Collinsville 500/230 Kilovolt Substation Project

Aquatic Resources Technical Report

Collinsville, Solano County, California

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List of Acronyms

AMM	Avoidance and Minimization Measure
BCDC	San Francisco Bay Conservation and Development Commission
ARTR	Aquatic Resources Technical Report
CAISO	California Independent System Operator
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
CEQA	California Environmental Quality Act
CFGC	California Fish and Game Code
CFR	Code of Federal Regulations
CNDDB	California Natural Diversity Database
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
Delta	Sacramento-San Joaquin Delta
DMMO	San Francisco Bay Dredge Material Management Office
EFH	Essential Fish Habitat
ESA	Federal Endangered Species Act
Estuary	Combined Areas of Delta, Suisun Bay, San Pablo Bay, and San Francisco Bay
HAPC	Habitat Areas of Particular Concern
HTL	High Tide Line
LSPGC	LS Power Grid California, LLC
MMPA	Marine Mammal Protection Act
NCCP	Natural Community Conservation Plan
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NTU	Nephelometric Turbidity Units
PG&E	Pacific Gas and Electric
PEA	Proponents Environmental Assessment
PPT	Parts Per Thousand
PTS	Post-traumatic stress
Project	LS Power's Collinsville 500/230 Kilovolt Substation Project
RHA	Rivers and Harbors Act
RMS	Root mean square
RWQCB	Regional Water Quality Control Board
SAV	Submerged Aquatic Vegetation
Study Area	Area where aquatic resources are evaluated for the Project
SWRCB	State Water Resource Control Board
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WRA	WRA, Inc.

1.0 INTRODUCTION

This Aquatic Resources Technical Report (ARTR) reviews existing fisheries biological resources, evaluates potential impacts associated with installation of sub-marine cables, as well as structures to support cables and Avoidance and Minimization Measures (AMMs) for the LS Power Grid California, LLC's (LSPGC) Collinsville 500/230 Kilovolt Substation Project (Proposed Project) located within the Sacramento-San Joaquin Delta (Delta) between Collinsville and Pittsburg (Appendix A - Figure 1). LSPGC proposes to complete construction of a new substation in Collinsville, which will then send electricity through an upland portion of the new transmission line, to a transition structure where six transmission lines will then pass beneath the Delta, to resurface at PG&E's Pittsburg Substation in the City of Pittsburg, where the lines will be tied into the existing grid. This ARTR specifically evaluates the aquatic components, fisheries related resources and marine mammals potentially affected by the Proposed Project (Study Area, Appendix A – Figure 2).

1.1 Overview and Purpose

This report provides an assessment of biological resources within aquatic portions of the Study Area and immediate vicinity as they pertain to fisheries and marine mammals. The purpose of the assessment is to support an evaluation of the Proposed Project for the Proponent's Environmental Assessment (PEA). This report evaluates (1) the presence of regulated fisheries habitats, and (2) the potential for the site to support special-status fish and wildlife species. Based on the results of the site assessment, potential impacts to sensitive habitat types and special-status species resulting from the Proposed Project were evaluated. If the project has the potential to result in significant impacts to these biological resources, measures to avoid, minimize, or mitigate those significant impacts are described.

An ARTR provides general information on the presence, or potential presence, of sensitive species and habitats. Additional focused studies including follow up submerged aquatic vegetation (SAV) surveys may be required to support regulatory permit applications or to implement mitigation measures included in this report. This assessment is based on information available at the time of the study and on-site conditions that were observed when the site was visited. Conclusions are based on currently available information used in combination with the professional judgement of the biologists completing this study.

1.2 Location and Setting

The aquatic portion of the Study Area is located within and beneath waters of the western Delta (Appendix A: Figure 3). The Delta generally extends from Sacramento in the north, to the confluence of the San Joaquin and Stanislaus River in the south, and west to the edge of Suisun Bay near Collinsville. The Delta is the eastern most segment of the San Francisco Estuary which consists of the Delta, Suisun Bay, San Pablo Bay, and San Francisco Bay (Estuary) (Moyle 2002). The Estuary drains all of the major rivers of the Central Valley and funnels them through the Estuary to the Pacific Ocean. The Delta is the transition zone between saline waters within San Francisco Bay and freshwater marshes that extended inland throughout much of the Central Valley.

Today the Delta is largely managed for agriculture and water conveyance. Many of the former islands and marshes are now surrounded by levees constructed over the last 120 years for agricultural management and flood control. The Central Valley Project and State Water Project facilities located throughout the Delta are also key to the local ecology. These projects withdraw water from the Delta and distribute it to areas across the state for agricultural and municipal uses. Additionally, the Delta contains hundreds of general agricultural diversions which pump water directly out of the rivers and bays and onto adjacent farm fields. As such, water diversions and operation of the two water supply projects dictate much of how water is allocated and distributed throughout the Delta.

Collinsville occupies a unique location in the Delta ecosystem at the transition zone between the freshwater habitats of the Delta and brackish habitats of Suisun Bay. Water is managed by the Water Projects to achieve specific salinity criteria at Collinsville, ideally maintaining a measurement at or below 2 parts per thousand (PPT) one meter from the bottom of the channel (DSC 2023). This measurement, known as the "X2" is a physical attribute of the estuary used as a habitat indicator for the location of the low salinity zone, such that higher productivity for Delta fishes is maintained inland of the X2 zone.

Within the X2 there is a mixing of species from both marine and freshwater environments due to the salt/fresh gradient. For example, the X2 is often used to model the distribution of Delta smelt (*Hypomesus transpacificus*) which is found solely within low salinity zones. As the X2 moves outward into Suisun Bay in winter, so to do Delta smelt. Other listed fish such as longfin smelt (*Spirinchus thaleichthys*) spawn within freshwater reaches of the Delta but make seasonal migrations into the marine portions of the Estuary to feed. This transition zone is also an important area for anadromous fishes including steelhead (*Oncorhynchus mykiss*), Chinook salmon (*O. tshawytscha*), green sturgeon (*Acipenser medirostris*), white sturgeon (*A. transmontanus*) and lamprey (genus: *Entosphenus*). Anadromous species rely on the fresh/saltwater gradients to physiologically adapt to marine or freshwater environments where they spend some portion of their lives. As such this area of the Delta is an environmentally fluid state which varies with outflow year, and water diversions, but also plays a key role for Delta and anadromous fishes by providing a transition zone for physiological adaptations from fresh to saltwater.

1.3 Project Elements

1.3.1 Project Description

The LSPGC Project would involve the construction of a new substation and transmission lines to address the California Independent System Operator (CAISO)-identified overloads to the greater Bay Area by increasing transmission reliability for the area and advancing additional renewable generation. As depicted in Figure 1 (Appendix A), the Proposed Project would be located in portions of Solano, Sacramento, and Contra Costa counties in California.

1.3.2 Project Components

The main components of the Proposed Project include the following:

- A new approximately 8-acre 500/230 kV substation (Collinsville Substation);

- Two approximately 1.5-mile-long single-circuit 500 kV transmission line segments that would interconnect Pacific Gas and Electric Company's (PG&E's) existing Vaca Dixon-Tesla 500 kV Transmission Line into the proposed Collinsville Substation[1]; and
- A new approximately 6-mile-long double-circuit 230 kV transmission line connecting the proposed Collinsville Substation to PG&E's existing Pittsburg Substation. The new 230 kV transmission line would include:
    - An approximately 1- to 2-mile-long overhead transmission line segment, that would connect the proposed Collinsville Substation to in-river H-frame transition structure (north side of the Sacramento River),
    - One steel and concrete in-river H-frame structure to transition the overhead conductors to submarine cables on the northern edge of the Sacramento River,
    - Six approximately 4.5-mile-long submarine cables running in a northeast to southwest direction installed approximately 6 to 15 feet below the sediment surface, and
    - A utility vault structure near PG&E's existing Pittsburg Substation to connect the submarine cables to underground cables that would terminate at approximately two new riser poles adjacent to PG&E's existing Pittsburg Substation.

1.3.3 Project Construction

The Collinsville Substation construction would require a portion of the approximately 8-acre substation site to be cleared of all vegetation and graded to create a generally flat area for the substation components. In addition, a new access road to the substation would be constructed. Next, the ground grid, equipment foundations, and cable trenches would be installed. Once the below-grade construction is complete, the above ground substation components would be installed. Finally, testing and commissioning would be conducted once the transmission lines are terminated at the substation prior to energization.

The overhead transmission lines would be constructed on land and would first require new temporary access roads and work areas to be established at each structure location. This process would involve vegetation clearing and blading, as required to create a flat area to facilitate construction. For the overhead structures, one or more foundations for each structure would be constructed prior to the erection of lattice steel structures or self-supporting, steel monopoles. The 500 kV structures would utilize a horizontal conductor configuration and the 230 kV poles would use a vertical conductor configuration. Finally, the conductors and two optical ground wires would be strung along the transmission line alignment. Following construction, an approximately 20-foot radius around the new structures would remain cleared to facilitate future operation and maintenance.

In-water work for the transmission lines would begin on the northern shore of the Sacramento River with the construction of in-river transition structure. The structure will be built on a foundation of 12 steel piles (up to 36-inches in diameter) and would measure approximately 130 feet in length by 40 feet in width. The surface of the structure will either be made of cast-in-

[1] PG&E will be responsible for the final configuration of the northern tie in of the 500 kV connection between the proposed Collinsville Substation and the existing Vaca Dixon-Tesla 500 kV Transmission Line. LSPGC will be responsible for the installation of dead-end structures near the Collinsville Substation to facilitate looping in the 500 kV lines.

place concrete or precast concrete sections which are mounted on the piles and then attached to each other. Sections may also incorporate sections of grated steel where structurally suitable, such that light can penetrate the surface of the structure to waters below. The structure would support a series of six "J" tubes which will guide cables from their above-ground towers to the submarine crossing. The submarine cables would be trenched under the riverbed using a hydroplow and water jetting or vertical injector methods with no backfilling required. The main mechanical components of the hydroplow are skids which allow a sled supporting the plow to slide across the river bottom, and an articulated blade which rotates down into the channel bottom. The blade is fitted with water injectors along its leading edge that liquefy substrate immediately ahead of the blade reducing the force required to pull the plow forward. The cable is strung through the plow blade from the ship, and as the plow moves forward, the cable runs through the blade and is embedded at a pre-determined depth in the sediment. Loose sediment on the walls of the furrow is then allowed to naturally sluff back in immediately after the plow is pulled through, filling the trench.

Vertical jet-setting uses a similar sled-mounted device but rather than having an articulated vertical blade, water jets are mounted vertically on the sled, and cut a similar trench, allowing the cable to be fed into the trench as soon as it is cut.

Near the southern edge of the Sacramento River and San Joaquin River confluence, open trench excavation will be used to dig the final section of trench for the submarine cable, making the transition to the vault on the southern shore where cables will daylight again. In the event that open-trenching is not possible, horizontal directional drilling would be used to connect the submarine cables to the onshore utility vault. At this southern shore junction, sheetpiles may also be driven partially in water, and partially on land to stabilize and protect cables on the upstream and downstream sides as they make landfall. The cables would then continue in an underground configuration to designated locations near the fence of PG&E's existing Pittsburg Substation. PG&E would be responsible for connecting the cables to the existing substation equipment.

The Proposed Project would also require the establishment of temporary staging areas, stringing sites, access roads, and construction areas to utilize during construction. These access and staging facilities are anticipated for work outside of the Delta waters and all temporarily impacted areas would be restored to near pre-construction conditions after work is complete.

1.3.4 Construction Schedule

Construction is anticipated to begin in early 2026 and take approximately 24 to 30 months to complete. The Proposed Project includes construction occurring on land and in water. The construction of in-water transition structures is anticipated to take approximately 6 months and installation of the submarine cables is anticipated to take approximately 7 months. In-water work would be restricted to between July 1 and November 30 and would require approximately 2 years to complete within the work windows. Land-based construction would occur year-round or as authorized by permits and authorizations. Per the CAISO technical specifications, the Proposed Project is required to be energized by June 1, 2028.

1.3.5 Operations and Maintenance

LSPGC would conduct ongoing operations and maintenance of all Proposed Project components. These planned activities would involve regular inspections of all facilities and repairs would be conducted on an as-needed basis, and maintenance of transmission line rights-of-way. The

proposed Collinsville Substation would be unstaffed and operated remotely. Maintenance of the buried submarine cables is not anticipated.

2.0 REGULATORY BACKGROUND

The following sections explain the regulatory context of the biological assessment, including applicable laws and regulations that were applied to the field investigations and analysis of potential project impacts.

2.1.1 Vegetation and Aquatic Communities

Waters of the United States, Including Wetlands: The Corps regulates "Waters of the United States" under Section 404 of the Clean Water Act (CWA). Waters of the United States are defined in the Code of Federal Regulations (CFR) as including the territorial seas, and waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, such as tributaries, lakes and ponds, impoundments of waters of the U.S., and wetlands that are hydrologically connected with these navigable features (33 CFR 328.3). Potential wetland areas, according to the three criteria used to delineate wetlands as defined in the *U.S. Army Corps of Engineers Wetlands Delineation Manual* (Corps Manual; Environmental Laboratory 1987), are identified by the presence of (1) hydrophytic vegetation, (2) hydric soils, and (3) wetland hydrology. Unvegetated waters including lakes, rivers, and streams may also be subject to Section 404 jurisdiction and are characterized by an ordinary high water mark (OHWM) identified based on field indicators such as the lack of vegetation, sorting of sediments, and other indicators of flowing or standing water. The placement of fill material into Waters of the United States generally requires a permit from the Corps under Section 404 of the CWA.

The Corps also regulates construction In navigable waterways of the U.S. through Section 10 of the Rivers and Harbors Act (RHA) of 1899 (33 U.S. Code [USC] 403). Section 10 of the RHA requires Corps approval and a permit for excavation or fill, or alteration or modification of the course, location, condition, or capacity of, any port, roadstead, haven, harbor, canal, lake, harbor or refuge, or enclosure within the limits of any breakwater, or of the channel of any navigable water of the United States. Section 10 requirements apply only to navigable waters themselves, and are not applicable to tributaries, adjacent wetlands, and similar aquatic features not capable of supporting interstate commerce.

Waters of the State, Including Wetlands: The term "Waters of the State" is defined by the Porter-Cologne Act as "any surface water or groundwater, including saline waters, within the boundaries of the state." The State Water Resources Control Board (SWRCB) and nine Regional Water Quality Control Boards (RWQCB) protect waters within this broad regulatory scope through many different regulatory programs. Waters of the State in the context of a California Environmental Quality Act (CEQA) Biological Resources evaluation include wetlands and other surface waters protected by the *State Wetland Definition and Procedures for Discharges of Dredged or Fill Material to Waters of the State* (SWRCB 2019). The SWRCB and RWQCB issue permits for the discharge of fill material into surface waters through the State Water Quality Certification Program, which fulfills requirements of Section 401 of the CWA and the Porter-Cologne Water Quality Control Act. Projects that require a Clean Water Act permit are also required to obtain a Water Quality Certification. If a project does not require a federal permit but does involve discharge of dredge or fill material into surface waters of the State, the SWRCB and RWQCB may issue a permit in the form of Waste Discharge Requirements.

Sections 1600-1616 of California Fish and Game Code: Streams and lakes, as habitat for fish and wildlife species, are regulated by the California Department of fish and Wildlife (CDFW) under Sections 1600-1616 of California Fish and Game Code (CFGC). Alterations to or work within or adjacent to streambeds or lakes generally require a 1602 Lake and Streambed Alteration Agreement. The term "stream," which includes creeks and rivers, is defined in the California code of regulations (CCR) as "a body of water that flows at least periodically or intermittently through a bed or channel having banks and supports fish or other aquatic life [including] watercourses having a surface or subsurface flow that supports or has supported riparian vegetation" (14 CCR 1.72). The term "stream" can include ephemeral streams, dry washes, watercourses with subsurface flows, canals, aqueducts, irrigation ditches, and other means of water conveyance if they support aquatic life, riparian vegetation, or stream-dependent terrestrial wildlife (CDFG 1994). Riparian vegetation has been defined as "vegetation which occurs in and/or adjacent to a stream and is dependent on, and occurs because of, the stream itself" (CDFG 1994). Removal of riparian vegetation also requires a Section 1602 Lake and Streambed Alteration Agreement from CDFW.

San Francisco Bay and Shoreline: Enacted in 1965, the McAteer-Petris Act (California Government Code Section 66600 *et seq*.) established the San Francisco Bay Conservation and Development Commission (BCDC) as a state agency charged with preparing a plan for the long-term use of the Bay. BCDC has several areas of jurisdiction, including San Francisco Bay (including sloughs and marshlands lying between mean high tide and five feet above mean sea level) and a shoreline band consisting of all territory located between the shoreline of the Bay and a line 100 feet landward of and parallel with the shoreline (California Government Code 66610). Any person or governmental agency wishing to place fill, to extract materials, or to make any substantial change in use of any water, land, or structure within BCDC jurisdiction must secure a permit from BCDC.

2.1.2 Special-status Species

ENDANGERED AND THREATENED FISH AND WILDLIFE

Specific species of plants, fish, and wildlife species may be designated as threatened or endangered by the federal Endangered Species Act (ESA), or the California Endangered Species Act (CESA). Specific protections and permitting mechanisms for these species differ under each of these acts, and a species' designation under one law does not automatically provide protection under the other.

The ESA (16 USC 1531 et seq.) is implemented by the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS). The USFWS and NMFS maintain lists of endangered and threatened plant and animal species (referred to as""listed specie"")."Propose"" or"candidat"" species are those that are being considered for listing and are not protected until they are formally listed as threatened or endangered. Under the ESA, authorization must be obtained from the USFWS or NMFS prior to take of any listed species. "Take" under the ESA is defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Take under the ESA includes direct injury or mortality to individuals, disruptions in normal behavioral patterns resulting from factors such as noise and visual disturbance and impacts to habitat for listed species. Actions that may result in take of an ESA-listed species may obtain a permit under ESA Section 10, or via the

interagency consultation described in ESA Section 7. Federal-listed plant species are only protected when take occurs on federal land.

The CESA (CFGC 2050 et seq.) prohibits the take of any plant and animal species that the CFGC determines to be an endangered or threatened species in California. CESA regulations include take protection for threatened and endangered plants on private lands, as well as extending this protection to candidate species that are proposed for listing as threatened or endangered under CESA. The definition of a“"tak”" under CESA “"hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kil”") only applies to direct impact to individuals, and does not extend to habitat impacts or harassment. CDFW may issue an Incidental Take Permit under CESA to authorize take if it is incidental to otherwise lawful activity and if specific criteria are met. Take of these species is also authorized if the geographic area is covered by a Natural Community Conservation Plan (NCCP), as long as the NCCP covers that activity.

FULLY PROTECTED SPECIES

This category includes specific plant and wildlife species that are designated in the CFGC as protected even if not listed under CESA or ESA. Fully Protected Species includes specific lists of birds, mammals, reptiles, amphibians, and fish designated in CFGC. Fully protected species may not be taken or possessed at any time. No licenses or permits may be issued for take of fully protected species, except for necessary scientific research and conservation purposes. The definition of "take” is the same under the California Fish and Game Code and the CESA. By law, CDFW may not issue an Incidental Take Permit for Fully Protected Species.

MARINE MAMMALS

The Marine Mammal Protection Act (MMPA) was enacted in 1972 and protects all marine mammals within the territorial boundaries of the United States from take. The definition of "take” in the MMPA is the same as that under the FESA. The law is administered by the NMFS, who may issue permits for incidental take and importation of marine mammals in certain circumstances.

SPECIES OF SPECIAL CONCERN, AND OTHER SPECIAL-STATUS SPECIES

To address additional species protections afforded under CEQA which would also be addressed through the PEA, CDFW has developed a list of special species as “a general term that refers to all of the taxa the CNDDB is interested in tracking, regardless of their legal or protection status.” This includes lists developed by other organizations, including for example, the Audubon Watch List Species, the Bureau of Land Management Sensitive Species, and USFWS Birds of Special Concern. Additionally, any species listed as sensitive within local plans, policies and ordinances are likewise considered sensitive under CEQA.

2.1.3 Special-status Habitats

CRITICAL HABITAT

The ESA also provides for designation of critical habitat, which are specific geographic areas containing physical or biological features “essential to the conservation of the species.” Protections afforded to designated critical habitat apply only to actions that are funded, permitted, or carried out by federal agencies. Critical habitat designations do not affect activities by private landowners if there is no other federal agency involvement.

ESSENTIAL FISH HABITAT

The Magnuson-Stevens Fishery Conservation and Management Act provides for conservation and management of fishery resources in the U.S., administered by NMFS. This Act establishes a national program intended to prevent overfishing, rebuild overfished stocks, ensure conservation, and facilitate long-term protection through the establishment of Essential Fish Habitat (EFH). EFH consists of aquatic areas that contain habitat essential to the long-term survival and health of fisheries, which may include the water column, certain bottom types, vegetation (e.g., sago pondweed (*Stuckenia filiformis*) or ditch-grass/widgeon grass (*Ruppia maritima or Ruppia cirrhosa*)), and complex structures such as oyster beds. Any federal agency that authorizes, funds, or undertakes action that may adversely affect EFH is required to consult with NMFS.

