original epoxy coating repaired above the mean lower low water (MLLW). Damaged wood on the existing retained walkways would be replaced in-kind. Minor repairs would be conducted on existing decking and railing of walkways, including adding a raised safety rail to existing decking. New HDPE fender piles and blocking would be installed to replace damaged, missing, and removed creosote-treated fender piles and block as needed. Repairs to the existing piles would be performed concurrently with demolition and/or construction activities within the in-water work window, and would be performed from a barge moored alongside the wharf, small work skiff, and work floats.

1.3.1.3 Demolition of Structures without Replacement

Selected reaches of the existing concrete and timber decking and framing along the northern and western margins of the existing wharf would be demolished and not replaced. This would result in a reduction of 590 ft^2 of solid over-water cover (Table 1) and removal of 56 creosote-treated piles (Table 2). Less than 65 ft^2 of pile-related fill would be removed. The decking would be removed by a combination of work on the wharf and by barge. Materials would be transported by barge to an approved disposal location.

Two clusters of existing creosote-treated piles (eight total) will be demolished immediately north of the pier and will not be replaced. This will result in the removal of 6 ft^2 of pile-related fill. A barge would be used to remove the timber creosote pilings by using one or a combination of the following methods: (1) vertical pulling -- gripping the pile with a chain, cable or collar and pulling up vertically with a cable or hydraulic crane (preferred method of removal), (2) vibratory extraction -- attaching a vibratory hammer to the pile and pulling vertically with a crane or excavator, or (3) horizontal snapping and breaking -- pushing or pulling the pile laterally to break the pile off near the mudline (*e.g.*, the weakest point). Because horizontal snapping and breaking does not completely remove the pile, a clamshell and/or chain would be used to grip the remaining broken piece and complete the removal process. The pilings and/or piling remnants would be loaded onto a barge and removed from the Project area to an approved disposal facility. Pile-removing equipment includes a derrick barge, a tug, a material barge to hold the removed piles and debris, and one or more smaller craft to move workers, supplies, anchors and other equipment.

Table 2. Summary of New and Removed In-Water Piles (Source: BA)

Structure Type	# Piles Removed	# New Piles	Removed In-Water Volume (yd^3)	Added In-Water Volume (yd^3)	Removed In-Water Surface Area (ft^2)	Added In-Water Surface Area (ft^2)
Breasting Dolphins (BD-1, BD-2, BD-3, BD-4, BD-5) [Remove 16 -12" creosote piles, ea, BD 1-4, Replace with 1-72" pile ea, BD 1-5]	64	5	71	190	50	141
Decking and Framing (including walkway between MD-1 & MD-2) [Remove 12" and 15" creosote piles]	56	--	79	--	65	--
East Pier Pile Clusters [Remove 12" creosote piles]	8	--	7	--	6	--
Stern Ramp Fender System [13" HDPE piles]	--	29	--	38	--	26
Stern Ramp and Walkway [24" concrete piles]	--	47	--	127	--	155
Mooring Dolphin (MD-5) [72" steel pile]	--	1	--	22	--	28
Totals	**128**	**82**	**157**	**377**	**121**	**350**
Net Change	**- 46**		**+ 220**		**+ 229**	

1.3.1.4 Demolition and Replacement of Existing Structures

All of the four existing breasting dolphins (BD-1 through BD-4) have failed, either structurally, geotechnically, or both. The existing breasting dolphins would be demolished and replaced with new dolphins equipped with energy absorbing fenders. This includes removing a total of 64 timber creosote piles, 16 12-inch piles per breasting dolphin using the pile removal methods described above. The new breasting dolphins would provide berthing capabilities to vessels along the face of the wharf. These four existing breasting dolphins would each be replaced with a single 72-inch steel pile outfitted with an energy-absorbing fender (Table 2). Approximately 601 ft^2 of existing solid over water cover will be demolished and removed and 600 ft^2 of new solid over-water cover will be installed during construction. This would result in 50 ft^2 of pile-related fill to be removed and 113 ft^2 of pile-related fill to be replaced (Table 1).

The portion of the western walkway from the existing wharf to mooring dolphin 2 (MD-2) is expected to be demolished and replaced with a new grated decking walkway. Wherever feasible, the Project has been designed to incorporate grated decking into areas being replaced. Approximately 1,441 ft^2 of solid over-water cover would be demolished and removed as a result of the Project, and replaced with approximately 667 ft^2 of grated decking material associated with the new stern ramp deck described below (Table 1).

Approximately 26 to 30 existing creosote-treated, 12- to 14-inch diameter, timber fender piles at the existing wharf would be removed and replaced by 13-inch diameter HDPE fender piles with no net change in volume or area (Table 2). Some associated creosote-treated blocking between the piles at the approximate deck elevation would also be replaced with HDPE lumber with no net change in cover area.

1.3.1.5 New Construction and Repairs

In order to accommodate larger vessels, one completely new breasting dolphin (BD-5) and one completely new mooring dolphin (MD-5) would be constructed. BD-5 would consist of one 72-inch steel pile and an energy-absorbing fender with new mooring hardware, while MD-5 would consist of one 72-inch steel pile with new mooring hardware (Table 2). The new breasting and mooring dolphins would result in approximately 186 ft^2 of new solid over-water cover and less than 28 ft^2 of new pile-related fill. Also, less than 380 ft^2 of new solid deck area will be installed (Table 1).

1.3.1.6 Pile Driving Activity

A vibratory hammer would be used for both removal and installation of piles. For pile extraction, a vibratory hammer would be attached to the pile and then the pile would be pulled vertically with a crane. Timber piles contained within the existing breasting dolphins would be broken off at the mudline to preserve the lateral soil capacities for the new steel piles to be placed nearby. For installation, a vibratory hammer would be used to sink steel piles until refusal, and installation is intended to be completed with an impact hammer. The vibratory hammer would also be used to install 29 new HDPE piles to the stern ramp fender system. Each steel pile is estimated to require approximately 30 minutes of vibratory driving, and 600 to 1,700 blows with an impact hammer to drive the piles to their final depth. Piles will be driven about 70 to 90 feet below the mudline, depending on location and pile use (Table 3). The impact hammer will be used for approximately 40 minutes on the steel piles. The impact hammer would employ a hammer metal cushion and "soft-start" (slowly increasing the intensity of strikes). In addition, a bubble curtain system would be deployed when installing steel piles to reduce underwater noise levels. A diesel impact hammer would be used to drive the 24-inch octagonal concrete piles for the stern ramp and walkway with a similar rate of 40 blows per minute and 500 blows per pile. AMPORTS anticipates that one steel pile (72-inch) and three concrete piles (24-inch) will be installed per day. Concrete pile driving is estimated to account for approximately 38 minutes of driving per day. In-water construction is estimated to be 56 to 98 days and will occur between July 1 and November 30.

Table 3. Pile Driving Estimations (Source: BA)

Pile Size and Type	Estimated Strikes	Attenuation	Single Strike Peak*	Single Strike RMS*	Single Strike SEL*	Cumulative SEL (dB) at 10 m	Distance to 187 dB Cumulative SEL (m)	Distance to 183 dB Cumulative SEL (m)
72-inch steel shell pile	1,600	bubble curtain, metal cushion block	206	188	176	208	253	470
24-inch octagonal concrete	500	Unattenuated	187	175	165	190	16	29
*= measurements at 10 m.								

1.3.1.7 Monitoring

Underwater sound monitoring will be conducted by a qualified biologist during impact hammer driving of steel piles and for the first five concrete piles. Accumulated sound exposure levels (SEL) will adhere to the levels permitted by NMFS and the USFWS (Fisheries Hydroacoustic Working Group 2008). Any incidents of exceedance of the SEL standards will be reported to NMFS by the applicant within 24 hours. The biologist will also monitor the site for injury or mortality of listed fish. Any injured or dead fish will be reported to NMFS within 24 hours.

1.3.2 Interrelated and Interdependent Actions

Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

Under the FWCA, an action occurs whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and drainage, by any department or agency of the United States, or by any public or private agency under Federal permit or license” (16 USC 662(a)).

“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 activities associated with the proposed action.

1.3.3 Proposed Minimization Measures to Protect Fish and Wildlife

Design features integrated into the Project to avoid, minimize, or compensate for potential impacts to listed species and designated critical habitats include the following:

1. All in-water work will be conducted between July 1 to November 30.

2. Prior to construction, a worker environmental awareness program (WEAP) will be conducted to discuss potential listed species on the site. At minimum, the WEAP will consist of a brief presentation by persons knowledgeable in listed species biology and legislative protection to those personnel performing in-water work associated with the Project. Contractors, their employees, and agency personnel will undergo WEAP training prior to involvement with Project construction activities. The WEAP includes:
    a. A description of the species and their habitat needs;
    b. Reports of occurrences in the action area;
    c. An explanation of the status of each listed species and their protection under the ESA; and
    d. A list of measures being taken to reduce potential effects to the species during construction and implementation.

3. To ensure contaminants are not introduced into the waterway, best management practices (BMPs) will be implemented during demolition and construction. BMPs used on site include:
    a. A Spill Prevention and Control Plan to prevent and control potential spill of hazardous material associated with mechanical equipment (*e.g.*, oil, gas, hydraulic fluid), as well as measures to minimize contact with the stream bed, such as work pads. The Spill Prevention and Control Plan and materials necessary to implement it will be accessible on site;
    b. A debris containment boom will be installed around the work area to ensure that any debris discharged into the water will be recovered immediately.

4. A vibratory hammer will be used to start the installation of each steel pile and will continue as long as geotechnical conditions permit. Vibratory hammering will be conducted without sound attenuation minimization measures.

5. When the steel pile has reached refusal with the vibratory hammer, then an impact hammer will be used to complete pile installation to its final elevation. Use of an impact hammer will include all of the following underwater sound reduction measures:
    a. Use of impact hammer only during daylight hours;
    b. Use of a “soft start,” gradually increasing the energy and frequency of impacts to permit wildlife to vacate the surrounding area;
    c. Use of a metallic or other such cushion block (not wood);
    d. Use of a bubble curtain surrounding piles during steel pile driving; and
    e. A qualified biologist to monitor the SELs during pile driving activity and survey for any injured fish. If 187 decibels (dB) SEL at 840 feet occurs, then work will pause for one hour. Weekly reports from the applicant will be submitted to NMFS with the description of daily activities and any take observed.

6. Concrete piles may be installed without the use of a bubble curtain or attenuation devices as they are not expected to surpass 206 dB at any distance.

7. All water quality protection requirements identified in the Clean Water Act 401 certification for the project will be followed.
8. Creosote-treated piles will be removed from the action area and disposed of at an approved disposal facility.

9. To ensure potential impacts to marine mammals are minimized, the Project Biologist will monitor for the presence of marine mammals within 500 m (1640 ft) of the Project site. If any marine mammals are observed, work is to be halted until the animal leaves the 500 m (1640 ft) buffer (Brinton 2019).

10. The applicant will purchase 0.6 acres of mitigation (3:1 mitigation ratio) at an approved bank (*e.g.*, Liberty Island or other such appropriate bank) to offset the impact for shading of the updated wharf (Smith 2019). Direct effects to critical habitat for SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon are intended to be reduced through the purchase of credits at an approved mitigation bank, removal or creosote piles from the San Joaquin River, and addition of light-penetrating surfaces at the improved wharf.

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, each Federal agency must ensure that its 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 habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1 Analytical Approach

This BO includes both a jeopardy analysis and/or 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.

This BO relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214).

The designations of critical habitat for SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon use the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ‘‘destruction or adverse modification’’ analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this BO, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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 expected 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 by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.
- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

Conservation banks present a unique factual situation, and this warrants a particular approach to how they are addressed. Specifically, when NMFS is consulting on a proposed action that includes conservation bank credit purchases, it is likely that physical restoration work at the bank site has already occurred and/or that a section 7 consultation occurred at the time of bank establishment. A traditional reading of "environmental baseline," might suggest that the overall ecological benefits of the conservation bank actions therefore belong in the environmental baseline. However, under this reading, all proposed actions, whether or not they included proposed credit purchases, would benefit from the environmental 'lift' of the entire conservation bank because it would be factored into the environmental baseline. In addition, where proposed actions did include credit purchases, it would not be possible to attribute their benefits to the proposed action, without double counting. These consequences undermine the purposes of conservation banks and also do not reflect their unique circumstances. Specifically, conservation banks are established based on the expectation of future credit purchases. In addition, credit purchases as part of a proposed action will also be the subject of a future section 7 consultation.

It is therefore appropriate to treat the beneficial effects of the bank as accruing incrementally at the time of specific credit purchases, not at the time of bank establishment or at the time of bank restoration work. Thus, for all projects within the service area of a conservation bank, only the benefits attributable to credits sold are relevant to the environmental baseline. Where a proposed action includes credit purchases, the benefits attributable to those credit purchases are considered effects of the action. That approach is taken in this BO.

2.2 Rangewide Status of the Species and Critical Habitat

This BO examines the status of each species that would be adversely affected by the proposed Project that the 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 BO 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 PBFs that help to form that conservation value. This BO analyzes the effects of the project on the endangered SR winter-run Chinook salmon ESU, the threatened CV spring-run Chinook salmon ESU, CCV steelhead distinct population segment, and the sDPS of North American green sturgeon (Table 4) and their designated critical habitats (Table 5).

