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

Refer to NMFS No: WCRO-2021-01050

September 3, 2021

Ryan T. Larson, P.E.
Chief, Levees and Channels Branch
Sacramento District
U.S. Army Corps of Engineers
Department of the Army
1325 J Street
Sacramento, California 95814-2922

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the City of Lathrop Outfall Installation Project [408 Permission Section (19535)]

Electronic transmittal only

Dear Mr. Larson:

Thank you for your letter of March 9, 2021, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the City of Lathrop Outfall Installation Project (Project). This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

The enclosed biological opinion, based on the biological assessment, and best available scientific and commercial information, concludes that the project is not likely to jeopardize the continued existence of the federally listed threatened Central Valley (CV) spring-run Chinook salmon (*Oncorhynchus tshawytscha*) Evolutionarily Significant Unit (ESU), the threatened California Central Valley (CCV) steelhead (*O. mykiss*) Distinct Population Segment (DPS), and the threatened Southern DPS of the North American green sturgeon (*Acipenser medirostris*). NMFS has also concluded that the Project is not likely to destroy or adversely modify the designated critical habitats for CCV steelhead, and sDPS green sturgeon that occur within the action area. NMFS has included an incidental take statement with reasonable and prudent measures, terms, and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of listed species associated with the Project.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA, 16 U.S.C. 1855(b)) for this action. The EFH consultation concludes that the proposed action would adversely affect the EFH of Pacific salmon in the action area. This letter also transmits NMFS' EFH conservation recommendations for Pacific salmon as required by the

MSA as amended (16 U.S.C. 1801 *et seq.*). The EFH consultation adopts the ESA reasonable and prudent measures and associated terms and conditions from the biological opinion and includes additional conservation recommendations specific to the adverse effects to Pacific salmon EFH in the action area as described in Amendment 18 of the Pacific Coast Salmon Plan.

The USACE has a statutory requirement under section 305(b)(4)(B) of the MSA to submit a detailed written response to NMFS within 30 days of receipt of these conservation recommendations, and 10 days in advance of any action, that includes a description of measures adopted by the USACE for avoiding, minimizing, or mitigating the impact of the Project on EFH (50 CFR 600.920(j)). If unable to complete a final response within 30 days, the USACE should provide an interim written response within 30 days before submitting its final response. In the case of a response that is inconsistent with our recommendations, the USACE must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the City of Lathrop Outfall Installation Project and the measures needed to avoid, minimize, or mitigate such effects.
Please contact Jeffrey Stuart in NMFS' West Coast Region, California Central Valley Office at (916) 930-3607 or via email at J.Stuart@noaa.gov if you have any questions concerning this section 7 consultation, or if you require additional information.

Sincerely,

A. Catherine Marcinkevage

Cathy Marcinkevage
Assistant Regional Administrator for
California Central Valley Office

Enclosure

cc: To the File ARN 151422-WCR2021-SA00066
Brian Luke, Natural Resources Specialist Brian.J.Luke@usace.army.mil
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Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion [and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response]

City of Lathrop Outfall Installation Project

NMFS Consultation Number: WCRO-2021-01050

Action Agency: United States Army Corps of Engineers

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
California Central Valley steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	Yes	No
Central Valley Spring-run Chinook salmon (*O. tshawytscha*)	Threatened	Yes	No	NA	NA
Southern Distinct Population Segment of North American Green Sturgeon (*Acipenser medirostris*)	Threatened	Yes	No	Yes	No

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

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

Issued By: A. Catherine Marcinkevage

Cathy Marcinkevage, PhD.

Assistant Regional Administrator for California Central Valley Office

Date: September 3, 2021

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1. INTRODUCTION

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

1.1. Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.), and implementing regulations at 50 CFR 402, as amended.

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

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the California Central Valley Office.

1.2. Consultation History

The list below summarizes correspondence, meetings, and discussions between regulatory agencies, the City of Lathrop (the applicant), and Robertson-Bryan Incorporated (RBI) (consultants for the applicant) that relate to potential effects of the City of Lathrop Outfall Installation Project (Project) on species addressed in this document.

3/9/2021 Letter from the United States Army Corps of Engineers (USACE) transmitting the Biological Assessment (BA) (RBI, 2020) and requesting informal consultation with NMFS for the Project and concurrence that the Project was "not likely to adversely affect" the federally listed endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) evolutionarily significant unit (ESU), threatened Central Valley (CV) spring-run Chinook salmon (*O. tshawytscha*) ESU, threatened California CV (CCV) steelhead distinct population segment (DPS) (*O. mykiss*), and the threatened southern DPS (sDPS) of North American green sturgeon (*Acipenser medirostris*). The USACE also determined that the proposed Project may affect, but is not likely to adversely affect designated critical habitat for CCV steelhead and sDPS green sturgeon which occurs in the action area. The USACE did not make any determination regarding the EFH of Pacific salmon under section 305(b)(2) of the MSA.