MOVEMENT CORRIDORS AND WILDLIFE NURSERY SITES

Movement and migratory corridors for native wildlife (including aquatic corridors) as well as wildlife nursery sites such as submerged aquatic vegetation are given special consideration under CEQA and as such are included for this letter to evaluate effects as part of the PEA.

3.0 ASSESSMENT METHODOLOGY

WRA biologists reviewed literature resources and performed database searches to assess the potential for sensitive habitat types and special-status species including:

- Antioch North and Honker Bay 7.5-minute U.S. Geological Survey (USGS) quadrangle (USGS 2023)
- Contemporary aerial photographs (Google Earth 2023)
- Historical aerial photographs (NETR 2023)
- National Wetlands Inventory (USFWS 2023a)
- California Natural Diversity Database (CNDDB, CDFW 2023a)
- USFWS Information for Planning and Consultation (USFWS 2023b)
- National Marine Fisheries Service Essential Fish Habitat Mapper (NMFS 2023a)
- National Marine Fisheries Critical Habitat Mapper (NMFS 2023b).

3.1 Special-status Species

3.1.1 General Assessment

Potential occurrence of special-status species in the Study Area was evaluated by first determining which special-status species occur in the vicinity of the Study Area through a literature and database review as described above. The presence of suitable habitat for special-status species was evaluated based on physical and biological conditions of the site, documented occurrences of species in CDFW trawl sampling, as well as the professional expertise of the investigating biologists. After reviewing background literature, it was determined that any species of special-status fish are either present year-round (i.e. they may spawn, rear and forage as adults in the vicinity), or species are present only seasonally when making migrations (e.g. when moving between natal streams and the Pacific Ocean). As such the evaluation below does not include categories such as unlikely, low, or moderate potential as any species are either likely to be present year-round, or are only present seasonally during migrations. As such the categories of classification were simplified. In case where the Study Area is outside of the species known range or similar factors make it so the species will not occur, the

species was determined to have no potential. As such the potential for special-status species were determined according to the following criteria:

- **No Potential.** Habitat on and adjacent to the site is clearly unsuitable for the species requirements (foraging, breeding, cover, substrate, elevation, hydrology, plant community, site history, disturbance regime). Alternatively, the Study Area may be outside of the species known range.
- **Present Seasonally.** Species is observed in the Study Area or has been recorded (i.e., CNDDB, other reports) on the site in the recent past during certain portions of the year, typically when migrating to the Pacific Ocean, or to natal streams.
- **Present Year-Round.** Species has been observed in waters of the Study Area year-round (i.e., CNDDB, CDFW trawl data) in the recent past. These species may spend a large portion of the year spawning, rearing or foraging as adults in the vicinity.

3.2 Wildlife Corridors and Native Wildlife Nursery Sites

To account for potential impacts to wildlife movement/migratory corridors, biologists reviewed maps from the California Essential Connectivity Project (CalTrans 2010), and habitat connectivity data available through the CDFW Biogeographic Information and Observation System (CDFW 2023b). Additionally, aerial imagery (Google Earth 2023) for the local area was referenced to assess if local core habitat areas were present within, or connected to the Study Area. This assessment was refined based on observations of on-site physical and/or biological conditions, including topographic and vegetative factors that can facilitate wildlife movement, as well as on-site and off-site barriers to connectivity.

The potential presence of native wildlife nursery sites is evaluated and discussion of individual wildlife species below. Examples of native wildlife nursery sites include nesting sites for native bird species (particularly colonial nesting sites), marine mammal pupping sites, and colonial roosting sites for other species (such as for monarch butterfly [*Danaus plexippus*]).

4.0 ASSESSMENT RESULTS

4.1 Aquatic Resources

Open Water and Submerged Aquatic Vegetation (no vegetation alliance). CDFW Rank: Sensitive. The subtidal waters located throughout the Study Area are tidal waters of the Sacramento and San Joaquin Delta. Open water constitutes the vast majority of the Study Area for this ARTR (1,167 acres/<99%) and is mapped at the High Tide Line (HTL). Figure 4 (Appendix A) illustrates the overall landcovers assessed for this ARTR.

Open waters contain several habitats (discussed below) which are also regulated either as critical habitat or EFH. Open waters are considered sensitive under CEQA; however, open waters also contain invasive submerged aquatic vegetation (SAV). While some species of SAV such as widgeon grass are considered sensitive or rare on a state level (CDFW 2023c, rank G4 S3), they are also regulated as EFH. Other species of SAV are invasive and can be deleterious to aquatic life. SAV species such as water hyacinth (*Eichhornia crassipes*), uruguay water primrose (*Ludwigia hexapetala*), alligatorweed (*Alternanthera philoxeroides*), Eurasian watermilfoil (*Myriophyllum spicatum*) and Brazilian waterweed (*Egeria densa*). These species can have several effects including slowing water which causes turbidity to clear leaving fish like Delata

smelt more vulnerable to predation (Hestir et al. 2015). The majority of SAV is typically wideon grass within this portion of the Delta, and as such SAV would be a sensitive resource.

Water quality within the Study Area is highly variable both seasonally and dependent on daily wind and outflow conditions from the Sacramento River. For example, turbidity within this region can shift quickly in response to weather, typically as a result of either high winter outflows or high summer winds (Bever et al 2018). During winter, high flows carry sediments into the Study Area resulting in naturally high turbidity which can increase during storm events. In summer, high winds cause wind-wave turbulence that resuspends river bed sediments, causing extreme turbidity spikes which can differentially affect large areas of the Sacramento River and Delta. Within the Sacramento River and Delta, turbidity is generally between 20-40 NTUs during the summer but can increase to as high as 250-500 NTUs when high winds stir light sediments (CDWR 2013). Turbidity spikes associated with summer windstorms may occur in as short as a few minutes, and may also occur differentially (i.e., not all areas are stirred or mixed equally). Shallow tidal flats around San Pablo Bay, Suisun Bay, Grizzly Bay, and Honker Bay are often most affected by this condition (Ruhl *et al*. 2001). However, once sediments are resuspended, these high turbidity zones are spread (via tides and river flow) into adjacent areas like the Study Area. As such, natural variation in water quality, especially turbidity can vary within the Study Area independent of human action by an order of magnitude or more.

The USFWS monitors water quality around the X2 which typically occurs near Collinsville and the Study Area in the summer. The USFWS has noted that secchi disk depths (a metric used to measure water turbidity) has not increased near the X2 boundary since the mid-1980s despite suspended sediment concentrations in Suisun Bay notably decreasing over this same time (USFWS 2022). Fluctuations in water quality due to summer winds or high winter outflows, and natural resuspension of large volumes of sediment partially contribute to these highly variable water quality conditions and therefore maintain similar levels of observed turbidity over time, despite a decrease in sediment quantity. These natural high turbidity events are also considered beneficial for Delta and longfin smelt as these species rely on turbid water for concealment from foraging non-native fish (e.g., bass) and for sources of forage (Bever et al 2018, Sommer and Mejia 2013).

4.2 Special-status Species

4.2.1 Special-status Fish

Following a background literature and database review, 11 species of fish have potential to occur within the aquatic portions of the Study Area. These species are listed in Appendix B alongside other species assessed but found to have no potential to occur. Those species with potential to occur are discussed in greater detail below.

CDFW TRAWL DATA

While general literature reviews can reveal the life-history patterns of fish, including their migratory patterns and likely seasonal presence in an area, a review of long-term field surveys can also help determine if species are known to occur in an area, and how readily they may be encountered at particular times of year. To help refine if species are present particularly during the late-summer and fall when work is proposed, WRA queried publicly available data from CDFW's website to help determine what species of fish may be present within the Study Area

during the in-water work window. Table 1 shows data queried from the CDFW Summer Townet Sampling which surveys in June, July, and August (CDFW 2023d), while Table 2 shows data from Fall midwater trawl database (CDFW 2023e). The fall midwater trawl surveys in August, September, October, November, and December. Station 513 was specifically queried as it was sampled by both survey efforts over the past 10 years (2012-2022) and provides long-term observations within the center of the Study Area.

Table 1. CDFW Summer Townet Survey Data at Station 513

	Summer Townet - Station 513 (2012-2022 Catch)			
Species	June	July	August	Total
Chinook Salmon	0	0	0	*0*
Delta Smelt	20	7	0	*27*
Green Sturgeon	0	0	0	*0*
Longfin Smelt	107	5	0	*112*
Pacific Lamprey	0	0	0	*0*
River Lamprey	0	0	0	*0*
Splittail	1	0	0	*1*
Steelhead	0	0	0	*0*
White Sturgeon	0	0	0	*0*

Table 2. CDFW Fall Midwater Trawl Survey Data at Station 513

	Fall Midwater Trawl–- Station 513 (2012-2022 Catch)					
Species	August	September	October	November	December	Total
Chinook Salmon	0	0	0	0	3	*3*
Delta Smelt	0	0	3	0	1	*4*
Green Sturgeon	0	0	0	0	0	*0*
Longfin Smelt	0	1	0	1	1	*3*
Pacific Lamprey	0	0	0	0	0	*0*
River Lamprey	0	0	0	0	0	*0*
Splittail	0	0	0	0	0	*0*
Steelhead	0	0	0	0	0	*0*
White Sturgeon	0	0	0	0	0	*0*

The occurrence of special-status species is very rare within the Study Area during the time of year when Project work is proposed to occur. In particular, between June and July, there is a steep drop in the only two special-status species that have been documented in the Summer Townet Survey, longfin and Delta smelt. Looking even closer at these data below, Table 3 shows the number of individuals documented in the Summer Townet Survey by year and month. Looking at the data in Table 3, no Delta smelt have been documented since 2016, and the one individual which was documented, occurred in June. Similarly, no longfin smelt have been documented in July since 2013, and the majority (94 of 112 individuals) were documented only in the month of June from 2012-2014. Considering the life history of these species, they are present in the vicinity of the Study Area at certain times of year. However, looking at the long-term datasets over the last 10 years, these species are almost entirely absent from the Study Area at

the time the Project is proposed to occur (July-November). Therefore, recommendations provided below following the species-specific evaluations are based on this trend in species absence.

Table 3. Longfin and Delta Smelt Observations by Year and Month in Summer Townet Surveys

	June	*July*	*August*
Longfin smelt			
2012	13	0	0
2013	80	5	0
2014	1	0	0
2015	0	0	0
2016	0	0	0
2017	0	0	0
2018	0	0	0
2019	0	0	0
2020	7	0	0
2021	2	0	0
2022	4	0	0
Delta Smelt			
2012	19	7	0
2013	0	0	0
2014	0	0	0
2015	0	0	0
2016	1	0	0
2017	0	0	0
2018	0	0	0
2019	0	0	0
2020	0	0	0
2021	0	0	0
2022	0	0	0

Chinook salmon – Central Valley Fall/late fall-run ESU (*Oncorhynchus tshawytscha*) CDFW Species of Special Concern.

The Central Valley Fall/late fall-run ESU includes all naturally spawned spring-run populations from the Sacramento San Joaquin River mainstem and its tributaries. Late-fall run Chinook salmon are morphologically similar to spring-run chinook. They are large salmonids, reaching 75-100 cm SL and weighing up to 9-10 kg or more. The great majority of late-fall Chinook salmon appear to spawn in the mainstem of the Sacramento River, which they enter from October through February. Spawning occurs in January, February, and March, although it may extend into April in some years. Eggs are laid in large depressions (redds) hollowed out in gravel beds. The embryos hatch following a 3–4-month incubation period and the alevins (sac-fry) remain in the gravel for another 2-3 weeks. Once their yolk sac is absorbed, the fry emerge and begin feeding on aquatic insects. All fry have emerged by early June. The juveniles hold in the river for nearly a year before moving out to sea the following December through March. Once in the ocean, salmon are largely piscivorous and grow rapidly. The specific habitat requirements of late-fall chinook

have not been determined, but they are presumably similar to other Chinook salmon runs and fall within the range of the physical and chemical characteristics of the Sacramento River above Red Bluff.

The Sacramento and San Joaquin Rivers as well as their tributaries are natal streams for fall-run chinook salmon, while late-fall run are limited to spawning within the main-stem of the Sacramento River or its more northern tributaries. There are no spawning or freshwater rearing streams within or immediately surrounding the Study Area. Thus, Chinook salmon do not reside in the waters of the Study Area, where conditions do not support its specific life history needs, or long term survival. This species occurs seasonally when migrating to natal streams in the fall as adults, or when migrating to the ocean in spring as juveniles or fry. This species is considered present within the Study Area, but only seasonally and for short periods when migrating.

Chinook salmon – Central Valley Spring-run ESU (*Oncorhynchus tshawytscha*), Federal Threatened, State Threatened.

The Central Valley Spring-run ESU includes all naturally spawned spring-run populations from the Sacramento San Joaquin River mainstem and its tributaries. Chinook salmon are anadromous (adults migrate from a marine environment into the freshwater streams and rivers of their birth) and semelparous (spawn only once and then die). Spring-run chinook salmon enter the Sacramento River between February and June. They move upstream and enter tributary streams from February through July, peaking in May-June. These fish migrate into the headwaters, hold in pools until they spawn, starting as early as mid-August and ending in mid-October, peaking in September. They are relatively faithful to the home streams in which they were spawned, using visual and chemical cues to locate these streams. While migrating and holding in the river, spring chinook do not feed, relying instead on stored body fat reserves for maintenance and gonadal maturation. Eggs are laid in large depressions (redds) hollowed out in gravel beds. Some fish remain in the stream until the following October and emigrate as “yearlings”, usually with the onset of storms starting in October through the following March, peaking in November-December. Large pools with cold water are essential over-summering habitat for this species.

There are no spawning or freshwater rearing locations within the Study Area. Thus, Chinook salmon do not reside in the waters of the Study Area, where conditions do not support its specific life history needs, or long term survival. However, this species occurs seasonally when migrating to natal streams within the Sacramento and San Joaquin Rivers in the spring, or when migrating to the ocean as smolts. As such the species is considered present within the Study Area, but only seasonally and for short periods when migrating to or from natal streams.

Chinook salmon – Sacramento River Winter-run ESU (*Oncorhynchus tshawytscha),* Federal Endangered, State Endangered.

The ESU includes all naturally spawned populations of winter-run chinook salmon in the Sacramento River and its tributaries in California, as well as two artificial propagation programs: winter run chinook from the Livingston Stone National Fish Hatchery, and winter run chinook in a captive broodstock program maintained at Livingston Stone NFH and the University of California Bodega Marine Laboratory. Winter-run chinook salmon are unique because they spawn during summer months when air temperatures usually approach their yearly maximum. As a result, these salmon require stream reaches with cold water sources that will protect embryos and juveniles from the warm ambient conditions in summer. Winter-run chinook salmon are primarily restricted to the mainstem Sacramento River.

There are no spawning or freshwater rearing locations within the Study Area. Thus, Chinook salmon do not reside in the waters of the Study Area, where conditions do not support its specific life history needs, or long-term survival. However, this species occurs seasonally when migrating to natal streams in the spring near the headwaters of the Sacramento River, or when migrating to the ocean. As such, the species is considered present within the Study Area, but only seasonally and for short periods when migrating to or from natal streams.

Delta smelt (*Hypomesus transpacificus*), Federal Threatened, State Endangered.

Delta Smelt are a pelagic (live in the open water column away from the bottom) and euryhaline species (tolerant of a wide salinity range) found in brackish water. They are found only in the Sacramento-San Joaquin Estuary and as far upstream as the mouth of the American River on the Sacramento River and Mossdale on the San Joaquin River. They extend downstream as far as San Pablo Bay. During the late winter to early summer, delta smelt migrate to freshwater to spawn. Larvae hatch between 10-14 days, are planktonic (float with the water currents), and are washed downstream until they reach areas near the entrapment zone where salt and freshwater mix. Delta smelt are fast growing and short-lived with the majority of growth within the first 7 to 9 months of life. Most smelt die after spawning in the early spring although a few survive to a second year. Delta smelt feed entirely on small crustaceans (zooplankton).

Delta smelt are largely restricted to the Sacramento Delta proper, as well as the eastern portions of Suisun Bay. As described in Bever et al (2018) and Sommer and Mejia (2013), Delta smelt are adapted to survive in areas of highly variable turbidity, such as the waters of the Project Area. Naturally high turbidity in these waters provide a benefit to the species through concealment from predators and increased foraging resources (Sommer and Mejia 2013). Given that the Study Area is within the Delta, this species is potentially present year-round.

Green sturgeon (*Acipenser medirostris*), Federal Threatened, CDFW Species of Special Concern. Green sturgeon is generally found in marine waters from the Bering Sea to Ensenada, Mexico; however, spawning populations have been found only in medium-sized rivers from the Sacramento-San Joaquin system north. Spawning occurs in the Sacramento River between March and June; it may extend slightly longer, into July, in the Klamath River. Water temperature during spawning is likely 50° to 70°F. Spawning occurs in deep, fast water. The fertilized eggs are slightly adhesive and hatch after four to 12 days. Larvae stay close to the bottom and appear to rear primarily in rivers well upstream of estuaries. Young sturgeon (8 inches) feed primarily on small crustaceans such as amphipods and opossum shrimp. As they develop, they take a wider variety of benthic invertebrates, including various species of clams, crabs, and shrimp. Larger green sturgeon diet includes fishes.

The Study Area is at the terminus of the Sacramento River. Green sturgeon are only known to spawn within the headwaters of the Sacramento River near Redding, or within the Feather River. As such, no spawning habitat is present. This species is known to rear within the greater San Francisco Bay region year-round. Green sturgeon are adapted to survive in the highly turbid waters of the Sacramento River and Delta and can tolerate the naturally variable turbidity fluctuations in the region. The species is potentially present year-round both as adults and juveniles either rearing within the Bay or when migrating to and from the Pacific Ocean.

Longfin smelt (*Spirinchus thaleichthys*), Federal Endangered, State Threatened.

Longfin Smelt is a pelagic, estuarine fish that ranges from Monterey Bay northward to Hinchinbrook Island, Prince William Sound Alaska. As this species matures in the fall, adults found throughout the San Francisco Bay migrate to brackish or freshwater in Suisun Bay, Montezuma Slough, and the lower reaches of the Sacramento and San Joaquin Rivers. Spawning is believed to take place in freshwater. In April and May, juveniles are believed to migrate downstream to San Pablo Bay. Juveniles tend to inhabit the middle and lower portions of the water column. This species tends to be abundant near freshwater outflow, where higher-quality nursery habitat occurs and potential feeding opportunities are greater.

Longfin smelt are known to occur within the Sacramento Delta proper, as well as Suisun Bay, and San Pablo Bay. Longfin smelt, like Delta smelt described in Bever et al (2018) and Sommer and Mejia (2013), thrive in areas of high turbidity, such as the waters of the Project Area, and the naturally high turbidity in these waters provide a necessary habitat benefit to the species through concealment from predators and higher foraging resources (Sommer and Mejia 2013). Given that the Study Area is within the Delta, this species is considered present year-round.

Pacific lamprey (*Entosphenus [Lampetra] tridentatus*), CDFW Species of Special Concern. This anadromous lamprey is found along the entire California coast with regularity until becoming disjunct south of San Luis Obispo County except for regular runs to the Santa Clara River (Calfish 2023). Apart from land-locked populations, this species spends the predatory phase of its life in the ocean, feeding off the bodily fluids of a variety of fish. This species is usually concentrated near the mouths of their spawning streams because its prey is most abundant in coastal areas (Moyle 2002). Adults move up into spawning streams between early March and late June. After hatching, ammocetes are washed downstream, where they burrow into soft substrates and filter feed. Five to seven years later, ammocetes undergo metamorphosis into the predatory phase of their life cycle and out-migrate to the ocean as adults.

Tributaries of the Sacramento and San Joaquin Rivers are natal streams for this species (Calfish 2023). There are no spawning or freshwater rearing locations within the Study Area. Pacific lamprey do not reside in brackish tidal waters of the Study Area, but use the area solely as a migratory pathway. As such this species occurs seasonally when migrating to natal streams within the Sacramento and San Joaquin Rivers in the spring, or when migrating to the ocean in spring. As such the species is considered present within the Study Area, but only seasonally and for short periods when migrating to or from natal streams.

River lamprey (*Lampetra ayresi*), CDFW Species of Special Concern. River lampreys prey upon a variety of fishes in the 10-30 cm TL size range, but the most common prey seem to be herring and salmon. Unlike other species of lamprey in California, river lampreys typically attach to the back of the host fish, above the lateral line, where they feed on muscle tissue. Little is known about habitat requirements in California, but presumably, the adults need clean, gravelly riffles in permanent streams for spawning, while the ammocetes require sandy backwaters or stream edges in which to bury themselves, where water quality is continuously high and temperatures do not exceed 25°C. Adults migrate back into fresh water in the fall and spawn during the winter or spring months in small tributary streams.

Tributaries of the Sacramento and San Joaquin Rivers are natal streams for this species (Calfish 2023). There are no spawning or freshwater rearing locations within the Study Area. Thus, river lamprey do not reside in the waters of the Study Area where conditions do not support its various life stage requirements. However, this species occurs seasonally when migrating to natal streams within the Sacramento and San Joaquin Rivers in the spring, or when migrating to the

ocean in spring. As such the species is considered present within the Study Area, but only seasonally and for short periods when migrating to or from natal streams.