Table 4. Description of species, current Endangered Species Act listing classification and summary of species status

Species	Listing Classification and Federal Register Notice	Status Summary
Sacramento River winter-run Chinook salmon ESU (SR winter-run)	Endangered, 70 FR 37160; June 28, 2005 (Original listing – 59 FR 440; January 4, 1994)	According to the NMFS (2016c) 5-year species status review, the status of SR winter-run has continued to decline since 2010. The extinction risk for SR winter-run has increased from moderate risk to high risk of extinction since 2005, and several listing factors have contributed to the recent decline, including drought, poor ocean conditions, and hatchery influence (National Marine Fisheries Service 2016c). NMFS (2016c) concluded that the ESU classification as an endangered species is appropriate and should be maintained. During the 2012 to 2016 drought, SR winter-run experienced increased water temperatures and low egg-to-fry survival (National Marine Fisheries Service 2016c). In addition, recent adult returns have been low (1,546 individuals in 2016 and 975 individuals in 2017; California Department of Fish and Wildlife 2018) likely due to impacts from the 2012 to 2016 drought.
Central Valley spring-run Chinook salmon ESU (CV spring-run)	Threatened, 70 FR 37160; June 28, 2005 (Original listing – 64 FR 50394; September 16, 1999)	According to the NMFS (2016a) 5-year species status review, the status of CV spring-run had improved since the 2011 5-year species status review (through 2014) due to extensive restoration and increases in spatial structure of historically extirpated populations (Battle and Clear creeks), which were trending in the positive direction. However, during the 2012 to 2016 drought, researchers observed high pre-spawn and egg mortality and uncertain juvenile survival, and since 2015, researchers have found many of the dependent populations in decline (National Marine Fisheries Service 2016a). In 2017, CDFW reported the lowest CV spring-run escapement in the record (California Department of Fish and Wildlife 2018).
California Central Valley steelhead DPS (CCV steelhead)	Threatened, 71 FR 834; January 5, 2006 (Original listing – 63 FR 13347; March 19, 1998)	According to the NMFS (2016b) 5-year species status review, the status of CCV steelhead has changed little since the 2011 status review, which concluded that the DPS was likely to become endangered within the foreseeable future. Most populations of natural-origin CCV steelhead are very small, are not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to natural-origin fish. The life history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates in CCV steelhead.
Southern DPS of North American green sturgeon (sDPS green sturgeon)	Threatened, 71 FR 17757; April, 7 2006	According to the NMFS (2015) 5-year species status review, some threats to the species have recently been eliminated, such as take from commercial fisheries and removal of some passage barriers, but the species viability continues to be constrained by factors such as a small population size, lack of multiple spawning populations, and concentration of spawning sites into just a few locations. The species continues to face a moderate risk of extinction.

Table 5. Description of critical habitat, designation details, and status summary

Species	Designation Date and Federal Register Notice	Status Summary
Sacramento River winter-run Chinook salmon critical habitat	June 16, 1993; 58 FR 33212	Critical habitat for SR winter-run was designated under the ESA on June 16, 1993 (58 FR 33212). Designated critical habitat includes the Sacramento River from Keswick Dam (RM 302) to Chipps Island (RM 0) at the westward margin of the Delta, all waters from Chipps Island westward to Carquinez Bridge, including Honker, Grizzly, and Suisun bays; Carquinez Strait, all waters of San Pablo Bay (west of the Carquinez Bridge), and all waters of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge) from San Pablo Bay to the Golden Gate Bridge (59 FR 440). Critical habitat in the Sacramento River includes the river water column, river bottom, and adjacent riparian zone. Currently, many of the PBFs of SR winter-run critical habitat are degraded and provide limited high quality habitat. Although the current conditions of SR winter-run critical habitat are significantly limited and degraded, the spawning habitat, migratory corridors, and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species.
Central Valley spring-run Chinook salmon critical habitat	September 2, 2005; 70 FR 52488	Critical habitat for CV spring-run includes stream reaches of the Feather, Yuba, and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, the Yolo Bypass, as well as portions of the northern Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation. Currently, many of the PBFs of CV spring-run critical habitat are degraded, and provide limited high quality habitat. Although the current conditions of CV spring-run critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species.
California Central Valley steelhead critical habitat	September 2, 2005; 70 FR 52488	Critical habitat for CCV steelhead includes stream reaches of the Feather, Yuba, and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, the Yolo Bypass, as well as portions of the northern Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation. Many of the PBFs of CCV steelhead critical habitat are currently degraded and provide limited high quality habitat. Although the current conditions of CCV steelhead critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain in the Sacramento/San Joaquin River watersheds and the Delta are considered to have high intrinsic value for the conservation of the species as they are critical to ongoing recovery effort.

Species	Designation Date and Federal Register Notice	Status Summary
Southern distinct population segment of North American green sturgeon	October 9, 2009; 74 FR 52300	Critical habitat includes the stream channels and waterways in the Delta to the ordinary high water line. Critical habitat also includes the mainstem Sacramento River upstream from the I Street Bridge to Keswick Dam (including the Sutter and Yolo bypasses and the lower American River confluence with the mainstem Sacramento River upstream to highway 160 bridge), the Feather River upstream to the fish barrier dam, and the Yuba River upstream to Daguerre Point Dam. Coastal bays and estuaries in California (San Francisco Bay, Suisun Bay, San Pablo Bay, and Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor) as well as the lower Columbia River estuary are also included as critical habitat for sDPS green sturgeon. Coastal marine areas include waters out to a depth of 60 fathoms from Monterey Bay in California to the Strait of Juan de Fuca in Washington. Currently, many of the PBFs of sDPS green sturgeon are degraded and provide limited high quality habitat. Although the current conditions of sDPS green sturgeon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain in both the Sacramento/San Joaquin River watersheds, the Delta, and nearshore coastal areas are considered to have high intrinsic value for the conservation of the species.

2.2.1 Recovery Plans

In July 2014, NMFS released a final Recovery Plan for SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead (National Marine Fisheries Service 2014). The Recovery Plan outlines actions to restore habitat access and improve water quality and quantity conditions in the Sacramento River to promote the recovery of listed salmonids. Key actions for the Recovery Plan include conducting landscape-scale restoration throughout the Delta, incorporating ecosystem restoration into CV flood control plans that includes breaching and setting back levees, and restoring flows throughout the Sacramento and San Joaquin River basins and the Delta.

In August 2018, NMFS released a final Recovery Plan for the sDPS green sturgeon (National Marine Fisheries Service 2018b), which focuses on fish screening and passage projects, floodplain and river restoration, and riparian habitat protection in the Sacramento River Basin, the Delta, San Francisco Estuary, and nearshore coastal marine environment as strategies for recovery.

2.2.2 Global Climate Change

One major factor affecting the rangewide status of the threatened and endangered anadromous fish in the CV and aquatic habitat at large is climate change. Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen et al. 2000). Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). Projected warming is expected to affect CV

Chinook salmon. Because the runs are restricted to low elevations as a result of impassable rim dams, if climate warms by 5°C (9°F), it is questionable whether any CV Chinook salmon populations can persist (Williams 2006).

SR winter-run Chinook salmon embryonic and larval life stages are most vulnerable to warmer water temperatures that occur during the summer, which makes the species particularly at risk from climate warming. The only remaining population of SR winter-run Chinook salmon relies on the cold water pool in Shasta Reservoir, which buffers the effects of warm temperatures in most years. The exception occurs during drought years, which are predicted to occur more often with climate change (Yates et al. 2008). Additionally, air temperature appears to be increasing at a greater rate than what was previously analyzed (Lindley 2008, Beechie et al. 2012, Dimacali 2013). These factors will compromise the quantity and/or quality of SR winter-run Chinook salmon habitat available downstream of Keswick Dam.

CV spring-run Chinook salmon adults are vulnerable to climate change because they oversummer in freshwater streams before spawning in autumn (Thompson et al. 2011). CV spring-run Chinook salmon spawn primarily in the tributaries to the Sacramento River, and those tributaries without cold water refugia (usually input from springs) will be more susceptible to impacts of climate change.

CCV steelhead will experience similar effects of climate change to Chinook salmon, as they are also blocked from the vast majority of their historic spawning and rearing habitat. The effects may be even greater in some cases, as juvenile CCV steelhead need to rear in the stream for one to two summers prior to emigrating as smolts. In the CV, summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile CCV steelhead, which range from 14°C to 19°C (57°F to 66°F).

The Anderson Cottonwood Irrigation District (ACID) Dam is considered the upriver extent of sDPS green sturgeon passage in the Sacramento River. However, the upriver extent of sDPS green sturgeon spawning is approximately 19 miles downriver of the ACID Dam where water temperature is warmer than at the ACID Dam during late spring and summer. Thus, if water temperatures increase with climate change, temperatures adjacent to the ACID Dam may remain within tolerable levels for the embryonic and larval life stages of sDPS green sturgeon, but temperatures at spawning locations lower in the river may be more affected.

In summary, observed and predicted climate change effects are generally detrimental to these listed species (McClure 2011, Wade et al. 2013), so unless offset by improvements in other factors, the status of the species and critical habitat is likely to decline over time. The climate change projections referenced above cover the time period between the present and approximately 2100. While the uncertainty associated with these projections increases over time, the direction of climate change is relatively certain (McClure et al. 2013).

2.3 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 wharf and areas where new structures and work will occur (Project Area) is located offshore along the San Joaquin River at 2301 Wilbur Avenue, in an unincorporated area of Contra Costa County, approximately 1.5 miles west of the Senator John A. Nejedly Bridge, and east of Suisun Bay (Figure 1). The existing wharf is situated approximately 60 feet (ft) off of the south shoreline and south of West Island. The area is at the confluence of the Sacramento and San Joaquin rivers, which creates a low salinity transition zone between the San Francisco Bay and the Sacramento-San Joaquin Delta region.

The action area is defined as the extent of the hydroacoustic effects (underwater sound) from pile driving. The portion of the Delta that will be affected by attenuated (*i.e.*, after minimization measures are implemented) sound levels (*i.e.*, SEL > 150 dB) during pile driving extends for 3,400 m (11,155 ft) from the AMPORTS wharf and includes approximately 1,514.6 acres. This is the distance to the 150 dB threshold, or the point at which the sound would not cause a change in fish behavior. The distance at which attenuated sound reaches the threshold for direct impacts, or physical injury (SEL >187 dB) is 470 m (1,542 ft) from the AMPORTS wharf and includes approximate 49.23 acres (Figure 3). This area includes the area under the dock and along the shoreline. At 206 dB, fish are likely to die or be injured; the maximum distance at which the attenuated sound would reach 206 dB is 10 m, or 1.18 acres around each pile driving location. Turbidity and other construction disturbance are anticipated to be entirely within this 10 m area. The action area is primarily located along the south bank of the San Joaquin River, but also extends across the river to West Island (Figure 3).

The Project Area is located in open water or consists of developed shoreline and paved parking lots. The shoreline on either side of the AMPORTS wharf is a steep bank armored with heavy rip rap and is mostly non-vegetated. Water depth at the AMPORTS wharf is approximately 4.7 m (15.5 ft) below MLLW. Depths along the south side (shore side) of the wharf are within this same range and vary from 2.9 m to 4.7 m (9.8 ft to 15.5 ft) below MLLW. Depths on the north side of the wharf (river side) quickly drop off to more than 9 m (29.7 ft) MLLW. Tidal velocities for the general area are predicted to be 1.2 knots at maximum ebb tide and a maximum water current of 0.7 knots. Small areas of ruderal vegetation occur along the top of the bank where a gap in the rip rap allows a chain-link security fence to surround the upland portions of the AMPORTS facility. The adjacent uplands are fully developed as parking lots which have been either paved or covered in gravel to allow easy movement of vehicles. No rooted submerged aquatic vegetation is present in the Project Area. The San Joaquin River deposits in the area surrounding the project generally consist of stiff to hard clays with medium-dense to very dense sand with varying amounts of silt and clay.

Since AMPORTS plans to purchase mitigation credits from a conservation bank, the action area also includes the areas affected by the mitigation banks that have service areas relevant to the project. These include the Liberty Island Conservation Bank, a 186-acre site in the California CV Delta; Consumnes Floodplain Mitigation Bank, a 472-acre site at the confluence of the Consumnes and Mokelumne Rivers; and Fremont Landing Conservation Bank, which is a 100-acre floodplain site along the Sacramento River at the confluence of the Feather River (Sacramento River Mile 80).

Figure 3. Hydroacoustic action area (Source: BA)

2.4 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).

2.4.1 Water Development, Conveyance, and Flood Control

The diversion and storage of natural flows by dams and diversion structures on CV watersheds has depleted stream flows in the tributaries feeding the Delta and altered the natural cycles by which juvenile and adult salmonids and sDPS green sturgeon base their migrations. As much as 60 percent of the natural historical inflow to CV watersheds and the Delta have been diverted for human uses. Depleted flows have contributed to higher temperatures, lower dissolved oxygen (DO) levels, and decreased recruitment of gravel and large woody debris. More uniform flows year round have resulted in diminished natural channel formation, altered food web processes, and slower regeneration of riparian vegetation (Mount 1995, Herbold et al. 2018).

The development of the water conveyance system in the Delta has resulted in the construction of more than 1,100 miles of armored levees to increase channel flood capacity elevations and flow capacity of the channels (Mount 1995). Levee development in the CV affects spawning habitat, freshwater rearing habitat, freshwater migration corridors, and freshwater riverine and estuarine habitat PBFs. The construction of levees disrupts the natural processes of the river, resulting in a multitude of habitat-related effects, including isolation of the watershed's natural floodplain behind the levee from the active river channel and its fluctuating hydrology.

Many of these levees use angular rock (*i.e.*, riprap) to armor the bank from erosive forces. The effects of channelization and riprapping include the alteration of river hydraulics and cover along the bank as a result of changes in bank configuration and structural features. These changes affect the quantity and quality of nearshore habitat for juvenile salmonids (U.S. Fish and Wildlife Service 2000). Simple slopes protected with rock revetment generally create nearshore hydraulic conditions characterized by greater depths and faster, more homogeneous water velocities than occur along natural banks. Higher water velocities typically inhibit deposition and retention of sediment and woody debris. These changes generally reduce the range of habitat conditions typically found along natural shorelines, especially by eliminating the shallow, slow-velocity river margins used by juvenile fish as refuge and escape from fast currents, deep water, and predators.

2.4.2 Physical Disturbance from Dredging and Boating

Little of the extensive tracts of wetland marshes that existed prior to 1850 along the valley's river systems and within the natural flood basins exist today. Most has been "reclaimed" for agricultural purposes, leaving only small remnant patches. Dredging of river channels to enhance inland maritime trade and to provide raw material for levee construction has also significantly and detrimentally altered the natural hydrology and function of the river systems in the CV. This has led to declines in the natural meandering of river channels and the formation of pool and bar segments.

Currently, waters around West Island experience heavy barge and recreational vessel traffic, creating hazards to listed fish species through both physical and acoustic disturbance. These impacts, including increased levels of noise and turbidity, may lead to direct mortality or may induce changes in behavior that impair feeding, rearing, migration, and/or predator avoidance. In a report on Delta boating needs through the year 2020, the California Department of Boating and Waterways stated an expected increase in boating activity in the Delta area (California Department of Boating and Waterways 2003).

2.4.3 Water Quality

Current land use in the Delta has seen a dramatic increase in urbanization, industrial activity, and agriculture. The water quality of the Delta has been negatively impacted over the last 150 years; increased water temperatures, decreased DO levels, and increased turbidity and contaminant loads have degraded the quality of the aquatic habitat for the rearing and migration of salmonids and sDPS green sturgeon. In general, water degradation or contamination can lead to either acute toxicity, resulting in death when concentrations are sufficiently elevated, or more typically, when concentrations are lower, to chronic or sublethal effects that reduce the physical health of the organism, and lessens its survival over an extended period of time.

Multiple studies have documented high levels of contaminants in the Delta, such as polychlorinated biphenyls, organochlorine pesticides, polycyclic aromatic hydrocarbons (PAHs), selenium, and mercury, among others (Stewart et al. 2004, Leatherbarrow et al. 2005, Brooks et al. 2012), suggesting that fish are exposed to them. Harmful algal blooms also occur in the Delta and, although toxic exposure of estuarine fish has been documented, the extent of their impacts to the aquatic food web is unknown (Lehman et al. 2010). More recently, concerns have been raised about ammonia levels in the Delta (Davis et al. 2018). Pesticides and herbicides are found in the water and bottom sediments throughout the Delta. Herbicide use for the treatment and elimination of invasive aquatic vegetation may have important consequences for water quality parameters including amount of light that reaches the water column, temperature, salinity, turbidity, and food availability, which may also influence the migratory paths that sDPS green sturgeon and salmonids utilize in the Delta (National Marine Fisheries Service 2018a).

2.4.4 Hydrology in the Delta

Substantial changes have occurred in the hydrology of the CV’s watersheds over the past 150 years. Many of these changes are linked to the ongoing actions of the CVP and SWP in their pursuit of water storage and delivery of this water. Reservoir operations flatten the natural hydrograph, resulting in a lack of the variability in seasonal and inter-annual runoff (Herbold et al. 2018). Currently, average winter/spring flows are typically reduced compared to natural conditions, while summer/fall flows have been artificially increased by reservoir releases.

Prior to the construction of the more than 600 dams in the mountains surrounding the CV, parts of the valley floor hydrologically functioned as a series of natural reservoirs seasonally filling and draining every year with the cycles of rainfall and snowmelt in the surrounding watersheds. The magnitude of the seasonal flood pulses was reduced before entering the Delta, but the duration of the elevated flows into the Delta were prolonged for several months, thereby providing extended rearing opportunities for emigrating Chinook salmon, steelhead, and sDPS green sturgeon to grow larger and acquire additional nutritional energy stores before entering the main Delta and upper estuarine reaches. Furthermore, the construction of these dams has led to a lack of the variability in seasonal and inter-annual runoff, which has been substantially reduced with muted peak flows except in exceptional runoff years. Currently, average winter/spring flows are typically reduced compared to natural conditions, while summer/fall flows have been artificially increased by reservoir releases.

These changes in the hydrographs of the two main river systems in the CV are also reflected in the inflow and outflow of water to the Delta. The operations of the dams and water transfer operations of the CVP and SWP have reduced the winter and spring flows into the Delta, while artificially maintaining elevated flows in the summer and late fall periods. The Delta has become a stable freshwater body, which is more suitable for introduced and invasive exotic freshwater species of fish, plants, and invertebrates than for the native organisms that evolved in a fluctuating and “unstable” Delta environment. Additionally, operating the CVP and SWP and the resultant conditions that are created, reduce survival of juvenile salmonids outmigrating through the Delta. Prior to the protections established by the CVP and SWP operations Opinion (National Marine Fisheries Service 2009), mortality of winter-run Chinook salmon juveniles entering the interior of the Delta was estimated to be approximately 66 percent, with a range of 35-90 percent mortality (Burau et al. 2007, Perry and Skalski 2008, Vogel 2008). Studies indicate overall mortality through the Delta for late fall-run Chinook salmon releases near Sacramento from 2006 through 2010 ranged from 46 to 83 percent (Perry et al. 2016).

2.4.5 Predation

Predation of juvenile salmonids and sDPS green sturgeon is thought to be a contributing factor to high mortality at this life stage (Hanson 2009, Vogel 2011, Michel et al. 2015). There have been significant alterations to aquatic habitat that are conducive to the success of non-native piscivorous fish such as creating a largely freshwater system out of the naturally estuarine, variable salinity Delta, riverbank armoring, and reduction of habitat complexity (Vogel 2011). The altered habitat and modified flow regimes have benefitted non-native striped bass, catfish, largemouth bass, and smallmouth bass, and Vogel (2011) found that predation was likely the highest source of mortality to anadromous fish in the Delta.

2.4.6 Status of Listed Species in the Action Area

The action area is used primarily as a migration corridor by SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. Generally, as flows increase, adult salmon, CCV steelhead, and sDPS green sturgeon migrate upstream and juveniles move downstream. Adult salmonids migrate from the Pacific Ocean through the San Francisco Bay estuary as they seek the upstream spawning grounds of their natal streams. The waterways in the action area also are expected to provide some rearing benefit to juvenile salmon and CCV steelhead smolts as they move through the action area.

All adult CCV steelhead originating in the San Joaquin River watershed will have to migrate through the action area in order to reach their spawning grounds and to return to the ocean. Likewise, most juvenile CCV steelhead smolts originating in the San Joaquin River watershed will also have to pass through the action area during their emigration to the ocean.

2.4.6.1 Status of Sacramento River Winter-Run in the Action Area

Adult SR winter-run Chinook salmon typically migrate through the Delta between November and June with the peak occurring in March on their way to their spawning grounds. They travel to the upper Sacramento River as late as July (Lindley et al. 2004), and then hold. Spawning occurs from August through October, with a peak in September (Moyle 2002). During their upstream migration, SR winter-run Chinook salmon adults have been known to stray into the San Joaquin River and around the Delta islands as they make their way through the maze of channels. Generally, juveniles migrate downstream in the winter and spring. Juvenile SR winter-run Chinook salmon occur in the Delta primarily from November through early May (based on length-at-date criteria from trawl and seine data in the Delta (U.S. Fish and Wildlife Service 2016)). SR winter-run Chinook salmon may be present in the action area from November to June for adults, and November to early May for juveniles. Since in-river work will occur during November, SR winter-run Chinook salmon may be present during Project construction (July 1 to November 30).

2.4.6.2 Status of Central Valley Spring-Run in the Action Area

Adult CV spring-run Chinook salmon migrate through the Delta from January to June, primarily from February to April (California Department of Fish and Game 1998). As with SR winter-run Chinook salmon, adult CV spring-run Chinook salmon may migrate through and rear within the action area, but they are not expected to be present in the action area during Project construction. From the tributaries, juvenile CV spring-run Chinook salmon migrate downstream soon after emergence as young-of-the-year, or they remain in the creeks until the following fall, which appears to be more typical (Moyle et al. 1995). According to trawl and seine data in the Delta, juvenile CV spring-run Chinook salmon may be present in the Delta from January to May (U.S. Fish and Wildlife Service 2016). CV spring-run Chinook salmon may be present from January to June for adults, and January to May for juveniles. Since in-river work will not be occurring during these months, CV spring-run Chinook salmon are not expected to be present during Project construction.

2.4.6.3 Status of California Central Valley Steelhead in the Action Area

Adult CCV steelhead enter freshwater in August (Moyle 2002) and peak migration of adults move upriver in late September (Hallock et al. 1957). They will hold until flows are high enough in the tributaries to migrate upstream where they will spawn from December to April (Hallock et al. 1961). A small percentage of CCV steelhead (typically females) migrate back downstream from the tributaries and reach the Sacramento River during March and April, and have a high presence in the Delta in May. CCV steelhead juveniles (smolts) can start appearing in the action area as early as October (California Department of Fish and Wildlife 2016b, U.S. Fish and Wildlife Service 2016). In the Sacramento River, juvenile CCV steelhead generally migrate to the ocean in spring and early summer at 1 to 3 years of age, with peak migration through the Delta in March and April (Reynolds et al. 1993). CCV steelhead presence in the CVP and SWP fish salvage facilities increases from November through January and peaks in February and March before rapidly declining in April. CCV steelhead smolts emigration from the San Joaquin River increases from February to June and peaks in April and May before rapidly declining in June (California Department of Fish and Wildlife 2013). By June, emigration essentially ends, with only a small number of fish being salvaged through the summer. Since adult CCV steelhead may be present in the Delta during their migration upstream, they have a higher chance of being present during the Project than Chinook salmon. Though unlikely, juvenile CCV steelhead may be present in the action area as early as October, during the in-river construction period (July 1 to November 30).

2.4.6.4 Status of sDPS Green Sturgeon in the Action Area

For sDPS green sturgeon, the action area functions as migratory, holding, and rearing habitat for adults, sub-adults, and juveniles; their presence is considered year-round in the Delta. Both non-spawning adults and sub-adult sDPS green sturgeon use the Delta and estuary for foraging during the summer. sDPS green sturgeon spawning primarily occurs in cool sections of the upper mainstem Sacramento River (National Marine Fisheries Service 2018b), therefore no eggs or larval sDPS green sturgeon are expected to occur in the action area.

Spawning in the San Joaquin River has not been recorded, although there appears to be at least some presence of adult fish in the river upstream of the Delta based on sturgeon report card data (California Department of Fish and Wildlife 2014, 2016a). sDPS green sturgeon salvage numbers are considerably lower than for other species of fish monitored at the facilities. Based on the salvage records from 1981–2015, sDPS green sturgeon may be present during any month of the year, but only a few juveniles have been observed since 2011 (California Department of Fish and Wildlife 2016b).

In summary, adult, sub-adult, and juvenile sDPS green sturgeon may be present during the Project since they occur in the Delta year-round, but due to their small population size, few are expected to be present during in-river work activities.

2.4.7 Status of Critical Habitat in the Action Area

The PBFs for SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead critical habitat within the action area include the following: freshwater migration corridors, sufficient water quality, and floodplain connectivity to form and maintain physical habitat conditions necessary for salmonid development and mobility; sufficient water quality, food and nutrients sources; migration routes free from obstructions; no excessive predation; holding areas for juveniles and adults; and shallow water areas and wetlands. Habitat within the action area is primarily utilized for freshwater migration by SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead smolts and for adult migration of CV spring-run Chinook salmon and CCV steelhead. No spawning of SR winter-run Chinook salmon, CV spring-run Chinook salmon, or CCV steelhead occurs within the action area.

In regards to the designated critical habitat for sDPS green sturgeon, the action area includes PBFs which provide: adequate food resources for all life stages utilizing the Delta; water flows sufficient to allow adults, sub-adults, and juveniles to orient to flows for migration and normal behavioral responses; water quality sufficient to allow normal physiological and behavioral responses; unobstructed migratory corridors for all life stages utilizing the Delta; a broad spectrum of water depths to satisfy the needs of the different life stages present in the Delta and estuary; and sediment with sufficiently low contaminant burdens to allow for normal physiological and behavioral responses to the environment. No spawning of sDPS green sturgeon occurs within the action area. As with CCV steelhead, it is important to both adult and juvenile sDPS green sturgeon to maintain the value of the critical habitat within the action area to provide a migratory corridor and freshwater rearing area within the Delta. Unlike salmonids, juvenile sDPS green sturgeon may spend from one to three years rearing in this habitat.