Sacramento splittail (*Pogonichthys macrolepidotus*), CDFW Species of Special Concern. Splittail are primarily freshwater fish that have been found mostly in slow-moving sections of rivers and sloughs, and in the Delta and Suisun Marsh they seemed to congregate in dead-end sloughs (Moyle et al. 1982, Daniels and Moyle 1983). Splittail are benthic foragers that feed extensively on opossum shrimp (*Neomysis mercedis*); however, detrital material typically makes up a high percentage of their stomach contents. They will feed opportunistically on earthworms, clams, insect larvae, and other invertebrates. They are preyed upon by striped bass and other predatory fishes. Splittail apparently require flooded vegetation for spawning and as foraging areas for young, hence are found in habitat subject to periodic flooding during the breeding season (Caywood 1974).

This species is known to spawn within backwater sloughs of the Sacramento Delta, within areas where the Project is located (Calfish 2023). This species has adapted to the variable and highly turbid conditions present in the waters of the Project Area and region. There are no spawning locations within the Study Area as it is composed of the main channel of the Sacramento River and this species requires slow, backwater sloughs for spawning. However, this species may rear and forage within the Study Area year-round.

Steelhead - Central Valley DPS (*Oncorhynchus mykiss*), Federal Threatened, CDFW Species of Special Concern. The Central Valley DPS includes all naturally spawned populations (and their progeny) in the Sacramento and San Joaquin Rivers and their tributaries, excluding San Francisco and San Pablo bays and their tributaries. Preferred spawning habitat for steelhead is in perennial streams with cool to cold water temperatures, high dissolved oxygen levels and fast flowing water. During the winter or early spring, the spawning fish reach suitable gravel riffles (shallow areas with gravel or cobble substrate) in the upper sections of streams and dig their redds. Abundant riffle areas for spawning and deeper pools with sufficient riparian cover for rearing are necessary for successful breeding. When steelhead spawn they nearly always return to the stream in which they were hatched. At that time they may weigh from two to twelve pounds or more.

There are no spawning or freshwater rearing locations within the Study Area. Steelhead do not reside in the waters of the Study Area where conditions do not support reproduction (spawning), rearing (freshwater streams) or typical adult foraging grounds (ocean). However, this species occurs seasonally when migrating to natal streams within the Sacramento and San Joaquin Rivers in the fall and winter, or when migrating to the ocean in spring. As such the species is considered present within the Study Area, but only seasonally and for short periods when migrating to or from natal streams.

White sturgeon (*Acipenser transmontanus*), State Candidate Threatened, CDFW Species of Special Concern. This sturgeon is found in most estuaries along the Pacific coast and are known to the San Francsico Bay Estuary. Adults in the San Francisco Bay Estuary system spawn in the Sacramento River and are not known to enter freshwater or non-tidal reaches of Estuary streams. White sturgeon typically spawn in May through June. The diet consists of crustaceans, mollusks, and some fish.

While the Study Area does not provide spawning habitat for any of the aforementioned species, waters of the Study Area at the junction of the Carquinez Strait, Mare Island Strait and San Pablo Bay support all of these species seasonally as they migrate between spawning and rearing habitats and the Pacific Ocean, or other areas of the greater San Francisco Bay region. Waters of the Study Area may support species as they temporarily forage and rear, but generally this area functions as migratory route for these species when moving between location.

White sturgeon spawn only within upstream portions of large rivers of the Sacramento Valley but must pass through the Study Area to reach those spawning grounds. Juveniles and adults may be present and forage within the surrounding waters year-round, but as shown above in the trawl database data, have not been documented in any trawls over the last 10-years, indicating they are likely only present in very low densities. White sturgeon have adapted to forage and rear within the Sacramento River and Delta and as such tolerate the highly turbid waters and naturally variable turbidity fluctuations in the region.

4.3 Critical Habitat and Essential Fish Habitat

4.3.1 Critical Habitat

A review of the background literature showed that the Study Area is located within an area designated as critical habitat for the following four species:

- Delta smelt,
- Southern DPS Green Sturgeon,
- California Central Valley steelhead, and
- Sacramento River Winter-run Chinook Salmon.

In cases such as this where critical habitat is within a bay or estuary, the extent of critical habitat is defined up to the high tide line (HTL). The extent of critical habitat therefore extends to all portions of the Study Area described as “Open Water” below the HTL in Figure 4 (Appendix A)

Critical habitat are areas designated for special protection associated with specific federally listed species. With each species the elements of habitats that support the reproduction, growth and success of the species are described in the individual critical habitat listings. In determining what areas are critical habitat, agencies will consider “those physical or biological features that are essential to the conservation of a given species, including space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, and rearing of offspring; and habitats that are protected from disturbance or are representative of the historical geographical and ecological distribution of a species.” The specific physical and biological elements required to promote use of a habitat are termed Primary Constituent Elements and vary from species to species. The physical and biological features, as well as primary constituent elements for each species as it pertains to the Study Area are quoted below from their respective listings.

DELTA SMELT

The physical and biological features for Delta smelt include the following (59 FR 65256):

- Space for individual and population growth, and for normal behavior;

- Food, water, air, light, minerals, or other nutritional or physiological requirements;
- Cover or shelter;
- Sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and
- Habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

The primary constituent elements essential to the conservation of the delta smelt are

- physical habitat;
- water;
- river flow; and
- salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration.

GREEN STURGEON

The primary constituent elements essential for the conservation of the Southern DPS of green sturgeon in estuarine habitats (74 FR 52299) are:

- (i) Food resources. Abundant prey items within estuarine habitats and substrates for juvenile, subadult, and adult life stages.
- (ii) Water flow. Within bays and estuaries adjacent to the Sacramento River (i.e., the Sacramento-San Joaquin Delta and the Suisun, San Pablo, and San Francisco bays), sufficient flow into the bay and estuary to allow adults to successfully orient to the incoming flow and migrate upstream to spawning grounds.
- (iii) Water quality. Water quality, including temperature, salinity, oxygen content, and other chemical characteristics, necessary for normal behavior, growth, and viability of all life stages.
- (iv) Migratory corridor. A migratory pathway necessary for the safe and timely passage of Southern DPS fish within estuarine habitats and between estuarine and riverine or marine habitats.
- (v) Depth. A diversity of depths necessary for shelter, foraging, and migration of juvenile, subadult, and adult life stages.
- (vi) Sediment quality. Sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages.

WINTER-RUN CHINOOK SALMON AND CENTRAL VALLEY STEELHEAD

The primary constituent elements essential for the conservation of both the Sacramento River, Winter-run Chinook salmon and Central Valley Steelhead which are applicable to this Project are elements 3 and 4 which are quoted as follows (70 FR 52488)*:*

- 3. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. These features are essential to conservation because without them juveniles cannot use the variety of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and reach the ocean in a timely manner. Similarly, these features are essential for adults because they allow fish in a

non-feeding condition to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores.

- 4. Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. These features are essential to conservation because without them juveniles cannot reach the ocean in a timely manner and use the variety of habitats that allow them to avoid predators, compete successfully, and complete the behavioral and physiological changes needed for life in the ocean. Similarly, these features are essential to the conservation of adults because they provide a final source of abundant forage that will provide the energy stores needed to make the physiological transition to fresh water, migrate upstream, avoid predators, and develop to maturity upon reaching spawning areas.

4.3.2 Essential Fish Habitat

A review of the background literature revealed that the Study Area is located within EFH for three fisheries management plans (NMFS 2023a): Coastal Pelagic, Pacific Groundfish and Pacific Salmon.

- The Coastal Pelagic Fisheries Management Plan (PFMC 2021) is designed to protect habitat for migratory pelagic species such as Pacific sardine (*Sardinops sagax*), Pacific mackerel (*Scomber japonicus*), northern anchovy (Engraulis mordax), market squid (*Doryteuthis opalescens*), jack mackerel (*Trachurus symmetricus*) and various species of krill or euphausiids. The east-west geographic boundary of EFH for coastal pelagic species is defined as all marine and estuarine waters from the shoreline along the coasts of California, Oregon and Washington offshore to the limits of the exclusive economic zone and above the thermocline where sea surface temperatures range between 10˚ C to 26˚ C. Species most likely to occur in the Study Area include Northern anchovy (*Engraulis mordax*) and Pacific sardine (*Sardinops sagax*) (NMFS 2022a).
- The Groundfish Fisheries Management Plan (PFMC 2022a) is designed to protect habitat for approximately 80 species of fish, including various species of flatfish, rockfish, groundfish, and several species of sharks and skates. EFH for Pacific coast groundfish is defined as the aquatic habitat necessary to allow groundfish production to support long-term sustainable fisheries for groundfish and for groundfish contributions to a healthy ecosystem. Species most likely to occur in the Study Area and Sacramento Delta include starry flounder (*Platichthys stellatus*) and English sole (*Pleuronectes vetulus*) (NMFS 2020).
- The Pacific Salmon Fisheries Management Plan (PFMC 2022b) is designed to protect habitat for commercially important salmonid species specifically Chinook and Coho salmon occur within the Study Area. While Coho salmon are extirpated from San Francisco Bay and its tributaries (NMFS 2012), four species of Chinook Salmon would be seasonally present within waters surrounding the Study Area. In the estuarine and marine areas, Chinook salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone 200 miles offshore of California north of Point Conception.

Along the West Coast, the PFMC also identifies habitats that fall within Habitat Areas of Particular Concern (HAPC). HAPCs are high priority areas for conservation, management, or

research because they are important to ecosystem function, sensitive to human activities, stressed by development, or are rare. These areas provide important ecological functions and/or are especially vulnerable to degradation and can be designated based on either specific habitat types or discrete areas. HAPCs are a discrete subset of EFH.

- HAPCs for Chinook salmon include complex channel and floodplain habitat, spawning habitat, thermal refugia, estuaries, and submerged aquatic vegetation as described in Appendix A to the Pacific Coast Salmon FMP (PFMC 2022b).
- Within the Study Area only "estuary" habitat is present among the HAPSCs listed by the FMP.
- HAPCs for Pacific coast groundfish are estuaries, rocky reefs, canopy-forming kelp, seagrasses, and "areas of interest" as described in Amendment 19 to the Pacific coast groundfish FMP (PFMC 2022a).

Similar to critical habitat discussed above, waters of the Study Area would also be regulated as EFH.

In addition to general designations as critical habitat, aquatic vegetation was mapped within the Study Area using side-scan sonar. Once mapped, these areas were cross referenced against bathymetric data to confirm the distribution of SAV which are shown in Figure 5 (Appendix A).

4.4 Marine Mammals

Marine mammals are known to occur within much of San Francisco Bay and can often move inland up the Sacramento River seasonally, especially when following salmon migrations. Less typically deep-sea marine mammals such as humpback or gray whales can stray into the Sacramento River as well (SFGate 2007); however, these occurrences are extremely rare, and only a small handful of such occurrences are known to have occurred in the last 50 years. As such these are extremely rare events that do not warrant the level of typical conditions as might be expected to be encountered by a project and are not included for this analysis.

Pinnipeds however do commonly occur within this area of the Delta and Sacramento River, as such these species have potential to occur as part of typical and baseline conditions and are discussed in more detail below.

Pacific harbor seal (*Phoca vitulina richardsi*), MMPA. Harbor seals are fairly common, non-migratory pinnipeds inhabiting coastal and estuarine waters from Alaska to Baja California, Mexico. They are a year-round resident in the San Francisco Bay Area (Grigg et al. 2004). They haul out on rocks, reefs, and beaches, and feed in marine, estuarine, and occasionally fresh waters (Grigg et al. 2004). This widespread true seal is commonly found throughout much of San Francisco Bay and further inland. Harbor Seals use open water for feeding and travelling, and terrestrial substrates adjacent to water for hauling out (resting). A haul-out site is generally considered a rookery if there are pups present at the site. Harbor seals in San Francisco Bay also tend strongly towards use of established haul-out areas, as opposed to hauling out in new areas (Kopec 1999).

No haul-outs are known within the vicinity of the Study Area; however, individual seals are commonly observed moving inland while foraging.

California sea lion (*Zalophus californianus*), MMPA. California sea lions are found from Vancouver Island, British Columbia to the southern tip of Baja California in Mexico. They breed mainly on offshore islands, ranging from southern Califo'nia's Channel Islands south to Mexico, although a few pups have been born on Año Nuevo and the Farallon Islands on the central Californian coast (TMMC 2023). Sandy beaches are preferred for haul out sites, although in California they haul out on marina docks as well as jetties and buoys (TMMC 2023).

No haul-outs are known within the vicinity of the Study Area; however, individual sea lions are commonly observed moving through these areas of the Sacramento and San Joaquin Rivers while foraging.

4.5 Wildlife Corridors and Native Wildlife Nursery Sites

4.5.1 Wildlife Corridors and Nursery Habitat

Wildlife movement between suitable habitat areas can occur via open space areas lacking substantial barriers. The terms "landscape linkage" and "wildlife corridor" are often used when referring to these areas. The key to a functioning corridor or linkage is that it connects two larger habitat blocks, also referred to as core habitat areas (Beier and Loe 1992; Soulé and Terbough 1999). It is useful to think of a "landscape linkage" as being valuable in a regional planning context, a broad scale mapping of natural habitat that functions to join two larger habitat blocks. The term "wildlife corridor" is useful in the context of smaller, local area planning, where wildlife movement may be facilitated by specific local biological habitats or passages and/or may be restricted by barriers to movement. Above all, wildlife corridors must link two areas of core habitat and should not direct wildlife to developed areas or areas that are otherwise void of core habitat (Hilty et al. 2019).

As discussed above, the Study Area lies along the migratory corridor for numerous anadromous species including four species of Chinook salmon, steelhead and three species of lamprey. Adult fish returning from the Pacific Ocean will pass through the Study Area at certain times of the year to reach natal streams. Juveniles will also pass through the Study Area at other times of the year in route to the Pacific Ocean. As such these species are only present at certain times of the year.

With the presence of core habitat areas upstream and downstream of the Study Area, waters within the Study Area function as corridor for anadromous fish species moving between natal streams and marine habitats.

In the case of more regional species, Delta and longfin smelt both spawn in the Delta, then remain within the local area to forage as adults, or rear as juveniles. These species can also make short-distance localized migrations to spawning areas or summer feeding areas but are generally present year-round (Moyle 2002). These species use waters in the Study Area as a movement corridor.

Nursery sites are those that function as rearing or spawning grounds for fish. While nursery sites can be a site that supports the raising and rearing of juvenile animals, within tidal estuaries, SAV is often an important nursery area. Within the Delta, widgeon grass can serve as rearing sites for native fish which take cover within the vegetation. For example, Sacramento splittail spawn on SAV, then larvae rear within the beds for several weeks before schooling together and moving to the Bay (Calfish 2023). As such SAV within the Study Area is also likely to support nursery sites.

Side-scan sonar was used to map and identify the extent of SAV within the Study Area. The extent of side scan sonar data was compared to the bathymetric profile of the channel on the most recent navigational charts (NOAA 2023) and the resulting areas where SAV is detected via sonar or has the highest potential to occur are shown in Figure 5 (Attachment A).

5.0 Impacts, Avoidance and Minimization Measures

5.1 Special-status Species

As described in the sections below, the Proposed Project may have potential to impact individual fish or habitats protected by the wildlife protection agencies including NMFS, USFWS, and CDFW. Prior to initiation of construction, it is anticipated the permittee will consult with regulatory agencies with jurisdiction over the Proposed Project activities.

This section analyzes the Proposed Project's potential impacts and provides recommendations for AMMs as well as mitigation for habitats if applicable.

5.1.1 Special-Status Fish Species

Twelve species of fish which are designated as special status are present within the Study Area either seasonally, or year-round. In the case of Chinook salmon, steelhead and lamprey, these species are only present seasonally when migrating to and from natal streams and core habitats are not present for these species. Other species such as longfin smelt are present year-round and have been documented in CDFW trawls late in the summer and fall (CDFW 2023b). The following analysis looks at the spectrum of potential impacts to seasonally and perennially present fish and describes AMMs as well as mitigation for potential impacts.

POTENTIAL IMPACT BIO-1: POTENTIAL INTRODUCTION OF INVASIVE SPECIES

San Francisco Bay is one of the busiest ports in the world with more than 7,000 container ships per year entering the Bay (Choksi 2009). One consequence of such a robust trade network is the introduction of non-native species which are carried in ballast water of vessels or on ship hulls with biofouling. Introductions of non-native species to San Francisco Bay includes both fish and invertebrate species, which cause a variety of impacts to native fauna. Non-native species have a variety of deleterious effects from competing with or consuming native species (Moyle 2002), to decreasing pelagic productivity (Baumsteiger et al. 2017). As a result of this impact and considering the danger that invasive species pose to native species and ecosystems, the U.S. Court of Appeals for the Ninth Circuit ruled that the U.S. Environmental Protection Agency must regulate ship discharges, including ballast water discharges containing invasive species, that pollute U.S. waters under the Clean Water Act (Choksi 2009). Further, Congress passed the Vessel Incidental Discharge Act, combining laws that regulate vessel discharge to help prevent the introduction of harmful species (Simmonds 2022).

Within aquatic environments, barges and boats used for construction are expected to be based in the Bay but may need to come in from outside of the local area. If ships were to come into the Bay from outside, this may introduce non-native species. Any materials used for the Proposed Project will be new, but if aquatic equipment (e.g., hydroplow) necessary for the Proposed Project

has not been properly cleaned and decontaminated, it could also potentially spread invasive species from other areas.

The potential introduction of invasive species during construction is a potentially significant impact. The following AMMs will be implemented by the Proposed Project to reduce effects to less-than-significant levels.

AMM BIO-1: INVASIVE SPECIES MANAGEMENT

In order to help reduce the potential effects of invasive species from construction of the Proposed Project the following measures will be implemented:

- Aquatic vessels brought to the Study Area from ports outside of San Francisco Bay and Delta for aquatic construction will follow all maritime regulations relating to the exchange of ballast water to prevent the spread of invasive species from outside ports.
- Any in-water fill materials such as piles will be new and not salvaged from areas outside of San Francisco Bay.
- Any pumps or in-water equipment that may be needed during construction will be cleaned and dried for at least 72 hours prior to first being used on the Proposed Project. Continual use onsite will not require drying between uses.

With the implementation of AMM BIO-1 effects from invasive species will be less than significant with mitigation incorporated.

POTENTIAL IMPACT BIO-2: SPILLS AND LEAKS

In-water construction requires specialized mechanical equipment including vibratory or impact pile driving hammers, workboats, pumps, floating barges, excavators and hydro plows. These larger pieces of equipment require generators, pumps, or compressors to run the equipment, and a variety of petroleum and plant-based fuels or lubricants, many of which can be toxic to aquatic ecosystems if spilled and introduced accidentally. Introduction of such materials could cause degradation to the aquatic environment, which is a potentially significant impact under CEQA. The following AMMs will be implemented by the Proposed Project to reduce effects to less-than-significant levels.

AMM BIO-2: SPILL PREVENTION AND CONTROL

A spill prevention and control plan will be developed and implemented for the Proposed Project throughout all phases of construction. This plan will at minimum include the following parameters to reduce potential effects from spills to less than significant levels:

- Procedures to clean equipment to ensure any equipment used in water (e.g. hydroplow or excavators) are cleaned of excess lubricants and fuels.
- Identification of any hazardous materials used by the Proposed Project.
- Storage locations and procedures for such materials.
- Spill prevention practices as well as BMPs employed for various activities.
- Requirements to inspect equipment daily such that it is maintained free of leaks.
- Spill kit location, cleanup, and notification procedures.

AMM BIO-3: WORK WINDOW

To minimize potential impacts to fish during in-water work (i.e., work that occurs below the waterline and causes disturbance to the Delta substrate) which may either cause general disturbance or has the potential to cause deleterious conditions that may disrupt both migratory events or cause impacts to species when more sensitive life stages (i.e., eggs and fry) are present, a work window of July 1 to November 30would be enacted.

AMM BIO-4: ENVIRONMENTAL AWARENESS TRAINING

A Proposed Project-specific environmental awareness training for construction personnel will be conducted by a qualified biologist before commencement of construction activities and as needed when new personnel begin work on the Proposed Project. The training will inform all construction personnel about the presence of sensitive habitat types; potential for occurrence of special status fish and wildlife species; the need to avoid damage to suitable habitat and species harm, injury, or mortality; measures to avoid and minimize impacts to species and associated habitats; the conditions of relevant regulatory permits, and the possible penalties for not complying with these requirements. The training may consist of a pre-recorded presentation to be played for new personnel, a script prepared by the biologist and given by construction personnel trained by the biologist, or training administered by on-site biological monitors. The training will include:

- Applicable State and federal laws, environmental regulations, Proposed Project permit conditions, and penalties for non-compliance. A physical description of special-status species with potential to occur on or in the vicinity of the Proposed Project Site, AMMs, and protocol for encountering such species including communication chain;
- BMPs enacted for habitat protection and their location on the Proposed Project site including the implementation of any Spill or Leak Prevention Programs.
- Contractors will be required to sign documentation stating that they have read, agree to, and understand the required AMMs. If they do not understand, they will withhold their signature until the Designated Biologist addresses their question. The contractor may not begin work until they have signed the documentation.
- Field identification of any Proposed Project site boundaries, egress points and routes to be used for work. Work will not be conducted outside of the Proposed Project site.
- A record of this training will be maintained on the Proposed Project site and will be made available to agencies upon request.

With the implementation of AMM BIO-2 through 4 effects from spills and leaks will be reduced to less-than-significant levels.

POTENTIAL IMPACT BIO-3: TURBIDITY AND TOXIC SUBSTRATES

In-water work for the Proposed Project is expected to contribute to localized increased water turbidity from mobilization of substrate during cable installation when using open trenching and hydroplowing construction techniques. The installation of submarine cables through the Study Area will primarily be with a hydroplow or vertical injector. The final section of installation at the southern shore will preferentially use open trenching via an excavator which is mounted aboard a work barge or operated from shore to complete the trench and bring cables to the onshore vault. During the installation process the jets which liquify and mobilize sediments ahead of the hydroplow blade, as well as use of an excavator will cause some of the sediment to be mobilized into the water column outside of the trench, increasing localized turbidity. Elevated turbidity can

impair gill function, reduce oxygen availability in the water column, decrease physiological capabilities, and increase stress in fish (Heath 1995). While turbidity can impact sensitive life stages of fish, especially eggs or fry, the Proposed Project will not occur at a time of year when these more sensitive life stages are present as described in AMM BIO-3. Elevated turbidity also does not represent a uniform impact to protected fish species. Delta smelt distribution has been positively correlated with turbidity which can help increase foraging efficiency and decrease predation threats (Sommer and Mejia 2013). As described above, turbidity within the Delta is generally between 20-40 NTUs but can increase to as high as 250-500 NTUs during high wind events that stir light sediments (CDWR 2013). Studies of turbidity in San Francisco Bay showed that turbidity associated with dredging (an activity which causes similar levels of disturbance to benthic environments as hydroplows or may use excavators for the dredging process) typically diminish to background levels within a radius of approximately 600 feet within one tidal cycle for singular events (Corps 2015). The actual distance suspended sediment caused by the Proposed Project would move is dependent upon multiple factors (i.e., tide, river outflows, wind condition, etc.); however, it is anticipated that the area affected and the duration of turbidity increases resulting from cable installation will be similar to turbidity increases resulting from dredging. Elevated turbidity due to in-water work may create temporary conditions which are unsuitable for some fish species in the immediate vicinity of the work area. These conditions are anticipated to be temporary, resolving to background conditions shortly after the conclusion of the Proposed Project. As noted above, turbidity in the waters within and surrounding the Study Area can vary substantially under natural conditions as a result of the dynamic hydrological conditions in San Francisco Bay and the Delta. Fish which are present year round have adapted to such conditions, and in the case of Delta and Longfin smelt, rely on high turbidity areas for concealment and forage (Sommer and Mejia 2013). Turbidity can vary with incoming and outgoing tides, as a result of windy conditions, with storm flows, and with passing boats under existing conditions. Based on these factors, the potential impacts resulting from increased turbidity are less than significant when accounting for the implementation of AMM BIO-3.

Turbidity from activities such as pile driving (discussed below) are also likely to be limited to a small area (approximately 150-200 ft of the pile) and typically dissipates within one hour or would be swept away and diluted by tidal exchange (USFWS 2013). Considering that natural fluctuations in turbidity due to summer winds or increased outflow can change turbidity for the entire region by an order of magnitude (10X) or more, the limited turbidity from pile driving activities is expected to be less than significant and no further recommendation is necessary.

Finally, disturbance of bottom sediments can disturb and spread contaminants that are potentially present within sediments. If contaminants are present, hydro plowing or trenching through them could mobilize these materials, spreading them to areas that are currently not affected by elevated levels of contaminants. These impacts would be considered potentially significant under CEQA.

In addition to AMM BIO-2 through BIO-4, the following AMM will be implemented by the Proposed Project to reduce effects from cable installation to less-than-significant levels.

AMM BIO-5: AQUATIC SEDIMENT SCREENING AND TESTING

- Prior to installation of cables, screening of the cable alignment based on available background resources (e.g., Envirostor) will be conducted to determine if there have been any known spills or other hazardous materials releases that potentially intersect with the

alignment. If any known spills or other hazardous materials releases are discovered, an aquatic sediment screening and testing program will be developed to evaluate the risk of exposing hazardous sediments to the marine environment. The program will entail the following:

- Representative aquatic sediment samples will be collected at a minimum of three locations placed evenly along the alignment. The depth of the samples would be consistent with the depth of trenching at each sample location.
- Sediment samples will be tested according to methods prescribed in the Guidelines for Implementation of the Inland Testing Manual in San Francisco Bay or updated similar manual approved by the San Francisco Bay Dredge Material Management Office (DMMO) (DMMO 2001). The results of this test would be compared to concentrations allowed for in-bay disposal by the San Francisco Bay DMMO to determine if sediments are clean or require special handling.
- Aquatic sediments that exceed San Francisco Bay DMMO testing standards would:
  - Be avoided by the cable installation route, or
  - Be removed through dredging and disposed of at an appropriate facility approved by the RWQCB, or
  - Be controlled via use of a silt curtain or other appropriate BMP approved by the RWQCB.
- Cable installation and hydroplow use would be limited to the specified areas and the minimum length necessary.

With the implementation of AMM BIO-2 through BIO-5, effects from cable installation will be less than significant.

POTENTIAL IMPACT BIO-4: Fish Entrainment

The primary means of installing the submarine cables across the majority of the Study Area will be with a hydroplow or through use of a vertical injector. Both represent similar means of installation as either the jet plow or vertical injector are towed behind a ship which supports the installation equipment and supplies the cables which will be buried.

For installation via jet plow or vertical injector, water is taken in at an inlet onboard the ship, then run through a pump to pressurize the system. High pressure water is then expelled through jets aimed at the substrate. The jets liquify the substrate ahead of the plow or below the injectors, digging a trench. A cable is simultaneously fed into the trench. Once the plow or injector is pulled forward by the ship, substrates naturally settle and fall back into the trench, burying the cable and furrow such that no further work is required to backfill.

Because operation of the hydroplow or vertical injector requires that water be pumped from the river to supply the jets, this type of operation poses a threat to fish via entrainment. Unscreened water diversions pose a threat to fish of all species as fish have the chance to be sucked into the inlet and entrained by the pump. In laboratory tests, up to 50% of green sturgeon were entrained when passing within 1.5 meters of an unscreened agricultural diversion pipe (Mussen et al. 2014). As such water intakes to support the hydroplow may cause significant impacts to fish if fish pass near to the inlet and are subsequently entrained.

Considering that some species are only present seasonally for migration, part of the impact can be minimized through the use of an in-water work window as is specified in AMM BIO-3, ensuring work occurs when critical life stages for these species are absent; however, as some

species are present year-round, additional AMMs are required to reduce the potential for entrainment to less-than-significant levels. AMM BIO-6 will be implemented by the Proposed Project to reduce the potential for fish entrainment to less-than-significant levels.

AMM BIO-6: INTAKE SCREENING

To minimize the potential for fish to be entrained by the Proposed Project, any pumps or water intakes used would be screened in accordance with the following CDFW and NMFS screening requirements for water diversions within the Delta (CDFG 2000, NMFS 1997). If any variation from these criteria is necessary, the Proponent would consult with the agency responsible for the species for recommendations to protect fish.

With the use of AMM BIO-3 and BIO-6, the potential impacts to fish due to entrainment will be reduced to less-than-significant levels.

POTENTIAL IMPACT BIO-6: UNDERWATER NOISE AND PILE DRIVING IMPACTS TO SPECIAL-STATUS FISH

Along the Pittsburg shoreline, lines will be trenched from the river, into the shore, where they will be routed through a vault. At the edge of the southern shoreline and slightly into the adjacent river this transition area will be protected and stabilized with a series of sheetpiles to protect from waves, tides and sluffing. In addition, the transition structure on the north side of the Study Area will be built on a foundation of steel piles (up to 12 piles, measuring up to 36-inches in diameter).

Pile driving produces underwater noise, which manifests as pressure waves in the aquatic environment. The louder the noise, the more pressure is present in the waves. High pressure sound waves in the aquatic environment can result in damage to fishes' internal organs. The NMFS has established thresholds based upon the size of the fishes under consideration for the onset of physical injury and adverse behavioral effects. Those thresholds are listed below in Table 4 (NMFS 2018). Because Delta smelt and longfin smelt are known to occur within the Study Area at certain times of the year, especially during their seasonal migrations in winter, the more conservative 183 dB Sound Exposure Level (SEL) threshold is the effective criteria for hydroacoustic effects analysis for the Proposed Project. Behavioral modification is based on the root mean square (RMS) and is considered standard for all species. The RMS of 150 dB represents the zone where fish may be affected behaviorally but not physically harmed; however, it should be noted that in busy ports and bays such as San Pablo Bay, background underwater noise is frequently measured at or above 150 dB under baseline conditions, therefore the baseline noise conditions are frequently at or above the standard thresholds for behavioral effects (Caltrans 2020).

Table 4. Fish Impact Criteria

EFFECT	METRIC	FISH MASS (GRAMS)	THRESHOLD
Onset of physical injury	Peak pressure	N/A	206 dB (re: 1 µPa)
	Accumulated SEL	≥ 2 g	187 dB (re: 1µPa^2•sec)
		< 2 g	183 dB (re: 1µPa^2•sec)
Adverse behavioral effects	RMS	N/A	150 dB (re: 1 µPa)

There are two primary styles in pile driving, vibratory and impact hammer driving. These styles of pile driving have different potentials for effect and are described below.

Vibratory Pile Driving

Vibratory pile driving uses hydraulicly powered, oscillating counterbalance weights to vibrate an object (i.e., pile) at high speed. The vibration mobilizes the earth beneath and around the pile causing the surrounding earth to liquify. Once mobilized, the weight of the hammer pushes the pile downward. Vibratory hammers do not "strike" a pile and as such have lower peak sound pressure than impact hammers, but also require more prolonged use as they drive piles slower. Even with prolonged use, vibratory hammers do not approach the peak or cumulative sound exposure thresholds that would cause injury or death to fish (Caltrans 2020). Because of the low level of effect, resource agencies generally agree that vibratory pile driving results in reduced adverse effects on fish and is therefore the preferred driving methodology. This reduced level of effect is also why agencies have not identified any peak or cumulative injury thresholds for vibratory pile driving to fish (Caltrans 2020). With the lower level of effect, use of a vibratory hammer is often employed as a minimization measure to reduce the overall number of strikes necessary to drive piles on a project. For this Proposed Project, removing any existing piles, or initially placing and driving new piles will be preferentially performed with a vibratory hammer to decrease the Proposed Project's acoustic effect on the aquatic environment.

The limiting factors to driving with a vibratory hammer are seating depth and pile size. Small diameter piles (e.g., 18–24-inch steel pipe piles) or sheetpiles may be able to be fully driven using a vibratory hammer when substrates are soft (i.e., silty, and low in clay); however, the presence of geotechnical conditions such as clay hardpans and sand lenses, especially when driving large diameter steel pipe piles to moderate depths, a vibratory hammer may not have sufficient energy to install the pile fully (Caltrans 2020). Once a vibratory hammer reaches refusal, an impact hammer is often necessary to complete the installation to drive piles to specified depths for structural integrity. Additionally, vibratory pile driving is often not able to achieve engineering criteria required to support design structural loads, and impact driving is necessary in these cases for "final seating" of the pile.

Impact Hammer Pile Driving

An impact hammer operates by using a sliding hammer head to strike a pile, causing the downward force of the head to drive the pile, similarly to the way a handheld hammer strikes and drives a nail. This method creates a pulse of sound that propagates through the pile, spreading outward into the aquatic environment. As shown in Table 5, peak, cumulative and RMS sound pressure levels all have different thresholds and types of effect. The "peak" is the highest value of the measured sound and may cause injury to fish exposed to instantaneous peak levels at or above 206 dB. Driving piles requires multiple strikes from the hammer, therefore there is also a cumulative effect of all strikes. In this case, cumulative exposure can cause injuries to fish at slightly lower decibel levels depending on the size of the fish. For fish less than 2 grams, the cumulative sound exposure level is 183 dB, while fish over 2 grams have a threshold of 187 dB. The distance at which these thresholds are reached vary based on the size and type of pile, number of strikes required, as well as the depth of water, and hammer size.

The Proposed Project will require installation of a series of steel shell or pipe piles to support the transition structure on the north shore, as well as temporary sheetpiles on the southern shore to protect lines as they come ashore and enter the vault. The general pile types identified in the plans are shown below in Table 5 along with the likely material, size, and number of piles. Of note, steel shell piles used to support the transition structure may ultimately be smaller (e.g. 30-inch) than those referenced in the table below. The larger a steel shell pile is, the more sound is created when the pile is driven. As such, 36-inch piles are referenced here as these are the largest potential piles that are potentially required to support the transition structure. Piles smaller than these would create less disturbance and as such would fall within this assessment and would be equally minimized by the following AMM.

Table 5. Anticipated Pile Material, Number and Type

PILE TYPE	PILE MATERIAL	PILE SIZE	NUMBER OF PILES ANTICIPATED
Elements to be Installed for the Northern Transition Structure			
Shell Pile (in-water)	Steel	≤ 36 inches	12
H Pile (in-water)[2]	Steel	14 inches	48
Sheetpile (in water)	Steel	Width may vary	540 LF
Elements to be Installed for the Southern Shoreline			
Sheetpile (in water)	Steel	Width may vary	80 LF
Sheetpile (on land)	Steel	Width may vary	450 LF

Driving piles between July 1 and November 30 (during the in-water work window) will minimize the possibility that fish are present when work occurs as most special-status fish species are not likely to be present during this period. Even noise produced which might behaviorally affect fish would not be likely to impede important stages of migrations that might pass through the Sacramento River in route to natal streams. During the in-water work window, more sensitive life stages (i.e., egg or larvae) are also not present, further reducing effects on these sensitive life

[2] H-Piles will be installed to guide larger 36-inch piles to ensure proper alignment. Once the larger 36-inch shell piles are installed, the H-piles will be removed.

stages. Sound levels shown below in Table 6 are examples of those effects which may be caused by the installation of piles of similar sizes anticipated for the Proposed Project. All projects referenced in Table 6 are from the Caltrans Technical Guidance for the Assessment of Hydroacoustic Effects of Pile Driving on Fish (Caltrans 2020). Any attenuation used for the referenced projects is noted.

Table 6. Reference Sound Measurements

PILE TYPE	HAMMER TYPE	REFERENCE PROJECT	ATTENUATION	WATER DEPTH (METERS)	DISTANCE (METERS)	RECORDED DECIBELS		
						Peak	*SEL*	*RMS*
In-water								
36-inch Steel Shell	Impact	Caltrans Generic Example (Caltrans 2020)	None	8	10	210	183	193
36-inch Steel Shell	Vibratory	WETA Downtown Ferry, San Francisco CA	None	2-3	10	191	159	159
Sheetpile	Impact	Napa River Flood Control Project	None	2-6	10	209	166	175
Sheetpile	Vibratory	Berth 23, Port of Oakland	None	15	10	177	162	163
H Pile	Vibratory	Chevron Long Wharf/Richmond, CA	None	1-2	10	-	-	150
On Land*								
Sheetpile (modeled)	Impact	Napa River Flood Control Project	None	-	10	199	156	165
Sheetpile (modeled)	Vibratory	Berth 23, Port of Oakland	None	-	10	-	-	153

**Note when modeling piles driven on land a 10dB attenuation is suggested by the Caltrans (2020) guidance for modeling sound effects; therefore, the same projects used to reference in water driving are used to model on-land pile driving, but the measurements are reduced by 10 dB.*

Most listed fish species only occur within the Project Area during seasonal migratory periods. Working during the recommended in-water work window reduces potential impacts to most species. However, some species such as green sturgeon and longfin smelt may be present in the Project Area during the work windows and are considered present year-round, and as such analysis is required for these species to determine what effects Project specific pile driving may have on them.

Using the NMFS pile driving calculator (NMFS 2022) WRA modeled the effects of pile driving with an impact hammer and vibratory hammer for each pile size. The following assumptions when accounted for when completing calculations:

1.) All steel piles will be driven to refusal with a vibratory hammer first to minimize the total number of blows required to drive them to specified depth.
   a. With 36-inch steel shell piles it is estimated that driving may require up to 4 hours of vibratory driving and 1,000 strikes with an impact hammer, per pile. Up to two piles may be installed per day.
   b. With sheetpiles it is estimated that vibratory driving on land or water may require up to 0.5 hours per sheet. An impact hammer may then be used for up to 100 strikes per pile to ensure they have achieved suitable stability. If piles reach

suitable depth without the need for an impact hammer, no impact hammers will be used. Up to 20 sheets may be driven per day (in water or on land).

c. With 14-inch "H" guidepiles it is estimated that it will take no more than 2 hours of vibratory driving per pile and up to 4 piles may be installed per day. It is not anticipated that an impact hammer will be needed for installation of guide piles.

2.) All steel shell piles will be impact hammer driven with the use of a bubble curtain. The bubble curtain is assumed to reduce effects by 10 dB for unattenuated data.

3.) A bubble curtain is not included for driving *steel sheetpiles* in water despite using an impact hammer.

4.) No attenuation is proposed for any vibratory hammer driving.

Unattenuated data is presented in Table 6. Modeling results in Table 7 use a 10 dB attenuation rate for impact hammer driving of in-water shell piles. Air bubble curtains, either confined or un-confined, have been shown to commonly reduce sound pressure levels for impact pile driving in water by more than 20 dB (Caltrans 2020). Noise measurements made in 2015 at the WETA Maintenance Facility in Vallejo (Caltrans 2020) indicate a range of measured 36-in steel pile levels from 172 to 205 dB peak, 149 to 183 dB RMS and 139 to 171 dB SEL for impact pile driving with a bubble curtain. These levels indicate an attenuation of approximately 30 dB with the use of a bubble curtain, when compared to unattenuated levels. To avoid under estimating impacts, a conservative 10-dB attenuation is assumed, consistent with the recommended attenuation standard for bubble curtains in the Caltrans Hydroacoustic Technical Guidance (Caltrans 2020).

The results of pile driving calculations are provided in Appendix C. Pile Driving Calculations and are summarized below in Table 7 for impact hammer driving and Table 8 for vibratory driving. All distances shown below are in meters (m).

Table 7. Modeled Impact Hammer Pile Driving Effects

ATTENUATION	FISH				MARINE MAMMALS			
	Peak (dB re: 1uPa)	Cumulative SEL (dB re:1uPa-sec2)		RMS (db re:1uPa)	RMS (db re:1uPa			
					PW Pinniped Peak (PK)	PW Pinniped PTS SEL	OW Pinniped Peak (PK)	OW Pinniped PTS SEL
Threshold (dB)	*206*	*187*	*183*	*150*	*218*	*185*	*232*	*203*
36-inch steel shell. 2,000 strikes per day								
Attenuated Distance (m)	4.0	185.1	341.5	1,584.9	<1	182.8	<1	13.3
Steel sheetpile (in-water). 2,000 strikes per day								
Unattenuated Distance (m)	15.8	63.2	116.6	464.2	2.5	62.4	<1	4.5
Steel sheetpile (on-land). 2,000 strikes per day								
Unattenuated Distance (m)	3.4	13.6	25.1	100	<1	13.4	<1	1

Table 8. Modeled Vibratory Hammer Pile Driving Effects

Attenuation	Fish				Marine Mammals		
	Peak (dB re: 1uPa)	Cumulative SEL (dB re:1uPa-sec2)		RMS (db re:1uPa)	RMS (db re:1uPa		
					PW Pinniped PTS SEL Threshold	OW Pinniped PTS SEL Threshold	Behavior (All Marine Mammals)
Threshold (dB)	N/A*	N/A*	N/A*	*150*	*201*	*219*	*120*
36-inch steel shell. 480 minutes (8 hours) per day.							
Unattenuated Distance (m)	N/A*	N/A*	N/A*	4.0	1.2	<1	398.1
Steel sheetpile (in-water). 480 minutes (8 hours) per day.							
Unattenuated Distance (m)	N/A*	N/A*	N/A*	7.4	2.3	<1	735.6
Steel sheetpile (on-land). 480 minutes (8 hours) per day.							
Unattenuated Distance (m)	N/A*	N/A*	N/A*	1.6	<1	<1	158.5
14-inch steel H pile. 480 minutes (8 hours) per day.							
Unattenuated Distance (m)	N/A*	N/A*	N/A*	1.0	<1	0	100

* Sound level will not exceed threshold limit at the source of the noise.

As shown in Table 6, larger piles create louder sounds during driving, especially when being driven with an impact hammer; therefore the 36-inch steel piles are the most critical piles to assess and to minimize for to ensure the Project effects are accounted for and minimized sufficiently.

Impact pile driving of 36-inch steel shell piles have the potential to cause direct injury or mortality to fish from peak sounds if fish occur within 4 meters of the pile. Impact driving of steel sheetpiles could cause injury or mortality to fish within 16 meters of the pile. Sound impacts at distances up to 10 meters are typically considered discountable since the 10 meter area around a pile is directly disturbed by the barge conducting pile driving, work boats, tugs and similar common equipment associated with pile driving (Caltrans 2020). The disturbance from such vessels serve to create low-level disturbance which que fish to relocate from those areas closest to the pile. While both 36-inch steel shell piles and steel sheetpiles surpass the 206 dB peak threshold, only sheetpiles may affect fish beyond the 10 meter zone. Therefore, impact driving of steel sheet piles may result in a significant impact to special status fish species, while impact driving of steel shell piles while using a bubble curtain would be a less than significant impact. The potential impact from pile driving of steel sheet piles is a temporary impact that extends to a distance of less than 20% of the width of the channel at its smallest point in this location, which leaves abundant room for temporary fish avoidance of the increased sound levels. Inclusion of minimization measures described below will help reduce this potential impact

to a level that is less than significant through use of measures such as a soft-start and only driving during the prescribed work window when fish are less likely to be present.