The general condition and function of the aquatic habitat has already been described in this section above. The substantial degradation over time of several of the essential critical elements has diminished the function and condition of the freshwater rearing and migration habitats in the action area. Even though the habitat has been substantially altered and its quality diminished through years of human actions, its conservation value remains high for SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. A number of juvenile and adults representing these DPSs and ESUs likely pass the site and spend some time there on their way to or from the ocean.

2.4.8 Mitigation Banks and the Environmental Baseline

The proposed outfall construction occurs within the service areas of three conservation or mitigation banks approved by NMFS. These include:

Liberty Island Conservation Bank: Established in 2010, the Liberty Island Conservation Bank is a 186-acre site located at the southern end of the Yolo Bypass on Liberty Island in the Delta. Out of the credits relating to salmonid restoration or preservation, 57.64 acres remain. The bank is approved by NMFS to provide credits for impacts to SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead. Riparian shaded aquatic, salmonid preservation, and salmonid restoration credits are available, and the ecological value of the sold credits (increased rearing habitat for juvenile salmonids) are part of the environmental baseline. Additional transactions may be pending but given the uncertainty, associated benefits are not considered part of the environmental baseline. All features of this bank are designated critical habitat for CCV steelhead.

Cosumnes Floodplain Mitigation Bank: Established in 2008, the Cosumnes Floodplain Mitigation Bank is 472-acre floodplain site at the confluence of the Cosumnes and Mokelumne Rivers (Mokelumne River Mile 22) and is approved by NMFS to provide credits for impacts to CCV steelhead. Shaded riverine aquatic, floodplain riparian, and floodplain mosaic wetlands credits are available. Currently, there are 63 acre credits of floodplain mosaic wetland. To date, there have been 34.32 of 38.13 riparian floodplain acre credits sold and the ecological value (increased rearing habitat for juvenile salmonids) of the sold credits are part of the environmental baseline. Additional transactions may be pending but given the uncertainty, associated benefits are not considered part of the environmental baseline. All features of this bank are designated critical habitat for CCV steelhead.

Fremont Landing Conservation Bank**:** Established in 2006, the Fremont Landing Conservation Bank is a 100-acre site located at the confluence of the Sacramento and Feather rivers (Sacramento River Mile 80), and 29.31 credit acres remain. It is approved by NMFS to provide credits for impacts to SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. Restoration credits are available for riparian floodplain, shaded riverine habitat, and salmonid and green sturgeon restoration. All features of this bank are designated critical habitat for SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon.

2.5 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.

The Project includes activities that may directly or indirectly impact SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon and/or the critical habitat of these species. The following is an analysis of the potential direct and indirect effects to the listed fish species and/or their critical habitat that may occur because of implementing the AMPORTS Berth Rehabilitation project.

To evaluate the effects of this wharf rehabilitation, NMFS examined the potential effects of the Project. We analyzed construction-related impacts and the fish response to habitat alterations. We also reviewed and considered the proposed conservation measures. This assessment relied heavily on the information from the Project BA.

Our assessment considers the nature, duration, and extent of the proposed activities relative to the spawning, rearing, and migration timing, behavior, and habitat requirements of all life stages of Federally-listed fish in the action area. Effects of the wharf rehabilitation on aquatic resources include both short- and long-term impacts. Short-term effects, which are related primarily to construction activities (*i.e.*, increased suspended sediment and turbidity, noise, etc.), may last several hours to several weeks. Long-term impacts may last months or years and generally involve operations of the wharf.

The wharf rehabilitation will also contribute to continued ship operations and shading of the riverine system that in turn negatively impacts listed fish species and their designated critical habitat. This analysis also evaluates the long-term impacts of the wharf rehabilitation on fish species and their critical habitat.

2.5.1 Effects of Construction on Listed Species

Adult and juvenile SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon are likely to use the action area, however, only CCV steelhead and sDPS green sturgeon are likely to be present during the in-water construction work window, and only in low numbers. No spawning habitat for CCV steelhead, CV spring-run Chinook salmon, SR winter-run Chinook salmon, or sDPS green sturgeon is present in the action area, therefore effects to spawning adults or incubating eggs are not expected.

Toxic substances used at construction sites, including gasoline, lubricants, and other petroleum-based products, could enter the waterway as a result of spills or leakage from machinery, and could potentially injure listed salmonids and sDPS green sturgeon. Petroleum products also tend to form oily films on the water surface that can reduce DO available to aquatic organisms. The exposure to these substances can kill fish directly in high enough concentrations through acute toxicity or suffocation from lack of oxygen. These chemicals may also kill the prey of listed fish species, reducing their ability to feed and therefore grow and survive. However, due to adherence of BMPs that dictate the use, containment, and cleanup of contaminants, the use of toxic substances at the construction site is not likely to result in adverse effects to listed fish species.

Direct effects associated with in-river construction work will involve equipment and activities that will produce underwater noise and vibration, temporarily altering in-river conditions. These changes can also impair feeding behaviors, which in turn impacts the fishes' abilities to grow and survive. Juvenile fish are the most vulnerable to these changes, since adults are better able to quickly swim away from the construction sites and escape injury. Construction disturbance can cause injury or harm by increasing the susceptibility of some individuals to predation by temporarily disrupting normal sheltering behaviors. Only those fish that are holding adjacent to or migrating past the wharf rehabilitation site will be directly exposed to or affected by construction activities. Those fish that are exposed to the effects of construction activities will encounter short-term (*i.e.*, minutes to hours) construction-related physical disturbance and noise.

Increased boat traffic around the AMPORTS wharf will result as part of the Project during construction. Work boats and barges will be used to move materials to and from the AMPORTS wharf and act as a platform from which to drive the piles. Effects from the use of work boats and material barges will last for the duration of the Project (*i.e.*, five months). Acoustic effects from the use of work boats and material barges are anticipated to be minimal, and are not expected to rise to the level where fish species could be impacted (*i.e.*, above the background level for San Francisco Bay, or 150 dB).

2.5.1.1 Effects of Physical Disturbance on Listed Species

2.5.1.1.1 Turbidity and Sedimentation from Construction-Related Activities

Turbidity and sedimentation events are not expected to affect visual feeding success of sDPS green sturgeon, as they are not believed to utilize visual cues (Sillman et al. 2005). sDPS green sturgeon, which can occupy waters containing variable levels of suspended sediment and thus turbidity, are not expected to be impacted by the slight increase in the turbidity levels anticipated from the proposed Project. Increases in turbidity can harm salmonids by temporarily burying submerged aquatic vegetation that supports invertebrates for feeding juvenile fish, leading to reduced growth and survival. High turbidity can also damage a fish’s gills, interfere with cues necessary for orientation in homing and migration, and reduce available spawning habitat (Bash et al. 2001). However, BMPs for the Project will minimize the amount of turbidity caused by the project such that turbidity levels are not likely to result in adverse effects to listed fish species.

2.5.1.1.2 Contaminants from Construction-Related Activities

Even though copper concentration in the sediment is low, small amounts that are disturbed or resuspended in the water column can alter the behavior of salmonids. Hansen et al. (1999a, 1999b) examined the effects of low dose copper exposure to the electrophysiological and histological responses of rainbow trout and Chinook salmon olfactory bulbs, and the two fish species exhibited behavioral avoidance. Even when copper concentrations are below lethal levels, substantial negative effects could occur to salmonids exposed to these low levels. Reduction in olfactory response is expected to increase the likelihood of morbidity and mortality in exposed fish by impairing their homing ability and consequently migration success, as well as by impairing their ability to detect food and predators. Less is known about the effects of copper toxicity on sturgeons when compared to salmonids. Dwyer et al. (2005) indicated that sturgeon, as a genus, were similar to rainbow trout in their sensitivity to contaminants. Little et al. (2012) found that while sturgeon fry were very susceptible to copper concentrations, they became much more resilient as the sturgeon matured.

Copper and selenium, as well as other in-organic compounds sequestered in the sediment, will come into chemical equilibrium with the overlying water column. Selenium is known to bioaccumulate in green sturgeon and cause birth deformities and decrease fry survival and growth (Presser and Luoma 2010). Even though the effects of contaminant exposure to species can be severe, the likelihood of occurrence is low. Only a few adults of ESA-listed Chinook salmon and steelhead would be expected in the action area during the August through November construction period. Adult SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead will not be exposed to contaminated sediments since they migrate in the upper third of the water column, above the disturbed area. The vast majority of returning adult salmon are fall-run Chinook salmon that pass through the action area. The potential for exposure would be limited to the bottom portion of the river under and around the AMPORTS wharf where contaminated sediments are exposed during pile driving and removal. Also, based on timing and the CVP/SWP salvage data, very few juvenile salmon would be expected in the action area during the construction. If salmonid adults are exposed to increased levels of contaminants from the proposed action, then they would exhibit a change in behavior such as straying into non-natal spawning areas or exhibiting pre-spawn mortality. Subadult sDPS green sturgeon are more likely to be exposed to chemicals that accumulate in the food web than adults since they are more likely to be rearing in the action area. However, sDPS green sturgeon are likely to exhibit avoidance behavior due the construction noise and activity. The effects of exposure to contaminants in the sediment or from the construction are expected to be reduced to background levels within a few months due to the large volume of tidal mixing in the action area.

2.5.1.2 Effects of Noise on Listed Species

Construction-related noise from in-water work and pile driving has the potential to disrupt behavior of any SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead or sDPS green sturgeon present in the action area, causing them to travel away from the disturbance to adjacent areas with similar habitats. This could result in temporary displacement from rearing habitat. However, CCV steelhead and sDPS green sturgeon are expected to avoid the work area, and based on salvage and Delta Juvenile Fish Monitoring Program (DJFMP) monitoring data, we expect that fish will either be present at extremely low numbers or not present at all. In addition, sDPS green sturgeon are expected to be present in benthic environments and closer to the mid-channel of the river, and not the shallow, near-bank habitats.

Piles that are driven into river bed substrate propagate sound through the water, which can damage a fish’s swim bladder and other organs by causing sudden rapid changes in pressure, rupturing or hemorrhaging tissue in the bladder (Gisiner 1998, Popper et al. 2006). The swim bladder is the primary physiological mechanism that controls a fish’s buoyancy. A perforated or hemorrhaged swim bladder has the potential to compromise the ability of a fish to orient itself both horizontally and vertically in the water column. This can result in diminished ability to feed, migrate, and avoid predators. Sensory cells and other internal organ tissue may also be damaged by noise generated during pile driving activities as sound reverberates through a fish’s viscera (Gaspin 1975). In addition, morphological changes to the form and structure of auditory organs (saccular and lagenar maculae) have been observed after intense noise exposure (Hastings 1995). It is important to note that acute injury resulting from acoustic impacts should be scaled based on the mass of a given fish. Juveniles and fry have less inertial resistance to a passing sound wave and are therefore more at risk for non-auditory tissue damage (Popper and Hastings 2009).

Although there are limited data documenting the effects of extreme sound pressure specific to salmonids, a review of studies by Popper and Hastings (2009) on fish in general found that those fishes with anatomical specializations that make them better able to detect lower levels of sound pressure (*i.e.*, hearing specialists) may be more susceptible to sound-induced hearing loss. For fish with anatomical hearing specializations, Popper and Hastings’ (2009) review showed a pattern of hearing loss when exposed to increased background noise levels for 24 hours or more, whereas fishes without such specializations (*i.e.*, hearing generalists) did not necessarily show hearing loss. For example, Smith et al. (2004, 2006) examined hearing loss after over 20 days of exposure to a broadband noise of 170 dB and found that there was a substantial hearing loss in goldfish (*Carassius auratus*), a fish with hearing specializations, making it more sensitive to sound pressure, but not in the Nile tilapia (*Oreochromis niloticus*), a fish without such specializations.

NMFS assumes that some level of negative impacts to salmonids can be inferred from the above results because of the similarity in anatomical hearing specializations of salmonids compared to the fishes represented in the studies reviewed by Popper and Hastings (2009). Exposures of these other fish species can serve as surrogates for salmonids, although sound exposure of 24 hours would not apply. The thresholds used by NMFS and other agencies for the onset of physical injury to fish greater than 2 grams in mass are a peak sound pressure level of 206 decibels (dB) and cumulative sound exposure level (SEL) of 187 dB (Fisheries Hydroacoustic Working Group

2008). Based on life history, all NMFS listed fish species would be greater than 2 grams by the time they reached the action area. For avoiding negative behavioral effects to fish, NMFS uses a Root Mean Square pressure (RMS) of 150 dB. Since the sound levels for vibratory pile driving (*i.e.*, 172– 185 dB) are expected to be below the physical injury level (187 dB), negative impacts are likely to be behavioral (*i.e.*, fish will move away from the sound) and dissipate to background levels (*i.e.*, RMS < 150 dB) within a short distance from the AMPORTS wharf. Therefore, acoustic impacts from vibratory hammers are not likely to rise to the level of adverse effects that cause harm to salmonids.
Acoustic impacts from impact hammers are shown above in Table 3. Actual sound impacts may vary depending on fish species and real world conditions mentioned above, however, NMFS assumes that the transmission loss (TL) model results for the attenuated (*i.e.*, with sound reduction measures applied) scenario will be similar to the actual results given the measures described in the Project description (*i.e.*, sound cushion blocks, use of a bubble curtain, pile driving only during daylight hours, use of a soft start, and use of a pipe caisson). The TL model uses the NMFS developed underwater calculator that uses a practical spreading formula to predict sound levels at various distances from the source.