The cumulative SEL for impact hammer driving of 36-inch steel shell piles, and steel sheetpiles may extend up to 342 and 117 meters (respectively) from the pile. Within this distance, injury to a fish may occur if it remains stationary within the isopleth for the entire duration of driving (approximately 12 hours). However, the Project is located within a tidal zone, which also receives outflow from the Sacramento River. Therefore, natural movement of water through the Project Area would make it highly improbable that a fish could remain stationary within the isopleth throughout the entire duration of pile driving. The SEL would extend to a distance that is less than 30% of the width of the channel at its smallest point in this location, leaving abundant room for avoidance of elevated sound levels. While effects to fish from the cumulative SEL require that those fish remain stationary throughout the entire duration of driving, effects may still occur and minimization measures described below are prescribed to reduce theses effects to less than significant levels.

As noted above and shown in Table 8, vibratory hammers do not result in peak or cumulative sound exposure thresholds that would cause injury or death to fish (Caltrans 2020). This is why all piles will be driven first using a vibratory hammer, before using an impact hammer. This method is incorporated below as a minimization measure to help minimize effects to fish from pile driving to a level that is less than significant.

All pile driving activities would result in some level of behavioral effects to fish species. The extent of behavioral effects varies between approximately 10% of the channel at its narrowest point to the entire width of the channel. The Project is located within one of the busiest shipping and recreational channels on the west coast. The Project Area is subject to daily disturbance by recreational boat traffic and trans-Pacific cargo ships making their way up the Sacramento - Stockton Deepwater Shipping Channel. These vessels create noise that exceeds the behavioral thresholds for fish (Caltrans 2020), resulting in a baseline condition of regular behavioral noise disturbance. Pile driving for the Project is a temporary incremental increase to this baseline condition. The Project's exceedance of the behavioral threshold for fish is a less than significant impact because it would not substantially alter the environment beyond existing baseline conditions.

Effects from pile driving may have significant impacts to fish unless AMMs are incorporated. To reduce potential impacts to fish to a less-than-significant level, the AMM BIO 7 will be implemented during any in-water work in addition to AMM BIO-1 through BIO-5:

AMM BIO-7: PILE DRIVING

The following measures will be implemented during the driving of all piles to reduce any effects from pile driving to less than significant levels:

- In-water work will be limited to the July 1–November 30 work window as stated in AMM BIO-3.
- To the greatest extent feasible, pile driving of steel piles will be conducted with a vibratory hammer.
- When installation with an impact hammer is required for steel piles driven in water, the following additional measures will be employed:

- Use of a soft start (gradually increasing energy and frequency) at the start of driving, or after a cessation of driving for more than one hour.
- Use a bubble curtain during the pile driving process when an impact hammer is used on steel shell piles.
- Underwater sound monitoring may also be performed during pile driving activities for a minimum of 1 day for each pile size and type utilized during construction to verify sound levels are not exceeding modeled levels anticipated by the bubble curtain. If monitoring indicates that these noise levels would be exceeded, additional noise reduction measures (e.g., isolation of the piles via a temporary cofferdam or limiting pile strikes) would be implemented to reduce noise levels.

With implementation of AMM BIO-1 through BIO-5 and BIO-7, impacts to fish from pile driving would be less than significant with mitigation incorporated.

POTENTIAL IMPACT BIO-7: IN-WATER HORIZONTAL DIRECTIONAL DRILLING

Horizontal directional drilling may be used on the southern shore to drill outward from the shoreline, connecting the cables in the waterway to the shoreside power grid only if the open trench construction method proves infeasible. In this case, any drilling machinery will be operated from land and standard spill management and prevention practices as described under AMM BIO-2 will be enacted to minimize the opportunity for contaminants from machinery to enter the adjacent waterway. Once the drill daylights within the riverbed, cables will be attached to the drill shaft such that the cable can be pulled back through the underground hole and onto land. During this process any in-water work would need to occur during the in-water work window as described in AMM BIO-3, such that disturbance occurs at a time when most special-status fish are absent, or if present are in a developed state such that they may freely relocate from the disturbance. During this process, there is also likely to be a small amount of turbidity created as the drill transitions from underground to the in-water environment; however, such turbidity is expected to be relatively minimal and would be far less than turbidity created from the hydroplow, open trenching, or pile driving as described above. As such, it is not anticipated that turbidity caused during the drilling process would be significant and any measures used to minimize effects of turbidity caused by the hydroplow or open trenching would similarly reduce effects of turbidity due to horizontal directional drilling.

However, horizontal directional drilling equipment requires lubrication for the drill as it cuts the hole. Materials commonly used to lubricate horizontal directional drilling equipment consist of a mixture of bentonite and water, which can have a relatively high pH. If released into the aquatic environment, these materials could adversely affect fish species in the area of the drill hole. Depending on the amount of fluid, this could be a significant impact to special-status fish species. Additionally, directional drilling carries a risk of “frac-out”, where excess pressure builds up in the drill hole, leading to vertical release of that pressure bringing a mixture of sediment and drilling lubricant to the surface above the bore hole. Such circumstances could cause potentially significant impacts to fish. To minimize such potential for impacts, in addition to AMMs described above, AMM BIO-8 will also be implemented to reduce effects from horizontal drilling to less-than-significant levels.

AMM BIO-8: IN-WATER TRENCHING OR DIRECTIONAL DRILLING

- For any equipment used by the Proposed Project which also contacts water, the equipment will be cleaned and free of excess grease, or other petroleum-based products prior to use.
- When using a horizontal boring machine, any drill bits which require lubrication will only use non-toxic, biodegradable substances that do not include petroleum products (such as polymers) or bentonite.
- Prior to horizontal directional drilling, the contractor will develop a Frac-Out Contingency Plan including measures to prevent and respond to a potential frac-out.
- Pumping of drill lubrication will cease immediately when the drill head is exposed to the water column.

POTENTIAL IMPACT BIO-8: OVERWATER CONCRETE POURING

The Proposed Project seeks to build a concrete and steel transition structure on the north side of the Study Area to direct transmission cables from the overhead transmission structures to the submarine crossing beneath the river. The structure itself will be supported on a series of steel piles (up to 36-inches in diameter) and will in turn provide a surface to support the J tubes as well as cables which are being undergrounded. In this case the surface of the structure will be made primarily of concrete as this is one of the few materials that provides the stability and rigidity that is required for such a platform. In its raw, uncured state, concrete can cause a spike in pH (i.e. increase in alkalinity) which can harm aquatic life (Caltrans 2016). If cast in place concrete were to spill or leak into the waters beneath, it could deleteriously affect aquatic species, which would be considered a significant impact. However, with the use of AMM BIO-9, effects from cast in place concrete would be reduced to less-than-significant levels.

AMM BIO-11: OVERWATER CONCRETE CASTING

The following measure will be implemented during the casting of overwater concrete:

- The bottom elevation of the transition structure will be set at an elevation above the 100-year flood level to allow water and debris to flow beneath the structure during the curing process.
- All overwater concrete will be poured into water-tight forms, and isolated from waters of the Sacramento River until concrete has fully cured (typically 30-days).
- Commercial sealants may be applied to the poured concrete surface where difficulty in excluding water flow for a long period may occur. If sealant is used, water will be excluded from the site until the sealant is dry.
- Any water used to keep concrete moist during the curing process will not be allowed to runoff of the structure. Concrete forms will also be sufficiently designed to catch and hold any such cure water.
- At all times when concrete is being poured or when working with wet concrete there will be a monitor present to inspect the containment structures and ensure that no concrete or cure water escapes the containment structure.

With the implementation of AMM BIO-9, effects to waters and fish from overwater concrete construction will be reduced to less-than-significant levels.

5.1.2 Critical Habitat

POTENTIAL IMPACT BIO-9: CRITICAL HABITAT

The Proposed Project will not withdraw water or divert water in any way that might affect water quality for critical habitat. The absence of any such changes to water quality will maintain salinity gradients, flow, volume, and similar characteristics noted in each critical habitat designation. Further, the Proposed Project will not create any large in-water barriers such as a salinity barrier, tide gate or similar structure that would physically impede fish from moving through the area during or after construction. As such any migratory corridors will remain free from obstructions that would be likely to impede movements. Further, conducting work during the in-water work window (July-November) will avoid periods when species such as Chinook salmon, and steelhead rely on waters in the vicinity of the Study Area to provide a migratory corridor, foraging grounds, as well as a salinity gradient that allows their physiological transition from salt to fresh water (and vice versa). Considering the manner of cable installation, sub-tidal sediments along the riverbed will be temporarily disturbed when the cables are installed via hydroplow or via open trenching, but immediately after installation the furrow will be refilled, such that sediments can re-settle and remain in a similar state as they were prior to disturbance. Testing prior to implementation will also ensure that contaminants are not spread causing indirect impacts to critical habitat. For species which are potentially present for longer periods of the year, such as Delta smelt, working outside of the spawning or rearing window avoids periods of the year when impacts could be most detrimental (AMM BIO-3). As such implementation of the Proposed Project as described, already negates a majority of potential effects to critical habitat which co-occurs within the Study Area.

The Proposed Project does seek to install an over-water transition structure above the HTL on the northern side of the Study Area to allow cables to transition from the overhead, land-based lines to the submarine river crossing. The structure itself will be located above the HTL and made of concrete (either cast in place, or precast) such that the power lines can run through the transition structure into the riverbed. The transition structure will be supported by 12, 30 to 36-inch steel piles and capped with a concrete and steel platform. Given the purpose of the transition structure to connect landside and below water cable alignments, the structures is a relatively small near-shore area measuring a maximum of 130 feet long by 40 feet wide. The over-water structure will be supported on piles so it is not likely to pose a migration barrier as it will not create an impassible barrier. However, the shading footprint can potentially affect productivity of critical habitat. Overwater structures can alter underwater light conditions and result in a decrease in photosynthesis of diatoms, benthic algae and other aquatic organisms which are light dependent. This decrease in primary productivity can lead to a decrease in prey items for fish and higher trophic levels (Nightingale and Simenstad 2001). Additionally, invertebrates, fish, and aquatic plant occurrences under overwater structures have been found to be limited when compared to unshaded and vegetated habitat (Nightingale and Simenstad 2001, Ono et al. 2010). In studies of shade impacts of fixed piers and pilings, several approaches can be used to offset light loss including installation of light-transimitting surfaces (e.g. glass block or steel grating). Alternatively, installation of lights beneath the structure can help offset impacts of shading. While the shade footprint of the structure will be small comparatively to the size of the overall Study Area, a loss of primary productivity from beneath the structure, within critical habitat for special-status species could be considered a significant impact. However, with the use of AMM BIO-10 that effect can be reduced to less-than-significant levels.

AMM BIO-10: MITIGATION FOR CRITICAL HABITAT

Where feasible, the Proposed Project will include the installation of light-transmitting surfaces to minimize shade beneath the over-water transition structure. Materials installed for light transmission should allow for a minimum of 40% light transmission to the waters below. If the final design can incorporate a minimum of 25% of the surface area using light transmitting surfaces, no additional measures are required.

In the event light-transmitting surfaces cannot be installed for safety, structural, or accessibility reasons, the Proposed Project may also install lights beneath the structure to offset light loss within the permanently shaded area.

If either of these options are infeasible, the Proposed Project will mitigate for the portion of the structural footprint, which is permanently shaded. Areas permanently shaded by the overwater structure may be mitigated with one, or a combination of the following means:

- Removing equivalent shaded coverage over open water and/or in-water fill at a nearby location,
- With the purchase of mitigation credits from an approved mitigation bank at a 1:1 ratio (critical habitat permanently shaded : mitigation habitat), or
- By other similar actions approved by regulatory agencies, so long as those alternative actions achieve a similar effect as described above (e.g., actions which cause ecological uplift of habitat quality).

With the implementation of AMM BIO-10, adverse effects to critical habitat will be reduced to less than significant levels.

5.1.3 Essential Fish Habitat, Wildlife Corridors and Native Wildlife Nursery Sites

The Study Area contains EFH listed under three fisheries management plans. The elements of EFH are similar to the elements listed above for critical habitat with the exception that EFH also provides protection for certain species of aquatic vegetation which provides cover, forage and rearing areas for native fishes.

The buildout of the Proposed Project within aquatic environments is largely sub-terranean, and sub-tidal. As such, the cables which form a majority of Proposed Project components will not be exposed to fish. Impacts associated with installation are also temporary, as the furrows created to install cables below the riverbed will be naturally backfilled immediately after the cables are installed. Further, conducting work in the late summer/fall focuses any disturbances near the end of the growing season for EFH protected SAV, thus avoiding effects which might stunt growth or hinder reproductive success during critical growth stages in the spring and summer (NMFS 2014). As such it is expected that any disturbance to EFH listed or other SAV beds would be at a time of year when the plants are becoming dormant, and thus disturbance would not be likely to impede their regrowth in future years. Further, the time of year when work occurs is also outside of the winter and spring months when EFH species are present within the Estuary to spawn and reproduce thereby avoiding potential effects on more critical life stages.

As such the Proposed Project, with its current list of AMMs including BIO-1 through BIO-10 above prescribe protections for individual fish, and habitats in such a way that these would equally reduce effects to EFH to less-than-significant levels.

5.1.4 Marine Mammals

While relatively rare, marine mammals including harbor seals and California sea lion are known to occur in the vicinity of the Study Area and may migrate into the waters of the Study Area. Potential impacts to marine mammals are discussed in more detail below.

POTENTIAL IMPACT BIO-10: MARINE MAMMALS – UNDERWATER SOUND

Similar to fish, marine mammals can be injured if sounds produced by construction surpass certain tolerances. Injury to marine mammals from noise relates primarily to hearing damage or loss, and the thresholds for injury differ from those established for fish. The NMFS threshold for Post-Traumatic Stress (PTS) onset of pinnipeds (i.e., harbor seal and California sea lion, the two species known to regularly occur in the area) is 185 to 203 dB for impulsive sounds (i.e., impact hammers) and 201 to 219 dB for non-impulsive sounds (i.e., vibratory hammers) (NMFS 2018).

The sound of a suction dredge is used as a proxy from non-impulsive sounds that might be created during operation of a hydroplow. Sound levels measured from a suction dredge vary from 163 to 188 dB (WODA 2013), which is below the PTS threshold for marine mammals as shown in Table 4. As such sounds created associated with operation of a hydroplow are considered less than significant to marine mammals. Vibratory hammers driving steel sheet piles would not be expected to surpass the PTS threshold as these produce between 153 and 177 dB and would be a non-impulsive sound. See Table 8 for Project specific hydroacoustic results. The modeled sound levels shown in Table 8 indicate that exceedance of PTS thresholds from vibratory hammers are limited to within 1-3 meters of the pile, and as such, would be considered less than significant because marine mammals are not likely to remain present within 3 meters of a pile during construction. Similarly, peak levels from impact pile driving would not result in significant impacts to marine mammals because the noise would remain below thresholds except for the immediate area (within 10 meters) surrounding the piles. However, use of impact hammers would exceed SEL thresholds for marine mammals (Table 7). This would surpass the PTS onset threshold at distances up to 183 meters for 36-inch steel shell piles and up to 63 meters for sheet pile. This is a potentially significant impact under CEQA. However, with the use of AMM BIO-11, impacts to marine mammals can be reduced to less-than-significant levels.

AMM BIO-11: MARINE MAMMALS – PILE DRIVING

When an impact hammer is necessary to drive piles, the following measure shall be implemented:

- For all impact hammer pile driving, a biological monitor shall be present to observe for wildlife and will halt pile driving operations if marine mammals are observed within a distance where they may be affected by sounds created during pile driving as determined by the NMFS Pile Driving calculator.

With the implementation of AMM BIO-11, adverse effects to marine mammals from pile driving sound will be reduced to less than significant.

5.2 Wildlife Corridors and Native Wildlife Nursery Sites

This section analyzes the Proposed Project's potential impacts and mitigation for habitat corridors and linkages in reference to the significance threshold outlined in CEQA Appendix G, Part IV (d):

> *d) Does the Project have the potential to interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;*

The Study Area lies along the migratory route for numerous anadromous species which move from natal streams in the Central Valley to adult foraging grounds in the Pacific Ocean; therefore, the Study Area functions as a migratory corridor for fish. As discussed above, the Study Area also contains SAV (Figure 5, Appendix A) which can function as a nursery site for various fish species which spawn are rear within the SAV.

If construction were to occur at times of year when migratory events for fish were occurring or when larval fish were present, construction activities may have the potential to disrupt migratory events or to disturb nursery sites which are occupied by rearing fish. These would be considered a significant impact under CEQA.

However, the AMMs described above would reduce potential impacts to wildlife migratory corridors and nursery sites to less than significant levels. AMM BIO-1 through 4 will address the potential introduction of invasive species and ensure Proposed Project elements are conducted in such a way that lingering effects will not create indirect effects. Further AMM BIO-4 limits construction to periods of time that avoid larval-rearing fish and critical migratory periods; therefore, most potential effects to both nursery site and migratory corridors are negated based on the timing of in-water work. Further, AMM BIO-5 will ensure that any existing toxic sediments are not disturbed during installation, while screening associated with AMM BIO-6 will ensure that any individual fish are not lost. Best management practices prescribed in AMM BIO-7 will ensure that sounds created from pile driving are reduced to the extent possible and that any regulatory agencies have an opportunity to review the Proposed Project and prescribe additional measures if they feel additional measures are warranted. Finally, AMM BIO-10 prescribes mitigation for any permanently lost habitat such that habitat value and productivity are maintained. With the implementation of these measures, potential impacts of the Proposed Project on wildlife migratory corridors and nursery sites are reduced to less than significant levels.

6.0 REFERENCES

Baumsteiger, J., Schroeter, R.E., O'Rear, T., Cook, J.D. and Moyle, P.B., 2017. Long-term surveys show invasive overbite clams (*Potamocorbula amurensis*) are spatially limited in Suisun Marsh, California.

Beier, P., and S. Loe. 1992. A checklist for evaluating impacts to wildlife movement corridors. Wildlife Society Bulletin 20(4):434–440.

Bever, A.J., MacWilliams, M.L. & Fullerton, D.K. Influence of an Observed Decadal Decline in Wind Speed on Turbidity in the San Francisco Estuary. Estuaries and Coasts 41, 1943–1967 (2018). https://doi.org/10.1007/s12237-018-0403-x

California Department of Fish and Game (CDFG). 1994. A Field Guide to Lake and Streambed Alteration Agreements, Sections 1600-1607. Environmental Services Division, California Department of Fish and Wildlife, Sacramento, California.

California Department of Fish and Game (CDFG). 2000. Exhibit A: Department Of Fish And Game Fish Screening Criteria. Dated June 19, 2000.

California Department of Fish and Wildlife (CDFW). 2023a. California Natural Diversity Database. Biogeographic Data Branch, Vegetation Classification and Mapping Program, Sacramento, California. Available online at: https://wildlife.ca.gov/Data/CNDDB/Maps-and-Data; most recently accessed: October 2023.

California Department of Fish and Wildlife (CDFW). 2023b. Biogeographic Information and Observation System. Biogeographic Data Branch. Sacramento, California. Online at: https://wildlife.ca.gov/Data/BIOS; most recently accessed: October 2023.

California Department of Fish and Wildlife (CDFW). 2023c. Natural Communities List. Available online at: https://wildlife.ca.gov/Data/VegCAMP/Natural-Communities; most recently accessed: October 2023.

California Department of Fish and Wildlife (CDFW). 2023d. Fish Distribution Map - Summer Townet Survey. Available online at: https://wildlife.ca.gov/Conservation/Delta/Fall-Midwater-Trawl/Map; most recently accessed: November 2023.

California Department of Fish and Wildlife (CDFW). 2023e. Fish Distribution Map - Fall Midwater Trawl. Available online at: https://wildlife.ca.gov/Conservation/Delta/Fall-Midwater-Trawl/Map; most recently accessed: November 2023.

California Department of Transportation (CalTrans). 2010. California Essential Habitat Connectivity Project: A Strategy for Conserving a Connected California. Prepared for California Department of Transportation, California Department of Fish and Game, and Federal Highways Administration. Available online at: https://www.wildlife.ca.gov/Conservation/Planning/Connectivity/CEHC. Most recently accessed: October 2023.

California Department of Transportation (CalTrans). 2016. Determining the Appropriate Amount of Time to Isolate Portland Cement Concrete from Receiving Waters. Preliminary Investigation

Caltrans Division of Research, Innovation and System Information. Available online at: https://dot.ca.gov. Most recently accessed: December 2023.

Caltrans. 2020. Technical Guidance for the Assessment of Hydroacoustic Effects of Pile Driving on Fish. October 2020

California Department of Water Resources (CDWR). 2013. Appendix 5H – Aquatic Construction and Maintenance Effects. Bay Delta Conservation Plan. Public Draft. November. Sacramento, CA. Prepared by ICF International (ICF 00343.12). Sacramento, CA.