Based on the literature and modeled results, any fish that comes within 10 m (33 ft) of the pile driving would be expected to be killed; from 10 m to 253 m (33 ft to 830 ft), we expect it to be injured; and from 253 m to 470 m (830 ft to 1,542 ft), the fish is expected to actively avoid the area. The acoustic impacts would be different on adults (salmon, steelhead or sturgeon) versus juveniles. Adults, due to their larger size, can tolerate higher pressure levels than juveniles and immediate mortality rates are expected to be less. Rasmussen (1967) found that immediate mortality of juvenile salmonids may occur at sound pressure levels greater than 208 dB, however, at less than 180 dB, no mortality would be expected. A gradual increase in the magnitude of physical injury is likely from 150 dB to 208 dB. However, with the sound reduction measures proposed during pile driving, sound levels are not expected to exceed 206 dB. The cumulative SEL (dB) for fish greater than 2 g at 10 m from the AMPORTS wharf ranges from 190-208 dB, depending on the size of the pile. This is enough to kill any juvenile salmonids that come close to the AMPORTS wharf. The underwater sound impacts for physical injury (*i.e.*, > SEL 187 dB) would extend from 10 m to 253 m (33 ft to 830 ft), or a maximum distance of one-third of the width of San Joaquin River. The behavioral impacts (*i.e.*, ≥ 183 SEL dB) would extend from 253 m to 470 m (830 ft to 1,542 ft), or completely across the width of the San Joaquin River to West Island (Figure 3). At the point that sound impacts reach the opposite bank, they would be blocked by West Island directly across from the AMPORTS wharf. Once the sound pressure waves reach shallow water, the rate of attenuation is expected to be much higher, reducing the expected area of negative effects compared to deeper water near the AMPORTS wharf.

The potential for negative 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 loss of hearing sensitivity may negatively affect a salmonid's ability to orient itself (*i.e.*, due to vestibular damage), detect predators, locate prey, or sense their acoustic environment. Fish also may exhibit noise-induced avoidance behavior that causes them to move into less-suitable habitat. In the action area, this may result in adult salmonids fleeing the pile driving-associated noises and moving into the Sacramento River which may delay migration and cause higher straying if they are bound for the San Joaquin River. Likewise, chronic noise exposure can reduce their ability to detect predators either by reducing the sensitivity of the auditory response in the exposed salmonid or masking the noise of an approaching predator. Disruption of the exposed salmonid's ability to maintain position or swim with the school will enhance its potential as a target for predators. Unusual behavior or swimming characteristics single out an individual fish and allow a predator to focus its attack upon that fish more effectively. Any sDPS green sturgeon in the action area are expected to move away from the immediate area of pile driving.

Underwater sound exposures have also been shown to alter the behavior of fishes (Hastings and Popper 2005). The observed behavioral changes include startle responses and increases in stress hormones. The startle response in fishes is a quick burst of swimming that may be involved in predator avoidance. 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. 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 effects include reduced predator awareness and reduced feeding. Adult and juvenile salmonids are likely to exhibit avoidance behavior within 3,400 m (11,155 ft) of the AMPORTS wharf, which may increase straying rates, alter feeding patterns, and reduce the ability to avoid predators.

Because the Project is located close to the shore, sound will mainly travel outwards towards West Island on the opposite side of the waterway. The radial distance to the threshold for behavioral effects (*i.e.*, 150 dB RMS) is 3,400 m (11,155 ft); thus the zone of behavioral effects inside that area is approximately 1,515 acres. For the purposes of this analysis, the zone of potential impact is defined as the area where there may be injury or mortality to listed salmonids and sDPS green sturgeon. Within this zone, listed fish species could experience a range of barotraumas or auditory damage described above. These injuries could result in immediate or delayed death. Fish within the range of 150 dB RMS (behavioral effects) may demonstrate temporary abnormal behavior indicative of stress or exhibit a startle response. As described previously, a fish that exhibits a startle response is not 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 discontinue after the first few pile strikes.

Due to the timing of the in-water work from August 1 through November 30, the majority of the noise impacts created by steel pile driving activity are expected to be experienced by a small portion of adult fall-run Chinook salmon and CCV steelhead migrating upstream to Sacramento and San Joaquin river tributaries. Unlike salmonids that pass quickly through the area in a matter of days, sDPS green sturgeon that are rearing or holding in the action area could be repeatedly exposed to sound effects throughout the in-water work window of 122 days. The proposed minimization measures will reduce, but not eliminate, the negative effects of underwater noise. Within 253 m (830 ft) of the dock, sDPS green surgeon that stay within that area will likely be physically injured or killed. From 253 – 470 m (830 - 1,542 ft), sDPS green sturgeon are likely to exhibit avoidance behavior similar to salmon, such as alter their feeding pattern and moving into less suitable habitat. These less suitable areas may have higher risk of predation, or a higher propensity for ship strikes (*e.g.*, within the Deep Water Ship Channel).

The majority of adult salmon and steelhead migration would occur after pile driving is completed, allowing the ESA-listed species to avoid exposure to any noise-related operations. Adult CV spring-run and SR winter-run Chinook salmon are not expected to be present in the action area due to run timing, however, outmigrating juveniles may be present in November. While juvenile salmonids migrating through the action area in November may incur sound-related effects generated during pile driving operations, their recovery from any behavioral effects has been shown to be relatively rapid in a laboratory setting (Casper et al. 2012b).

The Project's pile driving minimization measures (*i.e*., soft starts, daylight hours of operation, and acoustic monitoring) will provide long periods of time at night and between set-ups when listed fish species can pass through the action area without being injured or forced to move away. The nature of pile driving itself allows times during the day when no piling driving is taking place (*e.g.*, moving pile locations, re-aligning, and welding new sections). In addition, the Project's proposed measures to avoid marine mammals (*i.e*., delay, or shut down pile driving, if a marine mammal is observed within 500 m of the AMPORTS wharf) will also allow time for listed fish to pass through the action area. Therefore, there are safe periods of time when fish can avoid physical injury. Thus, although the negative effects of pile driving sound will not be eliminated, they will be reduced. There is still the potential for underwater sound to physically injure, kill, or alter fish behavior, depending on the distance of the fish from the AMPORTS wharf.

The impact of underwater acoustical noise upon sDPS green sturgeon is uncertain. NMFS has not found any specific reference literature investigating the hearing capabilities of sDPS green sturgeon. An important physiological aspect of sturgeon with regard to their hearing is that they lack a gas bladder. Casper et al. (2012a) has shown that fish species, such as sharks and sturgeons, that lack gas bladders tend to be less sensitive to noise in the marine environment. Since sturgeon lack a gas bladder, it is likely that sDPS green sturgeon would be less sensitive to anthropogenic noise effects. Sturgeon exposed to an accumulated SEL exceeding 187 dB can be physically injured, and this potentially could lead to delayed mortality (Clarke and Hoover 2009). Since sDPS green sturgeon would be repeatedly exposed to the underwater sound within the action area, it is likely that they would be either physically injured, or move out of the area to avoid injury. Noise may displace or impede sDPS green sturgeon that are rearing or holding in the action area, causing disruptions in feeding and sheltering behavior of individuals. Prolonged exposure to high sound levels may also result in temporary impacts to hearing ability.

Given that sDPS green sturgeon are on average significantly larger than salmon, they could, presumably, tolerate higher levels of sound pressure and be less affected by pile driving activities. Juvenile sDPS green sturgeon are typically around 600 mm in length by the time they inhabit the estuary, close in size to some adult salmonids. Therefore, it is anticipated that they will be more resilient than juvenile salmonids to higher levels of sound pressure and capable of recovering quickly from temporary disturbances associated with pile driving. However, they are vulnerable to injury or death from pile driving (especially if within 10 m of the AMPORTS wharf), as demonstrated by sound impacts that resulted in the death of a white sturgeon (likely a juvenile) documented during the construction of the Benicia-Martinez Bridge installation (National Marine Fisheries Service 2003).

In summary, the model results and literature information suggest a fish larger than 2 grams may be injured or killed at SEL exceeding 187 dB. However, several factors will reduce the number of sDPS green sturgeon or salmonids potentially injured or killed by pile driving during construction of this Project. First, pile driving will not be continuous over the entire work day because of the set-up time required between pile installations. In order to reach a cumulative SEL of 206 dB, an individual fish would have to remain within 10 m of the driven piles for more than 6 hours. Given the tidal action in the action area and migration behavior of salmonids, this would be unlikely. For sDPS green sturgeon, repeated disturbance by sound impacts are likely to cause them to move outside the action area. Secondly, the area of potential injury or mortality is very small (1.27 acres for 206 dB and 49.23 acres for 187 dB) within the action area (1,514.59 acres) and area of the Delta. Thirdly, the sound made by construction crews, boats, and barges prior to initiation of pile driving is likely to be perceived by fish as a stimulus indicating potential danger, and listed fish are not expected to remain in the area directly adjacent to a pile (greater than a 10 m radial distance from the pile).

2.5.2 Project Effects on Designated Critical Habitat

Critical habitat has been designated in the action area for SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. The PBFs that occur within the action area for SR winter-run Chinook salmon are: (1) access to and from spawning grounds, (2) habitat areas and adequate prey items that are free of contaminants, (3) riparian habitat for juvenile rearing, (4) adequate river flows, and (5) water temperatures between 42.5 and 57.5°F. The PBFs within the action area for CV spring-run Chinook salmon and CCV steelhead are: (1) freshwater rearing sites and (2) freshwater migration corridors. The PBFs within the action area for sDPS green sturgeon are: (1) food resources, (2) adequate flow regime for all life stages, (3) water quality, (4) migratory corridors, (5) adequate water depth for all life stages, and (6) adequate sediment quality.

Migratory corridor PBFs for SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon are likely to be affected by the Project. The construction of wharf piles associated with the Project will create a permanent loss of 220 yd^3 of critical habitat.

Although the wharf will add 667 ft^2 of grated over-water structure, the rehabilitated wharf will shade the San Joaquin River by 11,860 ft^2 (solid over-water structure). The grated over-water structure is intended to reduce over-water shading; however, with the rehabilitation of the wharf, there will be a net increase of 9,228 ft^2 of solid over-water structure. This increase in shading may impact foraging efficiency and will degrade the PBF of migratory corridors by increasing the predation risk. Over-water structures can alter underwater light conditions and provide potential holding conditions for juvenile and adult fish, including species that prey on juvenile listed fishes.

Habitat and prey items may be temporarily affected due to turbidity. This will affect the PBFs of food sources with prey items free from containments. Additionally, water quality will be affected by increased turbidity during pile removing and driving, which could cause a temporary drop in oxygen levels. This will affect the PBF of adequate flow. These effects on water quality PBFs, as well as those from construction debris, runoff, dust, and potential release of creosote from the existing piles will be minimized through the implementation of aforementioned pile removal BMPs, turbidity monitoring, spill prevention measures, and an emergency response plan. These BMP actions will minimize the extent of adverse effects associated with the Project and impacts to critical habitat are expected to be minimal and temporary.

Pile driving activities that create noise vibrations may temporarily degrade PBFs of rearing and migratory habitat in the action area. These temporary effects will be minimized through the use of the implementation of aforementioned pile removal BMPs. All pile driving activities will occur during daylight hours of the in-water work window (July 1 to November 30). Steel piles will be driven with a vibratory hammer until piles reach refusal. An impact hammer with sound attenuation measures (*i.e.*, bubble curtain, metallic cushion block) will be used to complete pile installation to its final level. A qualified biologist will monitor the SEL during pile driving activity. Work will pause for one hour if 187 dB at 840 ft occurs during pile driving activities.

Because the wharf is currently unusable due to the general degraded nature of the structure, NMFS expects that boat traffic to and from the wharf will increase after completion of the Project. Once the project is completed, the wharf provide regular service as ship traffic will again be able to safely berth at the wharf. Ships that use the wharf will be of similar size to those currently using the San Joaquin River or Sacramento River en route to the Ports of Stockton and Sacramento. Ships are anticipated to vary in length from 550 to 650 ft with a 90 to 100 ft wide beam and up to a 30 ft draft. Since the adjacent San Joaquin River is maintained as a commercial channel for the Port of Stockton, the wharf is limited by the draft for vessels accessing this area. No increase in dredging depth is anticipated to occur as a result of the Project as the ships calling on the berth are of similar size to those that already call upon ports upstream. Maintenance dredging is not anticipated for this Project as the current depths of the San Joaquin River are sufficient to handle any anticipated ships calling on the wharf. The increase in ship traffic is expected to be minimal since only six to eight ships per month currently use the wharf. The ship are anticipated to be at the berth for approximately 24 hours and would then depart the area.

2.5.3 Mitigation of Project Effects

The Project will build 11,860 ft^2 of permanent over-water structure. This is a net increase of 9,228 ft^2 of over-water structure from the original wharf (Table 1), the majority of which will be solid cover that will shade the habitat. Shading reduces the quality of habitat by decreasing submerged aquatic plants and food sources, and increasing predation. However, the new stairs and walkways will be made from a light transmitting material, increasing light exposure to 667 ft^2 of the project area. In addition, the relocation of fewer piles closer to shore will increase the amount of open water habitat. This increase in open water should decrease the amount of cover for predators and leave more of the bottom substrate available for benthic food species.

The removal of 128 creosote-treated timber piles will reduce the potential exposure of listed fish species to toxic contaminants (*i.e.*, copper, lead, and PAHs discussed above) in the San Joaquin River and the downstream San Francisco Bay-Delta waters. This should improve the overall water quality in the action area. The reduced number of toxic piles should have a small beneficial effect on critical habitat within the action area compared to the existing condition.

2.5.4 Mitigation/Conservation Bank Credit Purchases

To address permanent impacts to riparian and aquatic habitats, the Project includes purchase of 0.6 acres of mitigation bank credits at a 3:1 ratio (Smith 2019) for permanent aquatic habitat impacts. Both the riparian and aquatic habitat impacts are within designated critical habitat. The purchase of mitigation credits will address the loss of ecosystem functions due to 0.2 acres of shading of the aquatic habitat. These credit purchases are ecologically relevant to the impacts and the species affected because both banks include floodplain credits with habitat values that are already established and meeting performance standards. Also, the banks are located in areas that will benefit the ESUs/DPSs affected.

The purchase of credits provides a high level of certainty that the benefits of a credit purchase will be realized because each of the NMFS-approved banks considered in this BO have mechanisms in place to ensure credit values are met over time. Such mechanisms include legally binding conservation easements, long-term management plans, detailed performance standards, credit release schedules that are based on meeting performance standards, monitoring plans and annual monitoring reporting to NMFS, non-wasting endowment funds that are used to manage and maintain the bank and habitat values in perpetuity, performance security requirements, a remedial action plan, and site inspections by NMFS. In addition, each bank has a detailed credit schedule and credit transactions and credit availability are tracked on the Regulatory In-lieu Fee and Bank Information Tracking System (RIBITS). RIBITS was developed by the USACE with support from the Environmental Protection Agency, the U.S. Fish and Wildlife Service, the Federal Highway Administration, and NMFS to provide better information on mitigation and conservation banking and in-lieu fee programs across the country. RIBITS allows users to access information on the types and numbers of mitigation and conservation bank and in-lieu fee program sites, associated documents, mitigation credit availability, service areas, as well information on national and local policies and procedures that affect mitigation and conservation bank and in-lieu fee program development and operation.

2.6 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.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4).

2.7 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 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's BO 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) appreciably diminishes the value of designated or proposed critical habitat for the conservation of the species.

2.7.1 Status of the Sacramento River Winter-Run Chinook Salmon ESU

The SR winter-run Chinook salmon ESU is at high extinction risk because there is only one naturally-spawning population and it is not within its historical range (Lindley et al. 2007, National Marine Fisheries Service 2016c). The NMFS 2016 5-year Status Review of the SR winter-run Chinook salmon ESU demonstrated that continued loss of historical habitat and the degradation of remaining habitat continue to be major threats to the SR winter-run Chinook salmon ESU (National Marine Fisheries Service 2016c). Currently, only the one small population of winter-run Chinook salmon spawning downstream of Keswick Dam exists, making this species particularly vulnerable to environmental pressures such as the 2012-2015 drought. This vulnerability manifested with the drought as three consecutive year classes suffered heavy losses due to an inability to release cold water from Shasta Reservoir throughout the egg and fry life stages. Warm water releases from Shasta Reservoir contributed to egg-to-fry mortality rates of 85 percent in 2013, 94 percent in 2014, and 96 percent in 2015, the highest levels since estimates of that statistic began in 1996. Mortality decreased after the drought ended with 76 percent mortality in 2016 and 56 percent mortality in 2017.

Based on the Lindley et al. (2007) criteria, the population is at high extinction risk in 2019. High extinction risk for the population was triggered by the hatchery influence criterion, with a mean of 66 percent hatchery origin spawners over the last generation from 2016 through 2018. The threshold for high risk associated with hatchery influence is 50 percent hatchery origin spawners.

The population impacted is considered a Core 1 population by NMFS recovery plan for the ESU, meaning it has the potential to support a viable population, and recovery of the population through threat abatement efforts and recover actions should be considered a high priority (National Marine Fisheries Service 2014). Given the high priority nature of the population to recovery, harm to this population is considered especially detrimental to the ESU.

2.7.2 *Status of the Central Valley Spring-Run Chinook Salmon ESU*

In the 2016 status review (National Marine Fisheries Service 2016a), NMFS found, with a few exceptions, CV spring-run Chinook salmon populations had increased through 2014 returns since the last status review (2010/2011), which moved the Mill and Deer creek populations from the high extinction risk category to moderate; the Butte Creek population remains in the low risk of extinction category. Additionally, the Battle Creek and Clear Creek populations continued to show stable or increasing numbers in that period, putting them at moderate risk of extinction based on abundance. Overall, the NMFS Southwest Fisheries Science Center concluded in their viability report that the status of CV spring-run Chinook salmon (through 2014) had probably improved since the 2010/2011 status review and that the ESU's extinction risk may have decreased. However, the 2015 returning fish numbers were extremely low (1,488), with additional pre-spawn mortality reaching record lows. Since the effects of the 2012 to 2015 drought have not been fully realized, NMFS anticipates at least several more years of very low returns, which may result in severe rates of decline (National Marine Fisheries Service 2016a). This is supported by monitoring data which show sharp declines in adult returns from 2014 through 2018 (California Department of Fish and Wildlife 2018).

2.7.3 Status of the California Central Valley Steelhead DPS

The 2016 status review (National Marine Fisheries Service 2016b) found that overall the status of CCV steelhead appears to have changed little since the 2011 status review, and concluded that the DPS was likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Further, there is still a general lack of data on the status of natural-origin populations. There are some encouraging signs, as several hatcheries in the CV have experienced increased returns of CCV steelhead over the last few years. Video counts at Ward Dam show that Mill Creek likely supports one of the best natural-origin steelhead populations in the CV, though at much reduced levels from the 1950s and 1960s. Restoration efforts in Clear Creek continue to benefit CCV steelhead. There has also been a slight increase in the percentage of natural-origin CCV steelhead in salvage at the south Delta fish salvage facilities, and the percentage of natural-origin fish in those data remains much higher than at Chipps Island. However, the catch of unmarked (natural-origin) steelhead at Chipps Island is still less than 5 percent of the total smolt catch (U.S. Fish and Wildlife Service 2019), which indicates that natural production of CCV steelhead throughout the CV remains at very low levels. Despite the positive trend on Clear Creek and encouraging signs from Mill Creek, all other concerns raised in the previous status review (National Marine Fisheries Service 2016b) remain.

2.7.4 Status of the Southern DPS of the North American Green Sturgeon

The viability of sDPS green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into just a few locations. The risk of extinction is believed to be moderate because, although threats due to habitat alteration are thought to be high and indirect evidence suggests a decline in abundance, there is much uncertainty regarding the scope of threats and the viability of population abundance indices (National Marine Fisheries Service 2018b).

Although the population structure of sDPS green sturgeon is still being refined, it is currently believed that only one population of sDPS green sturgeon exists. Lindley et al. (2007), in discussing SR winter-run Chinook salmon, states that an ESU represented by a single population at moderate risk of extinction is at high risk of extinction over the long run. This concern applies to any DPS or ESU represented by a single population, and if this were to be applied to sDPS green sturgeon directly, it could be said that sDPS green sturgeon face a high extinction risk. However, NMFS, upon weighing all available information (and lack of information) has stated the extinction risk to be moderate (National Marine Fisheries Service 2018b).
There is a strong need for additional information about sDPS green sturgeon, especially with regards to a robust abundance estimate, a greater understanding of their biology, and further information about their micro- and macro-habitat ecology.

2.7.5 Status of the Environmental Baseline and Cumulative Effects

The environmental baseline and the status sections indicate SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon have experienced considerable 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 statuses and human-caused impacts. Within the action area in the Delta, the effects of shoreline development, industrialization, and urbanization are ongoing and not likely to be curtailed in the near future. These activities have eliminated tidal marsh habitats, introduced non-native species, degraded water quality, contaminated sediment, and altered the hydrology and fish habitat of the action area. As a result, forage species that are depended on by listed salmonids and green sturgeon have been reduced; periodic sources of contaminants continue from ships, piers, adjacent developed land areas, stormwater runoff; and natural shoreline habitat areas have been degraded.

2.7.6 Summary of Effects on Salmonids and sDPS Green Sturgeon

The AMPORTS wharf capacity is expected to change as a result of the Project, as the wharf is inoperable in its current state. However, the section of the San Joaquin River that surrounds the wharf is maintained as a commercial and shipping channel and is dredged to accommodate large ocean-going cargo ships moving to and from the Port of Stockton. The increase in larger vessel traffic in the vicinity of the project is limited to the size of the vessels that will arrive at the wharf, and thus, will not result in any increase in visual or underwater sound effects to fish. Additionally, since the channel depth limits the draft for vessels, no increase in vessel draft is anticipated to occur as a result of the Project. There is also no planned maintenance dredging in front of the AMPORTS wharf. Therefore, vessel traffic in the action area and downstream is expected to be unchanged as a result of the Project.

Because of the lack of change in vessel traffic associated with the project, the potential effects of the Project are results of construction and pile driving activities. Effects associated with these activities are not necessarily expected to be uniformly distributed across the entire action area. Instead, effects associated with the construction activity are expected to be contained in the area immediately adjacent to the AMPORTS wharf, while the effects associated with pile driving would radiate outward throughout the entire action area.

2.7.6.1 Direct Effects from Construction and Pile Driving Activities

Since construction activities under the Project (July 1–November 30) will occur during the October–November migration period; adult SR winter-run Chinook salmon, adult CV spring-run Chinook salmon, adult CCV steelhead, and subadult sDPS green sturgeon are likely to be present within the action area during pile driving activities. The upgrade and repair activities at the AMPORTS wharf would likely negatively affect listed fish through degradation of water quality and elevated underwater sound levels. During construction activities, water quality in the action area would likely be degraded through increased turbidity and suspension of sediment-borne contaminants. Increases in turbidity in the action area will be temporary and similar to the natural conditions typically encountered by listed fish in the action area.

Unanticipated spills into the San Joaquin River from toxic substances using during construction (*i.e.*, gasoline, diesel, or hydraulic fluids) can lead to negative effects and mortality in juvenile and adult salmonids and sDPS green sturgeon. If these toxic materials seep into the water, exposure to lethal concentrations can kill aquatic organisms, and exposure to non-lethal concentrations can cause physiological stress and reduce the ability to survive and reproduce. However, NMFS expects that the contractor for AMPORTS will adhere to the standard BMPs and a Spill Prevention and Control Plan during the construction and pile driving activities to prevent these kinds of effects on listed fish species. Therefore, NMFS does not expect the project will result in water contamination effects that will injure or kill listed salmonids or sDPS green sturgeon.

Underwater sound will be above ambient conditions during pile driving for a distance extending up to 3,400 m (11,155 ft) from the AMPORTS wharf (*i.e.*, zone of behavioral effects). Under the worst case scenario, elevated sound levels could result in a negative behavioral response for a portion of each day during the 5-month period of pile driving that would render a 1,514.59-acre area within the action area partially unusable by listed anadromous salmonids and sDPS green sturgeon for foraging and migrating. The partial loss of this portion of the action area is a temporary adverse effect because this area provides foraging habitat for listed fish. When the 5-month pile driving period has concluded, elevated sound levels within the zone of behavioral effects will cease and listed fish may again access food resources in the action area undisturbed by pile driving. Temporary delays to upstream and downstream passage are expected to occur during daylight hours of pile driving due to underwater noise. However, these impacts are expected to be temporary because pile driving operations are not continuous and do not completely block the channel to migrating fish.

2.7.7 Summary of Effects on Salmonids and sDPS Green Sturgeon Critical Habitat

Within the action area, the relevant PBFs of the designated critical habitat for listed salmonids are migratory corridors and rearing habitat, and for sDPS green sturgeon the PBFs include food resources, substrate type/size, flow, water quality, migration corridor free of passage impediments, depth (holding pools), and sediment quality.

The PBFs of freshwater rearing habitat and migration corridors for juvenile salmon and steelhead is expected to be affected by the increase in shading due to solid over-water structures. These activities are expected to reduce the quality of this habitat for rearing and migrating juvenile salmonids. The PBF of migratory corridors for adults will not be impacted, as migrating adult Chinook salmon and steelhead are unlikely to use the nearshore habitat that will be affected by this Project, as they tend to stay in deeper waters. Furthermore, the Project does not include the installation of any features that are expected to block or impede juvenile or adult migration. sDPS green sturgeon PBFs of water quality, substrate type/size and food resources will be affected by the proposed Project. Water quality will be degraded through increased turbidity and suspension of sediment-borne contaminants. Foraging habitat will be temporarily affected during Project construction by physical disturbance of the benthic habitat, elevated contaminants and PAH levels in suspended sediments, and the associated impacts to food resources. Shading from 11,860 ft^2 of permanent over-water structure will reduce habitat quality and prey availability, and will likely increase predation. Although there are negative impacts on critical habitat in the action area, the removal of 128 creosote piles is expected to provide long-term benefits to critical habitat in the action area.