California Fish Species (Calfish). 2023. University of California, Department of Agricultural and Natural Resources, California Fish Website. Available Online at: https://calfish.ucdavis.edu. Accessed: October 2023.

Caywood, M.L. 1974. Contributions to the life history of the splittail Pogonichthys macrolepidotus (Ayres). M.S. Thesis. California State University, Sacramento. 77 pp.

Choksi, S. 2009. The Hostile Takeover of San Francisco Bay. Available online at: https://baykeeper.org/. Most recently accessed: October 2023.

Daniels, R.A. and P.B. Moyle. 1983. Life history of splittail (Cyprinidae:Pogonichthys macrolepidotus) in the Sacramento-San Joaquin estuary. Fish. Bull. 84:105-117.

Delta Stewardship Council (DSC). 2023. Salinity, Delta Plan Performance Measures. Station C-2, Collinsville monitoring Station Compliance Monitoring. Available Online at: https://viewperformance.deltacouncil.ca.gov/pm/salinity. Accessed: October 2023.

Google Earth. 2023. Aerial Imagery 1993-2023. Most recently accessed: October 2023.

Grigg, E.K, Allen, S.G., Green, D.E., H. Markowitz. 2004. Harbor Seal, *Phoca vitulina richardii*, Population Trends in the San Francisco Bay Estuary, 1970-2002. California Fish and Game. Vol. 90, No. 3. pp 51-70.

Heath, A.G. 1995. Water pollution and fish physiology. Second Edition. CRC Press Inc. Boca Raton, Florida.

Hestir, E., Schoellhamer, D., Greenberg, J., Morgan-King, T., and Ustin, S. 2015. *The Effect of Submerged Aquatic Vegetation Expansion on a Declining Turbidity Trend in the Sacramento-San Joaquin River Delta*. Estuaries and Coasts, Vol 39.

Hilty, J. A., W. Z. Lidicker Jr, and A. M. Merenlender. 2019. Corridor Ecology: Linking Landscapes for Biodiversity Conservation. Second Edition. Island Press.

Kopec, Diane. 1999. Harbor Seals in the Bay. Tideline Vol 19 No. 1 1-3.

Mussen, T.D., Cocherell, D., Poletto, J.B., Reardon, J.S., Hockett, Z., Ercan, A., Bandeh, H., Kavvas, M.L., Cech Jr, J.J. and Fangue, N.A., 2014. Unscreened water-diversion pipes pose an entrainment risk to the threatened green sturgeon, Acipenser medirostris. *PloS one*, *9*(1), p.e86321.Nationwide Environmental Title Research (NETR). 2020. Historic Aerials. Available online at: https://historicaerials.com/viewer. Most recently accessed: October 2023.

Moyle, P.B., J.J. Smith, R.A. Daniels, and D.M. Baltz. 1982. Distribution and ecology of stream fishes of the Sacramento-San Joaquin Drainage System, California: a review. University of Calif. Publ. Zool. 115:225-256.

Moyle, P.B. 2002. Inland Fishes of California. University of California Press, Berkeley, California.

National Marine Fisheries Service (NMFS). 1997. Fish Screening Criteria for Anadromous Salmonids. Available online at https://nrm.dfg.ca.gov/. Accessed Novmeber 2023.

National Marine Fisheries Service (NMFS). 2018. 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-59, 167 p.

National Marine Fisheries Service (NMFS). 2014. California Eelgrass Mitigation Policy and Implementing Guidelines. Available online at https://media.fisheries.noaa.gov. Accessed August 2023.

National Marine Fisheries Service (NMFS). 2012. Final Recovery Plan for Central California Coast coho salmon Evolutionarily Significant Unit. National Marine Fisheries Service, Southwest Region, Santa Rosa, California.

National Marine Fisheries Service (NMFS). 2014. California Eelgrass Mitigation Policy and Implementing Guidelines. October 2014.

National Marine Fisheries Service (NMFS). 2020. Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Long-Term Operations of the Central Valley Project and State Water Project. NMFS No: WCRO-2016-00077

National Marine Fisheries Service (NMFS). 2023a. Essential Fish Habitat Mapper. Available online at: https://www.habitat.noaa.gov/protection/efh/efhmapper. Most recently accessed: October 2023.

National Marine Fisheries Service (NMFS). 2023b. National ESA Critical Habitat Mapper. Available online at: https://www.fisheries.noaa.gov/resource/map/national-esa-critical-habitat-mapper. Most recently accessed: October 2023.

National Oceanic and Atmospheric Association. 2023. Nautical Navigation Chart 18656. Suisun to York Slough. Most recently accessed: October 2023.

Nightingale, B. and Simenstad, C.A., 2001. Overwater structures: marine issues (No. WA-RD 508.1,). Washington State Transportation Commission, Planning and Capital Program Management.

Ono, K., Simenstad, C.A., Toft, J.D., Southard, S.L., Sobocinski, K.L. and Borde, A., 2010. Assessing and mitigating dock shading impacts on the behavior of juvenile pacific salmon (Oncorhynchus spp.): can artificial light mitigate the effects? (No. WA-RD 755.1). Washington (State). Dept. of Transportation. Office of Research and Library Services.

Pacific Fishery Management Council (PFMC). 2021. Coastal Pelagic Species Fishery Management Plan as Amended Through Amendment 18. January 2021. Available online at: www.pcouncil.org

PFMC. 2022a. Pacific Coast Groundfish Fishery Management Plan for The California, Oregon, And Washington Groundfish Fishery. August 2022. Available online at: www.pcouncil.org

PFMC. 2022b. Pacific Coast Salmon Fishery Management Plan For Commercial And Recreational Salmon Fisheries Off The Coasts Of Washington, Oregon, And California As Revised Through

Ruhl, C.A., D.H. Schoellhamer, R.P. Stumpf, and C.L. Lindsay. 2001. Combined use of remote sensing and continuous monitoring to analyse the variability of suspended-sediment concentrations in San Francisco Bay, California. Estuarine, Coastal, and Shelf Science 53:801-812.

SFGate. 2007. CALIFORNIA / 2 humpbacks making their way up delta / Agencies try to keep wayward whales, boats clear of each other. May 15, 2007.

Simmonds, J. 2022. Lawsuit Launched to Protect U.S. Waters from Ship Pollution, Invasive Species EPA Late on Rules to Limit Vessel Discharges of Live, Biological Pollution. Available online at: https://biologicaldiversity.org/. Accessed July 2023

Sommer, T. and F. Mejia. 2013. A place to call home: A synthesis of Delta smelt habitat in the upper San Francisco Estuary. San Francisco Estuary and Watershed Science 11(2): 25 pp.

Soulé, M. E., and J. Terbough. 1999. Conserving nature at regional and continental scales - a scientific program for North America. BioScience 49(10):809–817.

State Water Resources Control Board (SWRCB). 2019. State Wetland Definition and Procedures for Discharges of Dredged or Fill Material to Waters of the State, May 14, 2019.

The Marine Mammal Center (TMMC). 2023. Marine Mammal Information. Available Online at: http://www.marinemammalcenter.org. Most recently accessed: October 2023.

U.S. Army Corps of Engineers (Corps). 2015. Dredging and dredged material management. Engineer Manual. Washington D.C., USACE: 568 pp.

U.S. Fish and Wildlife Service (USFWS). 2013. Formal Endangered Species Act Consultation on the Mukilteo Multimodal Project Snohomish County, Washington. Biological Opinion 01EWFW00-2013-F-0360. Lacey, Washington.

U.S. Fish and Wildlife Service (USFWS). 2022. Formal Consultation for the Lind Marine Maintenance Dredging Project (Corps File No. 2020-00238) in the City of Vallejo, Solano County, California.

U.S. Fish and Wildlife Service (USFWS). 2023a. National Wetlands Inventory. Available online at: http://www.fws.gov/nwi. Most recently accessed: October 2023.

U.S. Fish and Wildlife Service (USFWS). 2023b. Information for Planning and Consultation. Available online at: https://ecos.fws.gov/ipac/. Most recently accessed: October 2023.

U.S. Geologic Survey (USGS). 2023. 7.5-minute quadrangle for Antioch North, Jersey Island, Brentwood, Antioch South, Clayton, Honker Bay, Denverton, Birds Landing, and Rio Vista.

World Organization of Dredging Associates (WODA). Technical Guidance on: Underwater Sound in Relation to Dredging. June 2013. Available online at:

https://dredging.org/documents/ceda/html_page/2013-06-woda-technicalguidance-underwatersound_lr.pdf. Most recently accessed: October 2023.

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APPENDIX A. FIGURES

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Sources: National Geographic, WRA | Prepared By: njander, 11/16/2023

Figure 1. Study Area Regional Location Map

Collinsville Project

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wra Environmental Consultants

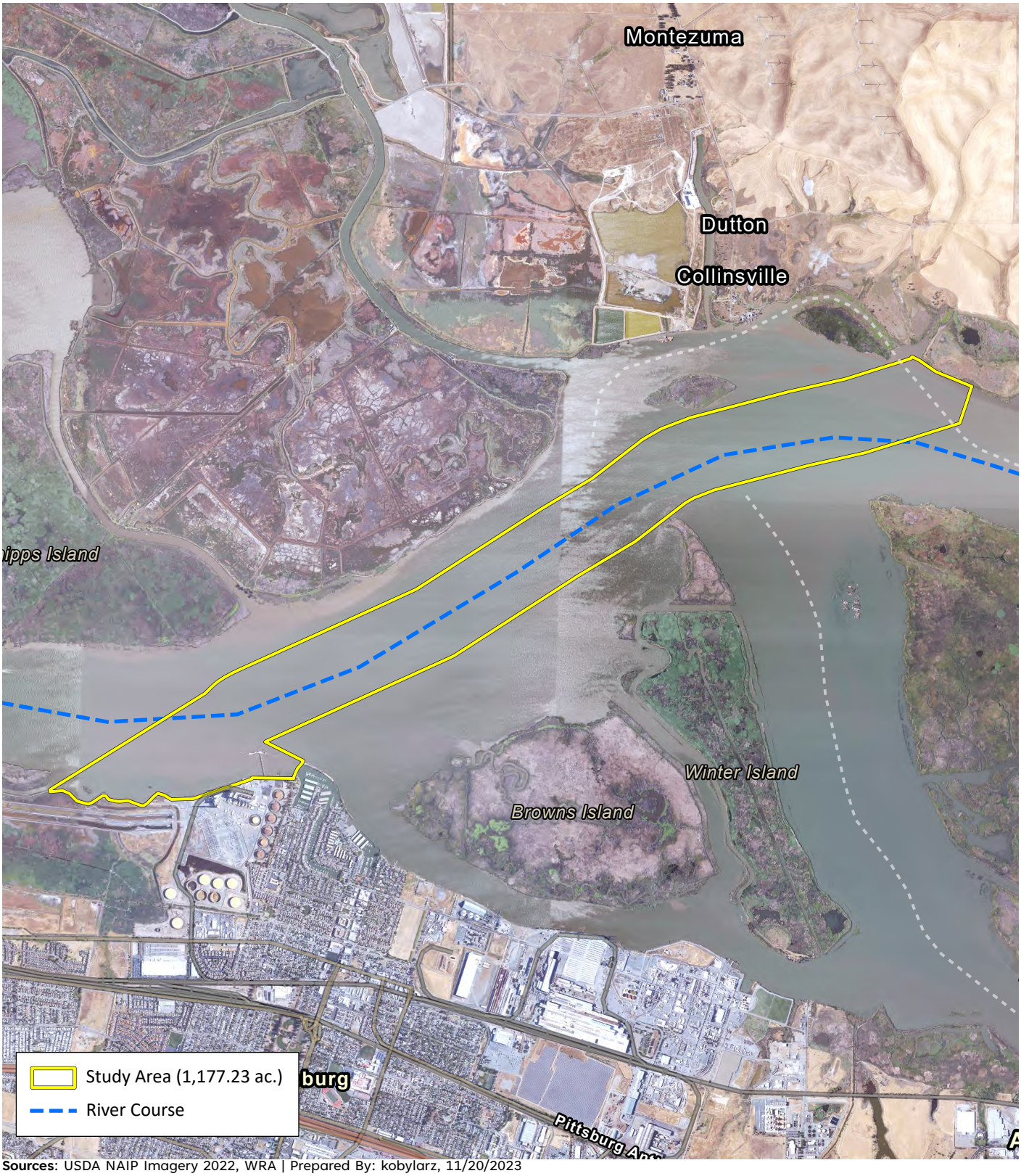

Figure 2. Study Area Details

Collinsville Project

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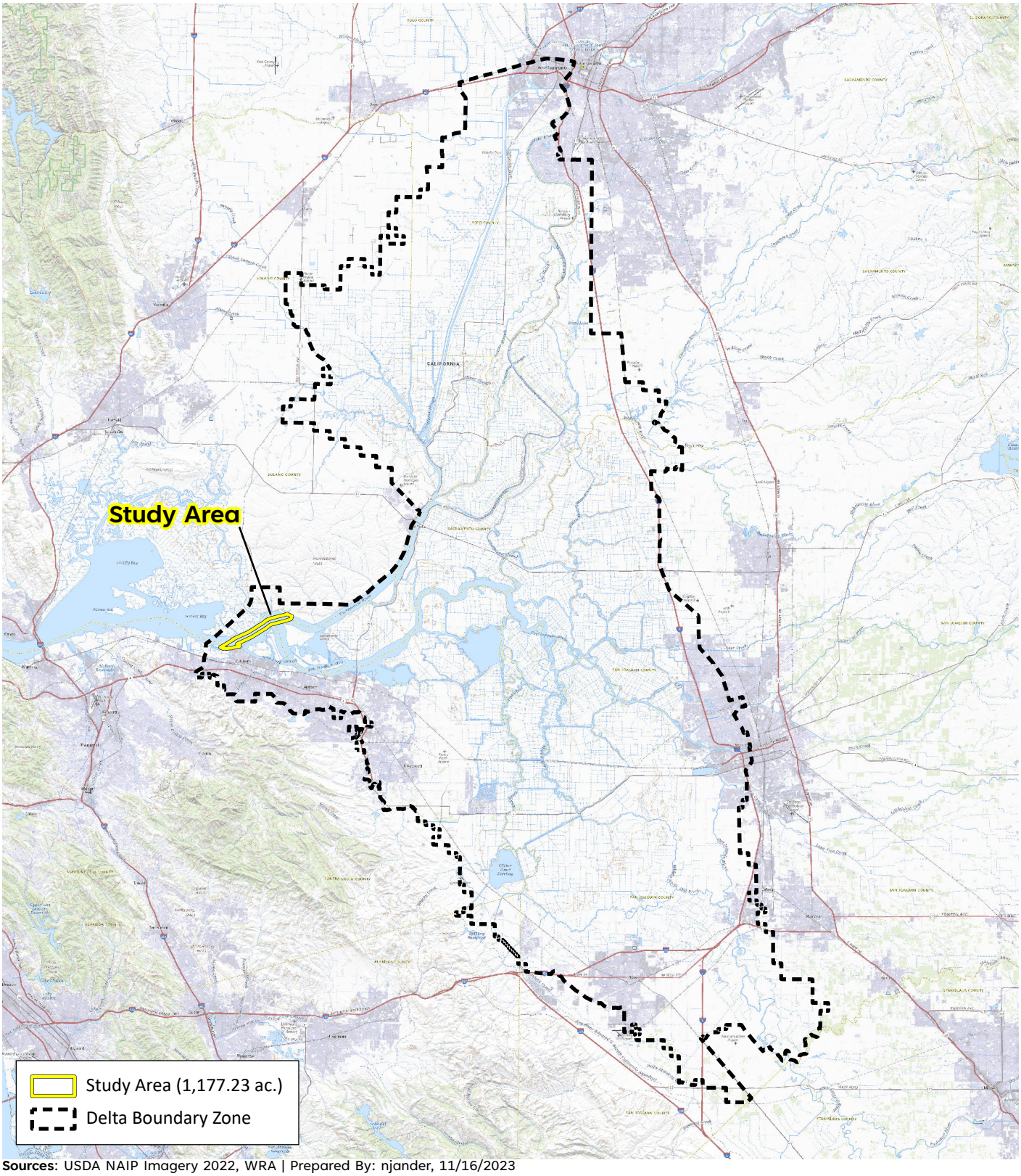

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Sources: USDA NAIP Imagery 2022, WRA | Prepared By: njander, 11/16/2023

Figure 3: Study Area within the Delta

Collinsville Project

wra Environmental Consultants

Sources USDA NAIP Imagery 2022, WRA | Prepared By: kobylarz, 11/20/2023

Figure 4. Habitats within the Study Area

Collinsville Project

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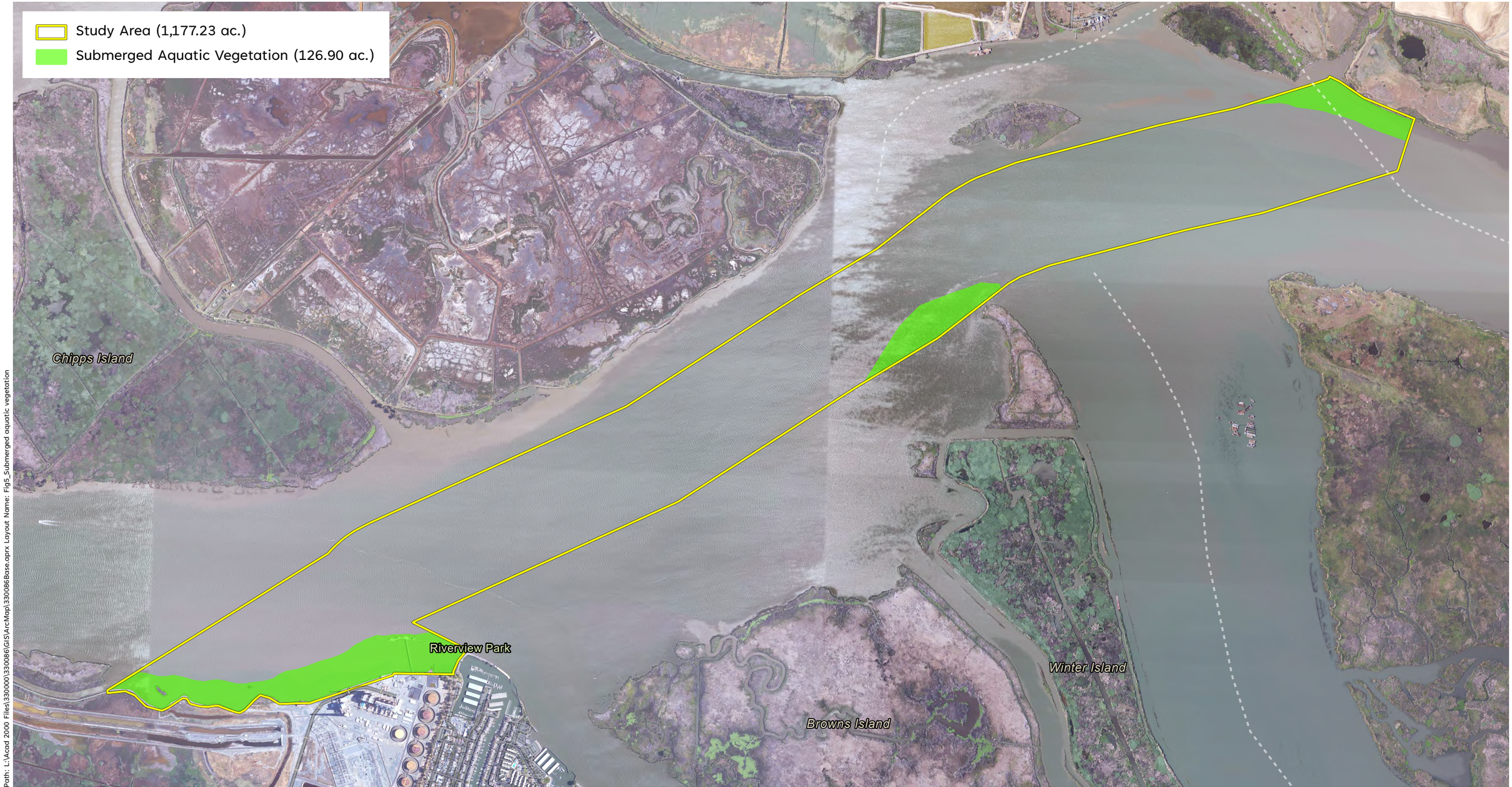
wra Environmental Consultants



Path: L:\Acad 2000 Files\330000\330086\GIS\ArcMap\330086Base.aprx Layout Name: Fig5_Submerged aquatic vegetation

Sources USDA NAIP Imagery 2022, WRA | Prepared By: kobylarz, 11/20/2023

Figure 5. Submerged aquatic vegetation

Collinsville Project

wra Environmental Consultants

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APPENDIX B. SPECIAL-STATUS SPECIES POTENTIAL TABLE

Appendix B. Potential for Fish Species to Occur within the Project Area

List Compiled from the California Department of Fish and Wildlife Natural Diversity Database (CDFW 2024), U.S. Fish and Wildlife Service Information for Planning and Consultation Species Lists (USFWS 2024), and CalFish (2024) search of the Antioch North and surrounding eight U.S. Geological Survey 7.5' quadrangles (Jersey Island, Brentwood, Antioch South, Clayton, Honker Bay, Denverton, Birds Landing, and Rio Vista).