As compensatory mitigation for permanent solid over-water structures and its shading impacts, AMPORTS plans to purchase credits from a NMFS-approved conservation bank at a 3:1 ratio for habitat. Although the conservation banks within the service area are located upstream of the proposed Project, they benefit the same juvenile SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon that use the construction portion of the action area by providing suitable rearing habitat. Liberty Island Conservation Bank, Cosumnes Floodplain Mitigation Bank, and Fremont Landing Conservation Bank all have adequate mechanisms in place to track credits and debits and ensure that more debits are not sold than credits that are available, and overall habitat improvement for SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead is expected. Fremont Landing is the only mitigation/conservation bank that allows for the purchase of green sturgeon credits. Although Liberty Island and Consumnes do not include green sturgeon credits (only salmonid credits), we expect that individual green sturgeon in the Delta will benefit from the purchase of these credits, as the banks provide areas with soft benthic substrate where juvenile and adult green sturgeon can forage. A description of these tracking mechanisms can be found in the respective banking instruments for Fremont Landing (Wildlands 2006), Cosumnes (Westervelt Ecological Services 2009), and Liberty Island (Wildlands 2010).

2.7.8 Summary

The Project will build 11,860 ft^2 of permanent over-water structure, which will shade the about 11,193 ft^2 of SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon critical habitat with solid cover. Shading reduces the quality of habitat by decreasing submerged aquatic plants and food sources, and increasing predation. Construction activities such over-water structure construction and pile driving will temporarily impact listed species and critical habitat. Under the worst case scenario, elevated sound levels could result in a negative behavioral response for a portion of each day during the 5-month period (July 1—November 30) of pile driving, which would render a 1,514.59-acre area within the action area partially unusable by listed anadromous salmonids and sDPS green sturgeon for foraging and migrating. When pile driving has concluded, elevated sound levels within the zone of behavioral effects will cease and listed fish may again access food resources in the action area undisturbed by pile driving. Temporary delays to upstream and downstream passage are expected to occur during daylight hours of pile driving due to underwater noise. However, this impacts are expected to be temporary because pile driving operations are not continuous and do not completely block the channel from migrating fish. Although there are some permanent and temporary impacts from the proposed Project, when added to the environmental baseline and cumulative effects, the impacts from the proposed Project in the action area are small, and in some cases occur during seasons when fish abundance is low. As compensatory mitigation for the effects of the Project, AMPORTS plans to remove 128 creosote-treated piles from the action area and purchase mitigation credits off-site at a 3:1 ratio. This is a restoration and preservation area larger than the spatial footprint of the wharf rehabilitation. In addition, the compensatory mitigation serves as a form of advanced mitigation because the habitat at the bank was restored between eight years (Liberty Island Conservation Bank) and twelve years (Fremont Landing Conservation Bank) before the impact of the wharf rehabilitation. Therefore, the Project is not expected to reduce appreciably the likelihood of either the survival and recovery of a listed species in the wild by reducing their numbers, reproduction, or distribution, or appreciably diminish the value of designated or proposed critical habitat for the conservation of the species.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species 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 proposed action is not likely to jeopardize the continued existence of SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, sDPS green sturgeon or destroy or adversely modify their designated critical habitats.

2.9 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 ITS.

2.9.1 Amount or Extent of Take

In the BO, NMFS determined that incidental take is reasonably certain to occur as follows:

NMFS anticipates incidental take of SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon in the action area through alteration of habitat conditions in a manner that may significantly disrupt normal behavior. Because of proposed Project timing, actual numbers of fish adversely affected are expected to be low. NMFS cannot, using the best available information, precisely quantify and track the amount or number of individuals that are expected to be incidentally taken (injure, harm, kill, etc.) per species as a result of the Project due to the variability and uncertainty associated with the long-term response of listed species to the effects of the Project, the varying population size of each species, annual variations in the timing of spawning and migration, individual habitat use within the action area, and difficulty in observing harassed, injured, or dead fish. However, it is possible to estimate the extent of incidental take by designating as ecological surrogates those elements of the Project that are expected to result in adverse effects to listed species that are more predictable and/or measurable, and with the ability to monitor those surrogates to determine the extent of take that is occurring.

The most appropriate threshold for incidental take is an ecological surrogate of habitat degradation, which includes the degradation of aquatic habitat through permanent over-water structure. The behavioral modifications or fish responses that result from the habitat disturbance are described below. NMFS anticipates annual take will be limited to the following forms:

1. Pile Driving and Acoustic Impacts

   Mortality and altered fish behavior causing delayed migration, reduced foraging, or greater predation, is expected to result from acoustic impacts that exceed 150 dB, which NMFS considers the threshold of behavioral and physiological changes in the exposed fish species. Based on USFWS fish monitoring data, during the construction period (July 1 to November 30), NMFS expects that a small number of adult SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead and subadult sDPS green sturgeon will be present during the pile driving activity. For this activity, 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 considers the extent of take exceeded if elevated sound pressure levels during pile driving rise above:

   a) 206 dB maximum peak at 10 m (33 ft) distance from the pile,
   b) 187 cumulative SEL at 253 m (830 ft) distance from the pile, and
   c) 150 dB RMS at a distance of 3,400 m (11,155 ft, attenuated) distance from the pile.

2. Shading from Permanent Over-Water Structure

   Incidental take is expected to occur from the permanent over-water structure, which will shade 11,860 ft^2 of the San Joaquin River. The structure will include the permanent installation of 6 72-inch steel piles, 47 24-inch octagonal concrete piles, and 29 13-inch

HDPE piles. These new piles will occupy 220 yd^3 of river bottom fill and 377 yd^3 of in-water volume. Disruption of habitat utilization is likely to result in increased predation risk, decreased feeding, and increased competition. The behavioral modifications are expected to result from disruption of habitat use. This area serves as the ecological surrogate for the permanent habitat affects to the listed species. If AMPORTS exceeds the 11,860 ft^2 of over-water shading and 220 yd^3 of new fill, the proposed Project will be considered to have exceeded anticipated take levels, thus requiring AMPORTS to cease operations and coordinate with NMFS within 24 hours on ways to reduce the amount of take down to anticipated levels.

Incidental take will be exceeded if the amount of habitat disturbance described in the surrogate is exceeded.

2.9.2 Effect of the Take

In the BO, 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 species or destruction or adverse modification of critical habitat.

2.9.3 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).

1. Measures shall be taken to minimize the impacts of permanent over-water shading by implementing integrated onsite and off-site conservation measures that provide beneficial growth and survival conditions for juvenile salmonids and the sDPS green sturgeon.

2. Measures shall be taken to avoid, minimize, and monitor the adverse effects of underwater noise on listed salmonids, sDPS green sturgeon, and their habitats.

3. Measures shall be taken to ensure that contractors, construction workers, and all other parties involved with this Project implement the Project as proposed in the BA and this BO.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the USACE or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). The USACE 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 ITS (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. The USACE shall purchase salmon, steelhead, and green sturgeon credits only from NMFS-approved mitigation banks with service areas that include the action area, including the Liberty Island Conservation Bank, Cosumnes Floodplain Mitigation Bank, and the Fremont Landing Conservation Bank. Credits shall be purchased prior to completing the wharf rehabilitation.

   b. Construction of the wharf and pile driving activities shall occur in accordance with BMPs and conservation measures described in this BO.

2. The following terms and conditions implement reasonable and prudent measure 2:

   a. AMPORTS, or its contractor, shall make available to NMFS data from the hydroacoustic monitoring on a real-time basis (*i.e.*, daily monitoring data should be accessible to NMFS upon request).

   b. AMPORTS, or its contractor, shall adhere to the Regional Water Quality Control Board (RWQCB) No. R5-2009-0085 concerning discharge and turbidity criteria. Copies of any sediment, effluent, or water quality monitoring reports required by the RWQCB that are related to the in-water work associated with this Project shall be sent to NMFS at the address above within 60 days of their completion.

3. The following terms and conditions implement reasonable and prudent measure 3:

   a. The USACE shall provide a copy of this BO to the prime contractor, making the prime contractor responsible for implementing all requirements and obligations included in this document and to educate and inform all other contractors involved in the Project of the requirements of the BO. A notification that contractors have been supplied with this information shall be provided to the reporting address below.

   b. A Worker Environmental Awareness Training Program for construction personnel shall be conducted by the NMFS-approved biologist for all construction workers prior to the commencement of construction activities. The program shall provide workers with information on their responsibilities with regard to Federally-listed fish, their critical habitat, an overview of the life history of all species, information on take prohibitions, protections afforded these animals under the ESA, and an explanation of the terms and conditions in the BO.

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

1. The USACE should recommend that AMPORTS contractors use biodegradable lubricants and hydraulic fluid in construction machinery. The use of petroleum

alternatives can greatly reduce the risk of contaminants such as PAHs or heavy metals directly or indirectly entering the aquatic ecosystem.

2. The USACE should support anadromous salmonid and sturgeon monitoring programs throughout the Sacramento River, San Joaquin River, and Delta region to improve the understanding of migration and habitat utilization by salmonids in this region.

3. The USACE should support and promote aquatic and riparian habitat restoration within the Delta region pursuant to actions identified in the CV Salmonid Recovery Plan (National Marine Fisheries Service 2014) and sDPS green sturgeon Recovery Plan (National Marine Fisheries Service 2018b), and encourage AMPORTS to modify maintenance procedures through the USACE's authorities so that those actions avoid or minimize negative impacts to salmon, steelhead, and sturgeon (See EFH recommendations 2-4).

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

2.11 Reinitiation of Consultation

This concludes formal consultation for AMPORTS Berth Rehabilitation.

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 ITS 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 BO, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat that was not considered in this BO, or (4) a new species is listed or critical habitat designated that may be affected by the action.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the Action Agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the applicant in the BA and descriptions of EFH contained in the fishery management plans (FMP) and developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce for coastal pelagic species (Pacific Fishery Management Council 1998), Pacific Coast groundfish (Pacific Fishery Management Council 2016), and Pacific Coast salmon (Pacific Fishery Management Council 2014).

3.1 Essential Fish Habitat Affected by the Project

Effects of the project will impact EFH for various federally managed fish species within the Coastal Pelagic Species FMP (Pacific Fishery Management Council 1998), Pacific Coast Groundfish FMP (Pacific Fishery Management Council 2016), and Pacific Coast Salmon FMP (Pacific Fishery Management Council 2014). Furthermore, the action area is located in an estuarine habitat area of particular concern (HAPC) for Pacific coastal pelagic, groundfish, and salmon species federally managed within the FMPs.

The coastal pelagic species fishery includes four finfish Pacific sardine (*Sardinops sagax*), Pacific mackerel (*Scomber australasicus*), northern anchovy (*Engraulis mordax*), and jack mackerel (*Trachurus symmetricus*); along with invertebrates, market squid (*Loligo opalescens*) and all krill (*Euphausiacea* spp.) species that occur within the U.S. West Coast exclusive economic zone (EEZ) (Pacific Fishery Management Council 1998). EFH for coastal pelagic species includes all marine and estuarine waters from the shoreline along the coasts of California, Oregon, and Washington offshore to the limits of the EEZ and above the thermocline where sea surface temperatures range between 10°C to 26°C (Pacific Fishery Management Council 1998). The Coastal Pelagic Species FMP also includes two ecosystem component species; jacksmelt (*Atherinopsis californiensis*) and Pacific herring (*Clupea pallasii*).

The Pacific Coast Groundfish FMP includes 90-plus species over a large and ecologically diverse area (Pacific Fishery Management Council 2016). EFH for Pacific coast groundfish is defined as the aquatic habitat necessary to allow for groundfish production to support long-term sustainable fisheries for groundfish and a healthy ecosystem. Within the Delta, EFH for groundfish include all waters from the high water line, and the upriver extent of saltwater intrusion in river mouths.

For Pacific Coast salmon, the PFMC (2014) has identified and updated the description of EFH, adverse impacts, and recommended conservation measures for salmon. Freshwater EFH for Pacific salmon in the California CV includes waters currently or historically accessible to salmon within the CV ecosystem as described in NMFS (2016a, c), and includes the San Joaquin Delta hydrologic unit (*i.e*., number 18040003). SR winter-run (*Oncorhynchus tshawytscha*), CV spring-run (*O. tshawytscha*), and CV fall-/late fall-run Chinook salmon (*O. tshawytscha*) are species managed under the Pacific Coast Salmon FMP that occur within the Delta hydrologic unit.

The implementing regulations for the EFH provisions of the MSA (50 CFR part 600) also recommend that HAPCs be identified, if present. The PFMC has designated the following five HAPCs: (1) complex channels and floodplain habitats, (2) thermal refugia, (3) spawning habitat, (4) estuaries, and (5) marine and estuarine submerged aquatic vegetation. The landward extent of the estuary HAPC is east of the Project as defined by the upstream extent of saltwater intrusion at 0.5 parts per thousand (ppt). Therefore, NMFS has determined that within the action area, the estuary HAPC is present for all three FMPs.