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
WILDLIFE				
FISH				
Chinook salmon - Central Valley fall/late fall-run ESU ***Oncorhynchus tshawytscha***	SSC	Populations spawning in the Sacramento and San Joaquin Rivers and their tributaries. Adults migrate upstream to spawn in cool, clear, well-oxygenated streams. Juveniles remain in fresh water for 1 or more years before migrating downstream to the ocean.	**Present Seasonally.** This species spawns within the main stem and tributaries of the Sacramento and San Joaquin Rivers. Adults and juveniles must pass through the Project Area in route to and from the Pacific Ocean. This species would be considered seasonally present during migratory periods.	*See Section 4.2 for further discussion of this species.*
Chinook salmon - Central Valley spring-run ESU ***Oncorhynchus tshawytscha***	FT, ST	Occurs in the Feather River and the Sacramento River and its tributaries, including Butte, Mill, Deer, Antelope and Beegum Creeks. Adults enter the Sacramento River from late March through September. Adults migrate upstream to spawn in cool, clear, well-oxygenated streams from mid-August through early October. Juveniles migrate soon after emergence as young-of-the-year or remain in freshwater and migrate as yearlings.	**Present Seasonally.** This species spawns within tributaries of the Sacramento and San Joaquin Rivers and must pass through the Project Area in route to the Pacific Ocean. This species would be considered seasonally present during migratory periods.	*See Section 4.2 for further discussion of this species.*
Chinook salmon – Sacramento River winter-run ESU ***Oncorhynchus tshawytscha***	FE, SE	Occurs in the Sacramento River below Keswick Dam. Spawns in the Sacramento River near Redding, but not in tributary streams. Requires clean, cold water over gravel beds with water temperatures between 6 and 14 degrees C for spawning. Adults migrate upstream to spawn in cool, clear, well-oxygenated streams. Juveniles typically migrate to the ocean soon after emergence from the gravel.	**Present Seasonally.** This species spawns within the main stem of the Sacramento River. Adults and juveniles must pass through the Project Area in route to and from the Pacific Ocean. This species would be considered seasonally present.	See section 4.2 for further discussion of this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
Coho salmon - central CA coast ESU ***Oncorhynchus kisutch***	FE, SE	Federal listing includes populations between Punta Gorda and San Lorenzo River. State listing includes populations south of San Francisco Bay only. Occurs inland and in coastal marine waters. Requires beds of loose, silt-free, coarse gravel for spawning. Also needs cover, cool water, and sufficient dissolved oxygen.	**No Potential.** This species is considered extirpated from San Francisco Bay and its tributaries (NMFS 2012).	No further action is necessary for this species.
Delta smelt ***Hypomesus transpacificus***	FT, SE	Lives in the Sacramento-San Joaquin estuary in areas where salt and freshwater systems meet. Occurs seasonally in Suisun Bay, Carquinez Strait and San Pablo Bay. Seldom found at salinities > 10 ppt; most often at salinities < 2 ppt.	**Present Year Round.** This species has been documented to occur within Suisun Bay less than a mile from the proposed Project Area (CDFW 2023d,e). The Project Area is also within the core sections of this species home range which are restricted to the Sacramento Delta, as such the species is considered present year-round.	*See Section 4.2 for further discussion of this species.*
green sturgeon, southern Distinct Population Segment ***Acipenser medirostris***	FT, SSC	Spawn in the Sacramento River and the Feather River. Spawn at temperatures between 8-14 degrees C. Preferred spawning substrate is large cobble but can range from clean sand to bedrock.	**Present Year Round**. The Project Area is at the terminus of the Sacramento River, where green sturgeon are known to spawn. This species is also known to rear within the greater San Francisco Bay region year-round. As such, the species would be considered present year-round.	*See Section 4.2 for further discussion of this species.*
longfin smelt ***Spirinchus thaleichthys***	FE, SE	Euryhaline, nektonic and anadromous. Found in open waters of estuaries, mostly in middle or bottom of water column. Prefer salinities of 15 to 30 ppt but can be found in completely freshwater to almost pure seawater.	**Present Year Round.** This species has been documented to occur within the vicinity of the Project Area which is also located within the species core habitat range (CDFW 2023d,e). This species would be considered present year-round.	*See Section 4.2 for further discussion of this species.*
Pacific lamprey ***Entosphenus* (*Lampetra*) *tridentatus***	SSC	Spawns between March and July in gravel bottomed streams in riffle habitat. Larvae drift downstream to areas of low velocity and fine substrates and are relatively immobile in the stream substrates.	**Present Seasonally.** This species is known to spawn and rear within tributaries of the Sacramento and San Joaquin Rivers. As such adults and juveniles must migrate through the Project Area when moving to and from spawning streams and would be considered seasonally present.	*See Section 4.2 for further discussion of this species.*

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
river lamprey ***Lampetra ayresi***	SSC	Lower Sacramento River, San Joaquin River and Russian River. May occur in coastal streams north of San Francisco Bay. Adults need clean, gravelly riffles, Ammocoetes need sandy backwaters or stream edges, good water quality and temps < 25 degrees C.	**Present Seasonally.** This species is known to spawn and rear within tributaries of the Sacramento and San Joaquin Rivers. As such adults and juveniles must migrate through the Project Area when moving to and from spawning streams and would be considered seasonally present.	*See Section 4.2 for further discussion of this species.*
Sacramento perch ***Archoplites interruptus***	SSC	(Only within native range) Historically found in the sloughs, slow-moving rivers, and lakes of the Central Valley. Prefer warm water. Aquatic vegetation is essential for young. Tolerate wide range of physio-chemical water conditions.	**Unlikely**. This species is known to occur within sloughs and slow backwater areas. The Project Area is comprised of swift waters of the Sacramento River. Such areas are too turbulent for the species.	No further action is necessary for this species.
Sacramento splittail ***Pogonichthys macrolepidotus***	SSC	Formerly endemic to the lakes and rivers of the Central Valley, but now confined to the Sacramento Delta, Suisun Bay, and associated marshes. Occurs in slow-moving river sections and dead-end sloughs. Requires flooded vegetation for spawning and foraging for young. A freshwater species, but tolerant of moderate salinity (10-18 parts per thousand).	**Present Year Round.** This species has a high potential to occur within the sloughs and marshes of Winter Island that is adjacent to the Project Area. As a result, the species could be found within the Project Area year-round.	*See Section 4.2 for further discussion of this species.*
steelhead - central CA coast DPS ***Oncorhynchus mykiss irideus***	FT	Occurs from the Russian River south to Soquel Creek and Pajaro River, also in San Francisco and San Pablo Bay Basins. Adults migrate upstream to spawn in cool, clear, well-oxygenated streams. Juveniles remain in fresh water for 1 or more years before migrating downstream to the ocean.	**No Potential.** This population segment is designated within watersheds that extend as far inland as the Carquinez Bridge, approximately 20 miles west of the Project Area. Any steelhead present are therefore likely to be Central Valley DPS, not Central California Coast DPS.	No further action is necessary for this species.

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
steelhead - central valley DPS ***Oncorhynchus mykiss irideus***	FT, SSC	Includes all naturally spawned populations (and their progeny) in the Sacramento and San Joaquin Rivers and their tributaries, excluding San Francisco and San Pablo bays and their tributaries. Preferred spawning habitat is in cool to cold perennial streams with high dissolved oxygen levels and fast flowing water. Abundant riffle areas for spawning and deeper pools with sufficient riparian cover for rearing are necessary for successful breeding.	**Present Seasonally.** This species is known to spawn and rear within tributaries of the Sacramento and San Joaquin Rivers. As such adults and juveniles must migrate through the Project Area when moving to and from spawning streams and would be considered seasonally present.	*See Section 4.2 for further discussion of this species.*
western brook lamprey ***Lampetra richardsoni***	SSC	Found in large coastal rivers and their tributaries. Ammocoetes, are typically found in slackwater areas or pools where they burrow into soft substrate. Larval stage lasts 2-4 years in California. Spawning takes place in riffles in the early spring	**Present Seasonally.** This species is known to spawn and rear within tributaries of the Sacramento and San Joaquin Rivers. As such adults and juveniles must migrate through the Project Area when moving to and from spawning streams and would be considered seasonally present.	*See Section 4.2 for further discussion of this species.*
white sturgeon ***Acipenser transmontanus***	SCT, SSC	Found in most estuaries along the Pacific coast. Adults in the San Francisco Bay Estuary system spawn in the Sacramento River and are not known to enter freshwater or non-tidal reaches of Estuary streams. Spawn May through June.	**Present Year Round.** This species is known to spawn and rear within the main stems of the Sacramento and San Joaquin Rivers as well as major river tributaries such as the Feather. Adults and juveniles also rear within these rivers year-round. Within the lower portion of the Sacramento River and into Suisun Bay, juveniles and adults may forage year round.	*See Section 4.2 for further discussion of this species.*
CRITICAL HABITAT				
Chinook salmon – Sacramento winter-run Evolutionary Significant Unit	Critical Habitat	Critical habitat for this species was designated under FR 58 FR 33212.	**Present.** Critical Habitat for this species is present within aquatic portions of the Project Area up to the high tide line.	*See Section 4.3.1 for further discussion of this specific habitat.*
Steelhead - Central Valley DPS	Critical Habitat	Critical habitat for this species was designated under 70 FR 52629.	**Present.** Critical Habitat for this species is present within aquatic portions of the Project Area up to the high tide line.	*See Section 4.3.1 for further discussion of this specific habitat.*
Delta smelt	Critical Habitat	Critical habitat for this species was designated under 59 FR 65256.	**Present.** Critical Habitat for this species is present within aquatic portions of the Project Area up to the high tide line.	*See Section 4.3.1 for further discussion of this specific habitat.*

SCIENTIFIC NAME	STATUS[1]	HABITAT	POTENTIAL FOR OCCURRENCE	RECOMMENDATIONS
green sturgeon, southern Distinct Population Segment	Critical Habitat	Critical habitat for this species was designated under 74 FR 52300.	**Present.** Critical habitat for this species is present within aquatic portions of the Project Area up to the high tide line.	*See Section 4.3.1 for further discussion of this specific habitat.*
ESSENTIAL FISH HABITAT				
Coastal Pelagic	Essential Fish Habitat	Essential Fisheries Habitat is designated under the Coastal Pelagic Species Fishery Management Plan (PFMC 2019)	**Present.** Essential fish habitat governed under this fisheries management plan is present within aquatic portions of the Project Area.	*See Section 4.3.2 for further discussion of this specific habitat.*
Groundfish	Essential Fish Habitat	Essential Fisheries Habitat is designated under the Groundfish Fisheries Management Plan (PFMC 2022a)	**Present.** Essential fish habitat governed under this fisheries management plan is present within aquatic portions of the Project Area.	*See Section 4.3.2 for further discussion of this specific habitat.*
Salmon	Essential Fish Habitat	Essential Fisheries Habitat is designated under the Salmonid Fishery Management Plan (PFMC 2022b)	**Present.** Essential fish habitat governed under this fisheries management plan is present within aquatic portions of the Project Area.	*See Section 4.3.2 for further discussion of this specific habitat.*

Key to Abbreviations:
FE: Federal Endangered
FT: Federal Threatened
SCT: State Candidate - Threatened
SE: State Endangered
ST: State Threatened
SSC: CDFW Species of Special Concern

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APPENDIX C. PILE DRIVING CALCULATIONS

IMPACT PILE DRIVING

VERSION 1.1-Multi-Species: 2022

KEY

	User Provided Information *Default values are in bold, italics turquoise (can be changed by user if project-specific information is available*
	Preset NMFS Provided Information (cannot be altered by user). **NMFS thresholds/default weighting value are in bold red.**
	OUTPUT: Resultant Isopleth/range to effects (cannot be altered by user); Note: isopleths are presented in meters and feet
	Automatically Calculated Values Based on User Provided Information (only weighting adjustment (-dB) can be altered by user, Row 67, if spectrum is available)

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE and CONTACT	Collinsville Substation Proejct, Pile Driving Calculations.
PROJECT/SOURCE INFORMATION (size, material, number, pile strikes, etc.)	36-Inch Steel Shell Pile. Referenced WETA Maintenance Facility, Vallejo, Data used for non-attenuated pile, reduced by 10dB for bubble curtain. Assumed 1,000 strikes per pile, two piles per day for maximum effect.

Notes (Please include all assumptions)

Bubble curtain is used and effective at reducing sound pressure by 10 dB.

STEP 2: QUANTITATIVE PROJECT-SPECIFIC INFORMATION

METRICS

	Peak	SELss	RMS		WEIGHTING (WFA in kHz)	
Unattenuated Single strike level (dB)(see Proxy Level Tab for surrogate values; Copy, ONLY Paste Values (123), not formulas)	210	183	193	**Effective Quiet (Fish Only)**	**Sea Turtle Default WFA (kHz)**	**Marine Mammal Default WFA (kHz)**
Attenuated Single strike level (dB)* (calculation done automatically)	**200**	**173**	**183**	**150**	**0.16**	**2**
					WFA: Weighting Factor Adjustment	
Distance associated with single strike level/Measurement distance from pile (meters); Typically, 10-m but please double check data being used	*10*	*10*	*10*			
Transmission loss constant (NMFS recommends: 15 if unknown)	*15*					
Number of piles per day (best estimate based on previous experience)	2	**Attenuation assumed (e.g., bubble curtain) (enter positive number)**	10			
Number of strikes per pile (best estimate based on previous experience)	1000		NMFS recommends 5 dB as default, If attenuation used			
Number of strikes per day	2000					
Cumulative SEL at measured distance	206					

RESULTANT ISOPLETHS†

(Range to Effects)

†Impulsive sounds have dual metric thresholds for injury (SEL_{cum} & PK).

Metric producing largest isopleth should be used.

FISHES

	ONSET OF	PHYSICAL	INJURY	BEHAVIOR
	Peak (PK) Threshold (dB)	SEL_{cum} Threshold (dB)**		RMS Threshold (dB)
		Fish ≥ 2 g	Fish < 2 g	
	206	187	183	150
Isopleths (meters)	**4.0**	**185.1**	**341.5**	**1,584.9**
Isopleth (feet)	13.1	607.2	1,120.3	5,199.8

**This calculation accounts for single strike SEL < 150 dB do not accumulate to cause injury (Effective Quiet)

SEA TURTLES

	PTS ONSET		BEHAVIOR
	Peak (PK) Threshold (dB)	SEL_{cum} Threshold (dB)	RMS Threshold (dB)
	232	204	175
Isopleths (meters)	**0.1**	**13.6**	**34.1**
Isopleth (feet)	0.2	44.7	112.0

MARINE MAMMALS

			PTS ONSET		
Hearing Group	LF Cetacean PTS Peak (PK) Threshold (dB)	MF Cetacean Peak (PK) Threshold (dB)	HF Cetacean PTS Peak (PK) Threshold (dB)	PW Pinniped PTS Peak (PK) Threshold (dB)	OW Pinniped PTS Peak (PK) Threshold (dB)
	219	230	202	218	232
Isopleths (meters)	**0.5**	**0.1**	**7.4**	**0.6**	**0.1**
Isopleth (feet)	1.8	0.3	24.1	2.1	0.2
	LF Cetacean PTS SEL_{cum} Threshold (dB)	MF Cetacean PTS SEL_{cum} Threshold (dB)	HF Cetacean PTS SEL_{cum} Threshold (dB)	PW Pinniped PTS SEL_{cum} Threshold (dB)	OW Pinniped PTS SEL_{cum} Threshold (dB)
	183	185	155	185	203
Isopleths (meters)	**341.5**	**12.1**	**406.8**	**182.8**	**13.3**
Isopleth (feet)	1,120.5	39.9	1,334.7	599.6	43.7

ALL MARINE MAMMALS	BEHAVIOR
	RMS Threshold (dB)
	160
Isopleths (meters)	**341.5**
Isopleth (feet)	1,120.3

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger & L. australis*
Phocid pinnipeds (PW):true seals
Otariid pinnipeds (OW):sea lions and fur seals

WEIGHTING FUNCTION CALCULATIONS (Sea Turtles and Marine Mammals Only)

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds	Sea Turtles
a	1	1.6	1.8	1	2	1.4
b	2	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94	0.077
f_2	19	110	140	30	25	0.44
C	0.13	1.2	1.36	0.75	0.64	2.35
Adjustment (-dB)†	-0.01	-19.74	-26.87	-2.08	-1.15	0.00

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

IMPACT PILE DRIVING

VERSION 1.1-Multi-Species: 2022

KEY

	User Provided Information *Default values are in bold, italics turquoise (can be changed by user if project-specific information is available).*
	Preset NMFS Provided Information (cannot be altered by user). NMFS thresholds/default weighting value are in bold red.
	OUTPUT: Resultant Isopleth/range to effects (cannot be altered by user); Note: isopleths are presented in meters and feet
	Automatically Calculated Values Based on User Provided Information (only weighting adjustment (-dB) can be altered by user, Row 67, if spectrum is available)

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE and CONTACT	Collinsville Substation Proejct, Pile Driving Calculations.
PROJECT/SOURCE INFORMATION (size, material, number, pile strikes, etc.)	Steelsheetpile. Referenced Napa River Flood Control Proejct, Data used for non-attenuated piles. In-water Pile Calculations

Notes (Please include all assumptions)

Assumed 100 strikes per pile, 20 piles in a day for maximum effect (2,000 strikes per day).

STEP 2: QUANTITATIVE PROJECT-SPECIFIC INFORMATION

	METRICS				WEIGHTING (WFA in kHz)	
	Peak	**SELss**	**RMS**			
Unattenuated Single strike level (dB)(see Proxy Level Tab for surrogate values; Copy, ONLY Paste Values (123), not formulas)	209	166	175	**Effective Quiet (Fish Only)**	**Sea Turtle Default WFA (kHz)**	**Marine Mammal Default WFA (kHz)**
Attenuated Single strike level (dB)* (calculation done automatically)	**209**	**166**	**175**	**150**	**0.16**	**2**
Distance associated with single strike level/Measurement distance from pile (meters); Typically, 10-m but please double check data being used	*10*	*10*	*10*		WFA: Weighting Factor Adjustment	
Transmission loss constant (NMFS recommends: 15 if unknown)	*15*					
Number of piles per day (best estimate based on previous experience)	20	**Attenuation assumed (e.g., bubble curtain) (enter positive number)**				
Number of strikes per pile (best estimate based on previous experience)	100		NMFS recommends 5 dB as default, If attenuation used			
Number of strikes per day	2000					
Cumulative SEL at measured distance	199					

RESULTANT ISOPLETHS‡ (Range to Effects)

‡Impulsive sounds have dual metric thresholds for injury (SEL_{cum} & PK). Metric producing largest isopleth should be used.

FISHES

	ONSET OF	PHYSICAL	INJURY	BEHAVIOR
	Peak (PK) Threshold (dB)	SEL_{cum} Threshold (dB)**		RMS Threshold (dB)
		Fish ≥ 2 g	Fish < 2 g	
	206	187	183	150
Isopleths (meters)	15.8	63.2	116.6	464.2
Isopleth (feet)	52.0	207.3	382.5	1,522.8

**This calculation accounts for single strike SEL < 150 dB do not accumulate to cause injury (Effective Quiet)

SEA TURTLES

	PTS ONSET		BEHAVIOR
	Peak (PK) Threshold (dB)	SEL_{cum} Threshold (dB)	RMS Threshold (dB)
	232	204	175
Isopleths (meters)	0.3	4.7	10.0
Isopleth (feet)	1.0	15.3	32.8

MARINE MAMMALS

	PTS ONSET				
Hearing Group	LF Cetacean PTS Peak (PK) Threshold (dB)	MF Cetacean Peak (PK) Threshold (dB)	HF Cetacean PTS Peak (PK) Threshold (dB)	PW Pinniped PTS Peak (PK) Threshold (dB)	OW Pinniped PTS Peak (PK) Threshold (dB)
	219	230	202	218	232
Isopleths (meters)	2.2	0.4	29.3	2.5	0.3
Isopleth (feet)	7.1	1.3	96.1	8.2	1.0
	LF Cetacean PTS SEL_{cum} Threshold (dB)	MF Cetacean PTS SEL_{cum} Threshold (dB)	HF Cetacean PTS SEL_{cum} Threshold (dB)	PW Pinniped PTS SEL_{cum} Threshold (dB)	OW Pinniped PTS SEL_{cum} Threshold (dB)
	183	185	155	185	203
Isopleths (meters)	116.6	4.1	138.9	62.4	4.5
Isopleth (feet)	382.6	13.6	455.7	204.7	14.9

ALL MARINE MAMMALS	BEHAVIOR
	RMS Threshold (dB)
	160
Isopleths (meters)	100.0
Isopleth (feet)	328.1

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*
Phocid pinnipeds (PW):true seals
Otariid pinnipeds (OW):sea lions and fur seals

WEIGHTING FUNCTION CALCULATIONS (Sea Turtles and Marine Mammals Only)

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds	Sea Turtles
a	1	1.6	1.8	1	2	1.4
b	2	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94	0.077
f_2	19	110	140	30	25	0.44
C	0.13	1.2	1.36	0.75	0.64	2.35
Adjustment (-dB)†	-0.01	-19.74	-26.87	-2.08	-1.15	0.00

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

IMPACT PILE DRIVING

VERSION 1.1-Multi-Species: 2022

KEY

	User Provided Information *Default values are in bold, italics turquoise (can be changed by user if project-specific information is available).*
	Preset NMFS Provided Information (cannot be altered by user). NMFS thresholds/default weighting value are in bold red.
	OUTPUT: Resultant Isopleth/range to effects (cannot be altered by user); Note: isopleths are presented in meters and feet
	Automatically Calculated Values Based on User Provided Information (only weighting adjustment (-dB) can be altered by user, Row 67, if spectrum is available)

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE and CONTACT	Collinsville Substation Proejct, Pile Driving Calculations.
PROJECT/SOURCE INFORMATION (size, material, number, pile strikes, etc.)	Steelsheetpile. Referenced Napa River Flood Control Proejct, Data used for non-attenuated piles. Assumed 100 strikes per pile, 20 piles in a day for maximum effect. On Land Calculation

Notes (Please include all assumptions)

Assumed 100 strikes per pile, 20 piles in a day for maximum effect. Assume 10-db reduction for piles driven on land.