Factors limiting salmon populations in the Delta include periodic reversed flows due to high water exports (drawing juveniles into large diversion pumps), loss of fish into unscreened agricultural diversions, predation by introduced species, and reduction in the quality and quantity of rearing habitat due to channelization, pile driving, pollution, rip-rapping, etc. (Dettman et al. 1987, Kondolf et al. 1996a, Kondolf et al. 1996b). Loss of vital wetland habitat along the fringes of the San Francisco and Suisun bays reduce rearing habitat and diminish the functional processes that wetlands provide for the bay ecosystem. Shipping ports are often located in estuaries where the development of port facilities (*e.g.*, docks, pile driving, filling, and rip-rap) have resulted in the loss of estuarine habitats.

3.1.1 Life History and Habitat Requirements

3.1.1.1 Coastal Pelagics

The habitat in the action area is unique in that it contains both freshwater and saltwater fish species that depend on the large tidal mixing zone for foraging, shelter, and as a nursery. Many of the EFH species such as Pacific herring and jacksmelt utilize the action area for a part of their early life history before migrating to the ocean. The most abundant EFH species within the Coastal Pelagics FMP in the action area are northern anchovy, *Engraulis mordax*.

Northern anchovy are small, short-lived, fish typically found in schools near the water surface. They spawn in every month of the year, but spawning increases during late winter and early spring (Moyle 2002). This species is a broadcast spawner and females can produce up to 30,000 eggs a year. The San Francisco Bay and Delta provide favorable reproductive habitat because abundant food exists for both adults and larvae. Anchovies feed diurnally by filter feeding. All life stages of northern anchovy are important prey for predatory fish, birds, and mammals, including Chinook salmon, seals, and sea lions.

3.1.1.2 Pacific Groundfish

Starry flounder (*Platichthys stellatus*) is the most abundant DFH species within the Pacific Groundfish FMP in the action area. They are flatfish with both eyes on the upper side of the body, and which prefers brackish water (average size 35–41 cm, maximum 91 cm). Most spawning occurs in shallow water near the mouths of rivers and estuaries during the winter (Moyle 2002). An average size female can produce about 11 million eggs. In California, starry flounder spawn from November to February with the peak months in December and January. Starry flounder larvae and juveniles are eaten by larger fish, wading birds, and marine mammals.

3.1.1.3Pacific Salmon

General life history information for CV Chinook salmon is summarized below. Further detailed information on SR winter-run and CV spring-run are available in the status of the species section (Section 2.2) of this BO.

Adult CV fall-run Chinook salmon typically enter the Sacramento and San Joaquin rivers from July through December and spawn from October through December (U. S. Fish and Wildlife Service 1995). Late fall-run Chinook salmon migrate into the rivers from mid-October through mid-April and spawn from January through mid-April. Chinook salmon spawning generally occurs in clean loose gravel in swift, relatively shallow riffles or along the edges of fast runs (Ford 2011).

Fall-run and late fall-run Chinook salmon egg incubation occurs from October through June (Reynolds et al. 1993). Shortly after emergence from their gravel nests, most fry disperse downstream towards the Delta and into the San Francisco Bay and its estuarine waters (Kjelson et al. 1982). The remaining fry hide in the gravel or station in calm, shallow waters with bank cover such as tree roots, logs, and submerged or overhead vegetation. These fall-run juveniles feed and grow from January through mid-May, and emigrate to the Delta and estuary from mid-March through mid-June (Lister and Genoe 1970). Late-fall run juveniles feed and grow from April through mid-October, and emigrate to the Delta and estuary from November until February (Reynolds et al. 1993). As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Along the emigration route, submerged and overhead cover in the form of rocks, aquatic and riparian vegetation, logs, and undercut banks provide habitat for food organisms, shade, and protect juveniles and smolts from predation. These smolts generally spend a very short time (three days to three months) in the Delta and estuary before entry into the ocean. Whether entering the Delta or estuary as fry or juveniles, CV Chinook salmon depend on passage through the Delta for access to the ocean.

3.2 Adverse Effects on Essential Fish Habitat

Based on the best available information, the proposed AMPORTS wharf rehabilitation would adversely affect EFH for Pacific salmon for five months from July 1 through November 30.

Adverse effects to EFH will occur through: (1) increased turbidity in the water column, (2) suspension of sediment-associated contaminants, and (3) disturbance of benthic habitat temporarily impacted by elevated underwater sound levels during pile driving.

The effects of the proposed action on salmonid habitat are described at length in Section 2.4 (Effects of the Action) of the preceding BO, and generally are expected to apply to Pacific salmon EFH. The Project's five month in-water work window from July 1 through November 30 is likely to overlap with adult fall-run Chinook salmon migration upstream in the Sacramento and San Joaquin rivers. Juvenile fall-run are not likely to be present in the action area during the later two months of the work window, however, juvenile late fall-run Chinook salmon could be present if there is any precipitation or increase in flows. Adult salmon that encounter increased turbidity, resuspension of sediments, or elevated sound from pile driving would likely swim away from the disturbance. The area of physical injury is very small (470 m or 1542 ft radial distance from the dock) considering the action area (1,514.59 acres) and the surface waters of the Delta (61,000 acres). Non-continuous operation and rest periods at night would allow both juvenile and adult salmon time periods for safe passage by swimming around or passing the action area without being injured. The majority of effects from the Project (*e.g.*, underwater sound, resuspension of sediments, increased turbidity, and temporary loss of foraging habitat) will temporarily degrade the quality of freshwater and estuarine EFH in the San Joaquin River.

Pile driving has been specifically identified in Amendment 18 to the Pacific Coast Salmon FMP as a source of impacts on salmon EFH (Pacific Fishery Management Council 2014). Pile driving may adversely affect infaunal and bottom-dwelling organisms at the site by removing immobile organisms such as polychaetes worms and other prey types or forcing mobile animals such as fish to migrate. These effects, have been described at length in Section 2.4 (Effects of the Action) of the preceding BO, and generally are expected to apply to Pacific Coast salmon EFH. The overall beneficial effect will be improved water quality associated with removal of 128 creosote-treated timber piles, which should, in the long-term, improve habitat conditions.

The effect of the proposed action on Pacific groundfish and coastal pelagics is similar to those listed above for Pacific salmon with the exception of sound effects. Since larvae and eggs of Pacific groundfish and coastal pelagics can be < 2 g within the action area, the lower threshold (183 dB) for sound impacts from pile driving would apply. This means that a larger area for physical injury would occur for EFH species than for salmon (*i.e.*, 470 m compared to 253 m). This radius distance from the AMPORTS wharf represents 120.42 acres of acoustic impact area.

The rehabilitation of the AMPORTS wharf involves the removal of 128 creosote-treated piles. Removal will re-suspend sediment that could contain accumulated PAHs from leachates. Pile driving also has the potential to resuspend PAH-contaminated sediments. The release of PAHs into the water column has a higher potential to impact species that are benthic oriented such as starry flounder. Furthermore, the newly exposed surface layer of sediment after dredging may allow for contaminants to be made available to organisms and assimilate into the food chain.

Pile removal and driving at the AMPORTS wharf will impact forage species, such as infaunal and bottom-dwelling organisms like polychaete worms and crustaceans, by directly removing or burying these organisms. Recolonization studies suggest that recovery may not be linear, and depends on physical factors such as particle size distribution, currents, and stabilization processes following disturbance. Rates of recovery listed in the literature range from several months to several years for estuarine muds and can take up to one to three years in areas of strong currents (Oliver et al. 1977, Currie and Parry 1996, Watling et al. 2001).

The act of removing soft-bottom sediments and their associated biotic assemblages during pile driving creates an area of disturbance which is extremely susceptible to recolonization by invasive species, often resulting in the displacement of native species. As a result, pile driving and removal can increase the distribution and abundance of existing invasive species in the bay. Introduced organisms increase competition with indigenous species or forage on indigenous species, which can reduce fish and shellfish populations. The introduction of exotic organisms could lead to changes in relative abundances of species and individuals that are native and important forage species.

3.3 Essential Fish Habitat Conservation Recommendations

The USACE should implement term and condition 2.b (*i.e*., compliance with RWQCB standards for discharge and turbidity) from this BO as an EFH Conservation Recommendation for Pacific Coast salmon, Pacific groundfish, and coastal pelagic species. In addition, the following Conservation Recommendations should to be implemented in the action area for Pacific Coast salmon, as well as those described in Amendment 18 (Pacific Fishery Management Council 2014). To promote recovery of Chinook salmon in the CV and minimize the adverse effects resulting from the Project, NMFS is including the following recovery actions from NMFS (2014) as EFH Conservation Recommendations. Fully implementing these Conservation Recommendations would minimize the adverse effects to EFH that are within the action area, approximately 1,514.59 acres of designated EFH for Pacific coast salmon.

3.3.1 Pile Driving and Associated Activities

In order to minimize adverse effects to the migratory corridor within the San Joaquin River portion of the action area, caused by pile driving, pile removal, or dock construction, the USACE and AMPORTS (applicant) should:

(1) Maintain riparian management zones of appropriate width for Pacific coast salmon (defined as mean higher high water in tidal areas) in the San Joaquin River that influences the estuary HAPC within the Delta EFH;
(2) Reduce erosion and runoff from the AMPORTS wharf associated with the Project into waterways within the action area.
(3) NMFS (2014) Delta Recovery Action 1.6: Provide access to new floodplain habitat in the South Delta for migrating salmonids from the San Joaquin system.
(4) NMFS (2014) Delta Recovery Actions 1.13, 1.14, 1.15, 1.16, and 1.7: Implement tidal marsh restoration projects at either Prospect Island, Chipps Island, Eastern Decker Island, Southport, or Dutch Slough.

3.3.2 Water Quality Impacts

Water quality essential to Chinook salmon EFH can be altered when pollutants are introduced through surface runoff, through direct discharges of pollutants into the water, or when deposited contaminants in the sediments are resuspended (*e.g.*, from pile removal or vessel traffic). Indirect sources of water pollution in salmon habitat includes storm water run-off from streets, yards, and industrial sites. In order to minimize these impacts, the USACE and the applicant should:

(1) Provide copies of any sediment, effluent, or water quality monitoring reports pre- and post-construction required by the RWQCB that are related to the in-water work associated with this Project. Reports should be sent to NMFS at the address above within 60 days of completion of the Project.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, approximately 1,514.59 acres of designated EFH for Pacific Coast salmon, Pacific Coast groundfish, and coastal pelagic species.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the USACE must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the Action Agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

The USACE must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations (50 CFR 600.920(l)).

4. FISH AND WILDLIFE COORDINATION ACT

The purpose of the FWCA is to ensure that wildlife conservation receives equal consideration, and is coordinated with other aspects of water resources development (16 USC 661). The FWCA establishes a consultation requirement for Federal agencies that undertake any action to modify any stream or other body of water for any purpose, including navigation and drainage (16 USC 662(a)), regarding the impacts of their actions on fish and wildlife, and measures to mitigate those impacts. Consistent with this consultation requirement, NMFS provides recommendations and comments to Federal action agencies for the purpose of conserving fish and wildlife resources, and providing equal consideration for these resources. NMFS' recommendations are provided to conserve wildlife resources by preventing loss of and damage to such resources. The FWCA allows the opportunity to provide recommendations for the conservation of all species and habitats within NMFS' authority, not just those currently managed under the ESA and MSA.

The following recommendations apply to the proposed action:

1. Establishment of a Safety Zone and requirements for marine mammals. If a marine mammal is observed within 500 m (1640 ft) when driving 72-inch steel piles, the applicant should delay pile driving until the animal has moved outside of the Safety Zone, or after 15 minutes has elapsed since the last sighting.

   Rationale: Harbor seals and California sea lions are known to be present in the waters surrounding the AMPORTS wharf, and may be impacted by pile driving noise. Marine mammals are more sensitive to underwater sound impacts than fish species. Currently, NMFS practice regarding exposure of marine mammals to underwater noise is that in order to avoid injury, pinnipeds should not be exposed to impulsive sounds above 190 dB. This level is considered precautionary as it is likely that more intense sounds would be required before injury occurs (Southall et al. 2008). Potential for behavioral harassment (Level B) is considered to occur when exposed to sounds (RMS) greater than 160 dB for impact pile driving. The analysis for impact pile driving in the BA calculated that the distance to physical injury (Level A) is 35 m and the distance to harassment (Level B) is 500 m.

The Action Agency must give these recommendations equal consideration with the other aspects of the proposed action so as to meet the purpose of the FWCA.

This concludes the FWCA portion of this consultation.

5. 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 BO addresses these DQA components, documents compliance with the DQA, and certifies that this BO has undergone pre-dissemination review.

5.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this BO is the USACE. Other interested users could include the applicant (AMPORTS), USFWS, CDFW, RWQCB, the City of Antioch, and others interested in the conservation of the affected ESUs/DPSs. Individual copies of this BO were provided to the USACE. The format and naming adheres to conventional standards for style.

5.2 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.

5.3 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, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this BO and EFH consultation 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 and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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