STEP 2: QUANTITATIVE PROJECT-SPECIFIC INFORMATION

	Peak	SELss	RMS		WEIGHTING (WFA in kHz)	
	METRICS					
Unattenuated Single strike level (dB)(see Proxy Level Tab for surrogate values; Copy, ONLY Paste Values (123), not formulas)	209	166	175	**Effective Quiet (Fish Only)**	**Sea Turtle Default WFA (kHz)**	**Marine Mammal Default WFA (kHz)**
Attenuated Single strike level (dB)* (calculation done automatically)	**199**	**156**	**165**	**150**	**0.16**	**2**
Distance associated with single strike level/Measurement distance from pile (meters); Typically, 10-m but please double check data being used	*10*	*10*	*10*		WFA: Weighting Factor Adjustment	
Transmission loss constant (NMFS recommends: 15 if unknown)	*15*					
Number of piles per day (best estimate based on previous experience)	20	**Attenuation assumed (e.g., bubble curtain) (enter positive number)**	10			
Number of strikes per pile (best estimate based on previous experience)	100		NMFS recommends 5 dB as default, If attenuation used			
Number of strikes per day	2000					
Cumulative SEL at measured distance	189					

RESULTANT ISOPLETHS[‡] (Range to Effects)

[‡]Impulsive sounds have dual metric thresholds for injury (SEL_{cum} & PK). Metric producing largest isopleth should be used.

FISHES

	ONSET OF	PHYSICAL	INJURY	BEHAVIOR
	Peak (PK) Threshold (dB)	SEL_{cum} Threshold (dB)**		RMS Threshold (dB)
		Fish ≥ 2 g	Fish < 2 g	
	206	187	183	150
Isopleths (meters)	3.4	13.6	25.1	100.0
Isopleth (feet)	11.2	44.7	82.4	328.1

**This calculation accounts for single strike SEL < 150 dB do not accumulate to cause injury (Effective Quiet)

SEA TURTLES

	PTS ONSET		BEHAVIOR
	Peak (PK) Threshold (dB)	SEL_{cum} Threshold (dB)	RMS Threshold (dB)
	232	204	175
Isopleths (meters)	0.1	1.0	2.2
Isopleth (feet)	0.2	3.3	7.1

MARINE MAMMALS

	PTS ONSET				
Hearing Group	LF Cetacean PTS Peak (PK) Threshold (dB)	MF Cetacean Peak (PK) Threshold (dB)	HF Cetacean PTS Peak (PK) Threshold (dB)	PW Pinniped PTS Peak (PK) Threshold (dB)	OW Pinniped PTS Peak (PK) Threshold (dB)
	219	230	202	218	232
Isopleths (meters)	0.5	0.1	6.3	0.5	0.1
Isopleth (feet)	1.5	0.3	20.7	1.8	0.2
	LF Cetacean PTS SEL_{cum} Threshold (dB)	MF Cetacean PTS SEL_{cum} Threshold (dB)	HF Cetacean PTS SEL_{cum} Threshold (dB)	PW Pinniped PTS SEL_{cum} Threshold (dB)	OW Pinniped PTS SEL_{cum} Threshold (dB)
	183	185	155	185	203
Isopleths (meters)	25.1	0.9	29.9	13.4	1.0
Isopleth (feet)	82.4	2.9	98.2	44.1	3.2

ALL MARINE MAMMALS	BEHAVIOR
	RMS Threshold (dB)
	160
Isopleths (meters)	21.5
Isopleth (feet)	70.7

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*
Phocid pinnipeds (PW):true seals
Otariid pinnipeds (OW):sea lions and fur seals

WEIGHTING FUNCTION CALCULATIONS (Sea Turtles and Marine Mammals Only)

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds	Sea Turtles
a	1	1.6	1.8	1	2	1.4
b	2	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94	0.077
f_2	19	110	140	30	25	0.44
C	0.13	1.2	1.36	0.75	0.64	2.35
Adjustment (-dB)†	-0.01	-19.74	-26.87	-2.08	-1.15	0.00

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\}$$

Vibratory Pile Driving

VERSION 1.1-Multi-Species: 2022

KEY

	User Provided Information *Default values are in bold, italics turquoise (can be changed by user if project-specific information is available*
	Preset NMFS Provided Information (cannot be altered by user). NMFS thresholds/default weighting value are in bold red.
	OUTPUT: Resultant Isopleth/Range to Effects (cannot be altered by user); Note: isopleths are presented in meters and feet
	Automatically Calculated Values Based on User Provided Information (only weighting adjustment (-dB) can be altered by user; Row 64, if spectrum is available)

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE and CONTACT	Collinsville Substation Proejct, Pile Driving Calculations.
PROJECT/SOURCE INFORMATION (size, material, number, duration to drive pile, etc.)	36-inch steel shell pile. Caltrans 2020, WETA Downtaown Ferry Terminal, San francisco Ca.

Notes (please include all assumptions)

STEP 2: QUANTITATIVE PROJECT-SPECIFIC INFORMATION

1 sec SEL = RMS	METRIC: RMS (NOT Peak)	WEIGHTING (WFA in kHz)	
Unattenuated Sound Pressure Level (dB) (see Proxy Level Tab for surrogate values; Copy, ONLY Paste Values (123), not formulas)	159	**Sea Turtle Default WFA (kHz)**	**Marine Mammal Default WFA (kHz)**
Attenuated Sound Pressure Level (dB)* (calculation done automatically)	**159**	**0.16**	**2.5**
Distance associated with sound pressure level measurement/Measurement distance from pile (meters); Typically, 10-m but please double check data being used	*1*		
Transmission loss constant (NMFS recommends: 15 if unknown)	*15*		
Number of piles per day (best estimate based on previous experience)	1	**Attenuation (e.g., bubble curtain) (enter positive number)**	0
Duration to drive a single pile (minutes) (best estimate based on previous experience)	480		
Duration of Sound Production within a day (seconds)	28800	**Cumulative SEL at measured distance (dB)**	203.59
10 Log (duration of sound production)	44.59		

*If sound pressure level provided includes attenuation methods (e.g., bubble curtain), please note this in Project/Source Information in Step 1

RESULTANT ISOPLETHS

(Range to Effects)

For vibratory pile driving, only behavioral thresholds exist for fishes

	FISHES
	BEHAVIOR
	RMS Threshold (dB)
	150
Isopleth (meters)	**4.0**
Isopleth (feet)	**13.1**

	SEA TURTLES	
	PTS ONSET	**BEHAVIOR**
	PTS SEL_{cum} Threshold (dB)	**RMS Threshold (dB)**
	220	**175**
Isopleth (meters)	**0.1**	**0.1**
Isopleth (feet)	**0.3**	**0.3**

	MARINE MAMMALS				
			PTS ONSET		
Hearing Group	**LF Cetacean PTS SEL_{cum} Threshold (dB)**	**MF Cetacean PTS SEL_{cum} Threshold (dB)**	**HF Cetacean PTS SEL_{cum} Threshold (dB)**	**PW Pinniped PTS SEL_{cum} Threshold (dB)**	**OW Pinniped PTS SEL_{cum} Threshold (dB)**
	199	**198**	**173**	**201**	**219**
Isopleth (meters)	**2.0**	**0.2**	**3.0**	**1.2**	**0.1**
Isopleth (feet)	**6.6**	**0.6**	**9.7**	**4.0**	**0.3**

ALL MARINE MAMMALS	**BEHAVIOR**
	RMS Threshold (dB)
	120
Isopleth (meters)	**398.1**
Isopleth (feet)	**1,306.1**

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*
Phocid pinnipeds (PW):true seals
Otariid pinnipeds (OW):sea lions and fur seals

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds	Sea Turtles
a	1	1.6	1.8	1	2	1.4
b	2	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94	0.077
f_2	19	110	140	30	25	0.44
C	0.13	1.2	1.36	0.75	0.64	2.35
Adjustment (-dB)†	-0.05	-16.83	-23.50	-1.29	-0.60	0.00

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^a}\right\}$$

Vibratory Pile Driving

VERSION 1.1-Multi-Species: 2022

KEY

	User Provided Information *Default values are in bold, italics turquoise (can be changed by user if project-specific information is available*
	Preset NMFS Provided Information (cannot be altered by user). NMFS thresholds/default weighting value are in bold red.
	OUTPUT: Resultant Isopleth/Range to Effects (cannot be altered by user); Note: isopleths are presented in meters and feet
	Automatically Calculated Values Based on User Provided Information (only weighting adjustment (-dB) can be altered by user; Row 64, if spectrum is available)

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE and CONTACT	Collinsville Substation Proejct, Pile Driving Calculations.
PROJECT/SOURCE INFORMATION (size, material, number, duration to drive pile, etc.)	Steel sheetpile. Caltrans 2020, Berth 23, Port of Oakland.

Notes **(please include all assumptions)**

No attenuation included.

STEP 2: QUANTITATIVE PROJECT-SPECIFIC INFORMATION

1 sec SEL = RMS	METRIC: RMS (NOT Peak)	WEIGHTING (WFA in kHz): Sea Turtle Default WFA (kHz)	Marine Mammal Default WFA (kHz)
Unattenuated Sound Pressure Level (dB) (see Proxy Level Tab for surrogate values; Copy, ONLY Paste Values (123), not formulas)	163		
Attenuated Sound Pressure Level (dB)* (calculation done automatically)	**163**	**0.16**	**2.5**
Distance associated with sound pressure level measurement/Measurement distance from pile (meters); Typically, 10-m but please double check data being used	*1*		
Transmission loss constant (NMFS recommends: 15 if unknown)	*15*		
Number of piles per day (best estimate based on previous experience)	1	**Attenuation (e.g., bubble curtain) (enter positive number)**	0
Duration to drive a single pile (minutes) (best estimate based on previous experience)	480		
Duration of Sound Production within a day (seconds)	28800	**Cumulative SEL at measured distance (dB)**	207.59
10 Log (duration of sound production)	44.59		

*If sound pressure level provided includes attenuation methods (e.g., bubble curtain), please note this in Project/Source Information in Step 1

RESULTANT ISOPLETHS

(Range to Effects)

For vibratory pile driving, only behavioral thresholds exist for fishes

	FISHES
	BEHAVIOR
	RMS Threshold (dB)
	150
Isopleth (meters)	**7.4**
Isopleth (feet)	**24.1**

	SEA TURTLES	
	PTS ONSET	**BEHAVIOR**
	PTS SEL_{cum} Threshold (dB)	**RMS Threshold (dB)**
	220	**175**
Isopleth (meters)	**0.1**	**0.2**
Isopleth (feet)	**0.5**	**0.5**

	MARINE MAMMALS				
			PTS ONSET		
Hearing Group	**LF Cetacean PTS SEL_{cum} Threshold (dB)**	**MF Cetacean PTS SEL_{cum} Threshold (dB)**	**HF Cetacean PTS SEL_{cum} Threshold (dB)**	**PW Pinniped PTS SEL_{cum} Threshold (dB)**	**OW Pinniped PTS SEL_{cum} Threshold (dB)**
	199	**198**	**173**	**201**	**219**
Isopleth (meters)	**3.7**	**0.3**	**5.5**	**2.3**	**0.2**
Isopleth (feet)	**12.2**	**1.1**	**18.0**	**7.4**	**0.5**

ALL MARINE MAMMALS	BEHAVIOR
	RMS Threshold (dB)
	120
Isopleth (meters)	**735.6**
Isopleth (feet)	**2,413.5**

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*
Phocid pinnipeds (PW):true seals
Otariid pinnipeds (OW):sea lions and fur seals

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds	Sea Turtles
a	1	1.6	1.8	1	2	1.4
b	2	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94	0.077
f_2	19	110	140	30	25	0.44
C	0.13	1.2	1.36	0.75	0.64	2.35
Adjustment (-dB)†	-0.05	-16.83	-23.50	-1.29	-0.60	0.00

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^a}\right\}$$

Vibratory Pile Driving

VERSION 1.1-Multi-Species: 2022

KEY

	User Provided Information *Default values are in bold, italics turquoise (can be changed by user if project-specific information is available*
	Preset NMFS Provided Information (cannot be altered by user). NMFS thresholds/default weighting value are in bold red.
	OUTPUT: Resultant Isopleth/Range to Effects (cannot be altered by user); Note: isopleths are presented in meters and feet
	Automatically Calculated Values Based on User Provided Information (only weighting adjustment (-dB) can be altered by user; Row 64, if spectrum is available)

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE and CONTACT	Collinsville Substation Proejct, Pile Driving Calculations.
PROJECT/SOURCE INFORMATION (size, material, number, duration to drive pile, etc.)	Steel sheetpile (on land). Caltrans 2020, Berth 23, Port of Oakland.

Notes (please include all assumptions)

Data for sheetpiles in water modeled for driving on land. Used 10 db recommended reduction per Caltrans 2020.

STEP 2: QUANTITATIVE PROJECT-SPECIFIC INFORMATION

1 sec SEL = RMS	METRIC: RMS (NOT Peak)	WEIGHTING (WFA in kHz)	
Unattenuated Sound Pressure Level (dB) (see Proxy Level Tab for surrogate values; Copy, ONLY Paste Values (123), not formulas)	163	**Sea Turtle Default WFA (kHz)**	**Marine Mammal Default WFA (kHz)**
Attenuated Sound Pressure Level (dB)* (calculation done automatically)	**153**	**0.16**	**2.5**
Distance associated with sound pressure level measurement/Measurement distance from pile (meters); Typically, 10-m but please double check data being used	*1*		
Transmission loss constant (NMFS recommends: 15 if unknown)	*15*		
Number of piles per day (best estimate based on previous experience)	1	**Attenuation (e.g., bubble curtain) (enter positive number)**	10
Duration to drive a single pile (minutes) (best estimate based on previous experience)	480		
Duration of Sound Production within a day (seconds)	28800	**Cumulative SEL at measured distance (dB)**	197.59
10 Log (duration of sound production)	44.59		

*If sound pressure level provided includes attenuation methods (e.g., bubble curtain), please note this in Project/Source Information in Step 1

RESULTANT ISOPLETHS

(Range to Effects)

For vibratory pile driving, only behavioral thresholds exist for fishes

FISHES	
	BEHAVIOR
	RMS Threshold (dB)
	150
Isopleth (meters)	**1.6**
Isopleth (feet)	**5.2**

SEA TURTLES		
	PTS ONSET	**BEHAVIOR**
	PTS SEL_{cum} Threshold (dB)	**RMS Threshold (dB)**
	220	**175**
Isopleth (meters)	**0.0**	**0.0**
Isopleth (feet)	**0.1**	**0.1**

MARINE MAMMALS					
			PTS ONSET		
Hearing Group	**LF Cetacean PTS SEL_{cum} Threshold (dB)**	**MF Cetacean PTS SEL_{cum} Threshold (dB)**	**HF Cetacean PTS SEL_{cum} Threshold (dB)**	**PW Pinniped PTS SEL_{cum} Threshold (dB)**	**OW Pinniped PTS SEL_{cum} Threshold (dB)**
	199	**198**	**173**	**201**	**219**
Isopleth (meters)	**0.8**	**0.1**	**1.2**	**0.5**	**0.0**
Isopleth (feet)	**2.6**	**0.2**	**3.9**	**1.6**	**0.1**

ALL MARINE MAMMALS	BEHAVIOR
	RMS Threshold (dB)
	120
Isopleth (meters)	**158.5**
Isopleth (feet)	**520.0**

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*
Phocid pinnipeds (PW):true seals
Otariid pinnipeds (OW):sea lions and fur seals

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds	Sea Turtles
a	1	1.6	1.8	1	2	1.4
b	2	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94	0.077
f_2	19	110	140	30	25	0.44
C	0.13	1.2	1.36	0.75	0.64	2.35
Adjustment (-dB)†	-0.05	-16.83	-23.50	-1.29	-0.60	0.00

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^a}\right\}$$

Vibratory Pile Driving

VERSION 1.1-Multi-Species: 2022

KEY

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	OUTPUT: Resultant Isopleth/Range to Effects (cannot be altered by user); Note: isopleths are presented in meters and feet
	Automatically Calculated Values Based on User Provided Information (only weighting adjustment (-dB) can be altered by user; Row 64, if spectrum is available)

STEP 1: GENERAL PROJECT INFORMATION

PROJECT TITLE and CONTACT	Collinsville Substation Proejct, Pile Driving Calculations.
PROJECT/SOURCE INFORMATION (size, material, number, duration to drive pile, etc.)	Steel H piles. Caltrans 2020, Cheveron Long Wharf/Richmond, CA

Notes (please include all assumptions)

STEP 2: QUANTITATIVE PROJECT-SPECIFIC INFORMATION

1 sec SEL = RMS	METRIC: RMS (NOT Peak)	WEIGHTING (WFA in kHz)	
Unattenuated Sound Pressure Level (dB) (see Proxy Level Tab for surrogate values; Copy, ONLY Paste Values (123), not formulas)	150	**Sea Turtle Default WFA (kHz)**	**Marine Mammal Default WFA (kHz)**
Attenuated Sound Pressure Level (dB)* (calculation done automatically)	**150**	**0.16**	**2.5**
Distance associated with sound pressure level measurement/Measurement distance from pile (meters); Typically, 10-m but please double check data being used	*1*		
Transmission loss constant (NMFS recommends: 15 if unknown)	*15*		
Number of piles per day (best estimate based on previous experience)	1	**Attenuation (e.g., bubble curtain) (enter positive number)**	
Duration to drive a single pile (minutes) (best estimate based on previous experience)	480		
Duration of Sound Production within a day (seconds)	28800	**Cumulative SEL at measured distance (dB)**	194.59
10 Log (duration of sound production)	44.59		

*If sound pressure level provided includes attenuation methods (e.g., bubble curtain), please note this in Project/Source Information in Step 1

RESULTANT ISOPLETHS

(Range to Effects)

For vibratory pile driving, only behavioral thresholds exist for fishes

FISHES	
	BEHAVIOR
	RMS Threshold (dB)
	150
Isopleth (meters)	**1.0**
Isopleth (feet)	**3.3**

SEA TURTLES		
	PTS ONSET	**BEHAVIOR**
	PTS SEL_{cum} Threshold (dB)	**RMS Threshold (dB)**
	220	**175**
Isopleth (meters)	**0.0**	**0.0**
Isopleth (feet)	**0.1**	**0.1**

MARINE MAMMALS					
			PTS ONSET		
Hearing Group	**LF Cetacean PTS SEL_{cum} Threshold (dB)**	**MF Cetacean PTS SEL_{cum} Threshold (dB)**	**HF Cetacean PTS SEL_{cum} Threshold (dB)**	**PW Pinniped PTS SEL_{cum} Threshold (dB)**	**OW Pinniped PTS SEL_{cum} Threshold (dB)**
	199	**198**	**173**	**201**	**219**
Isopleth (meters)	**0.5**	**0.0**	**0.7**	**0.3**	**0.0**
Isopleth (feet)	**1.7**	**0.1**	**2.4**	**1.0**	**0.1**

ALL MARINE MAMMALS	BEHAVIOR
	RMS Threshold (dB)
	120
Isopleth (meters)	**100.0**
Isopleth (feet)	**328.1**

Marine Mammal Hearing Group
Low-frequency (LF) cetaceans: baleen whales
Mid-frequency (MF) cetaceans: dolphins, toothed whales, beaked whales, bottlenose whales
High-frequency (HF) cetaceans: true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*
Phocid pinnipeds (PW):true seals
Otariid pinnipeds (OW):sea lions and fur seals

WEIGHTING FUNCTION CALCULATIONS

Weighting Function Parameters	Low-Frequency Cetaceans	Mid-Frequency Cetaceans	High-Frequency Cetaceans	Phocid Pinnipeds	Otariid Pinnipeds	Sea Turtles
a	1	1.6	1.8	1	2	1.4
b	2	2	2	2	2	2
f_1	0.2	8.8	12	1.9	0.94	0.077
f_2	19	110	140	30	25	0.44
C	0.13	1.2	1.36	0.75	0.64	2.35
Adjustment (-dB)†	-0.05	-16.83	-23.50	-1.29	-0.60	0.00

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^a}\right\}$$

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