3/25/2021 NMFS requested additional information related to the Project description and construction activities, including the installation of the cofferdam, the number and type of sheet piles to be used, fish relocation actions, erosion control materials to be used, as well as details regarding the long term monitoring of effluent constituents, application of mitigation measures, and frequency of effluent discharge. Information needed in order to determine whether or not the USACE's determination that the Project was "not likely to adversely affect" listed species or their designated critical habitat, was appropriate, and whether the EFH for Pacific Coast Salmon may be adversely affected under the MSA. NMFS requested in its communication that additional information be provided to proceed with the consultation.

4/15/2021 NMFS received a response from the USACE including an addendum to the BA (RBI 2021a) that contained the additional information requested, as well as additional engineering drawings for the Project.

4/29/2021 NMFS indicated that it did not agree with their determination of "not likely to adversely affect". NMFS however, concluded that there was sufficient information contained in the BA and supplementary information to initiate formal consultation and recommended that the USACE request formal consultation for this Project.

4/30/2021 NMFS received the USACE's request for formal consultation for the City of Lathrop Outfall Installation Project. The USACE determined that the Project as proposed would adversely affect CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon and the designated critical habitat for CCV steelhead and sDPS green sturgeon. In addition, the USACE determined that the Project would adversely affect EFH for Pacific Coast salmon.

5/11/21 NMFS sent a letter to the USACE acknowledging receipt of the request for formal consultation for the Project and that there was sufficient information contained in the BA and supplementary information to initiate formal consultation with the USACE on this Project. NMFS informed the USACE that a biological opinion was initiated on April 30, 2021, and would be completed on or before September 12, 2021.

7/14/2021 Email communication between NMFS and the USACE to discuss their authorities regarding potential Term and Conditions for the formal consultation.

7/21/2021 NMFS received a second addendum from RBI (RBI 2021b) clarifying additional conservation measures for the Project.

8/11/21 NMFS sent a draft Incidental Take Statement and Terms and Conditions to the USACE for review regarding their authorities.

8/20/21 USACE confirmed that the Terms and Conditions met the USACE's authorities.

1.3. Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). Under the MSA, a Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

1.3.1. Federal Authorities

The City of Lathrop Public Works Department, through the Central Valley Flood Protection Board, has requested Section 408 permission under Section 14 of the Rivers and Harbors Act of 1899 [33 U.S.C. 408; (Section 408)] from the USACE to conduct work on a federally constructed levee. The work will include installation of a 20-inch-diameter discharge pipe up and over the right (east) bank levee of the San Joaquin River, construction of a concrete outfall structure below the water line, and to place erosion protection on the bank both above and below the ordinary high water line. The City of Lathrop Public Works Department is also seeking USACE authorization under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act for the discharge of dredged or fill material and any modification to a navigable water associated with the construction of the proposed Project. The proposed action for USACE is to make a combined permit decision on the Project under the authority of a Clean Water Act Section 404 (33 USC 1344) permit and a Section 10 and 14 of the Rivers and Harbors Act of 1899 (33 USC 403 and 408) permit for placement of fill into jurisdictional waters of the United States and encroachment upon a Federal levee.

1.3.2. Project Location

The Project is located at approximately river mile (RM) 55.8 of the San Joaquin River, which is approximately 0.7 miles downstream of the I-5 bridge crossing over the river. The new side-bank outfall structure will be constructed on the eastern bank (right side looking downstream) of the San Joaquin River at latitude 37.79513°, longitude -121.30695°, within the City of Lathrop, San Joaquin County, California (Figure 1).

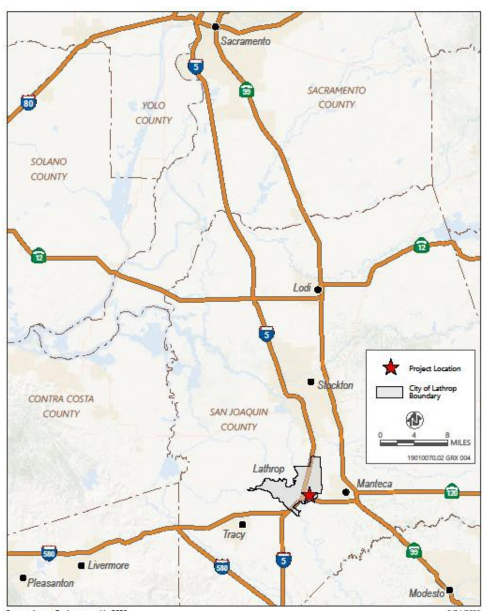


Figure 1: Regional map showing the location of the Project. (From RBI 2020)

1.3.3. Project Purpose and Objectives

The purpose of the proposed project is to provide the capability to directly discharge tertiary treated effluent from the consolidated treatment facility (CTF), which has been disinfected and dechlorinated, to the San Joaquin River when generation of treated CTF effluent exceeds the capacity of the City of Lathrop's recycled water system to store and reuse treated effluent for landscape irrigation. The discharge of treated effluent to the river is necessary to allow the City of Lathrop (also referred to as "City" in this document) to accommodate CTF flows that will be generated at full City buildout under the Lathrop General Plan. Currently, the City of Lathrop treated effluent is stored in above ground-lined ponds and used for public landscape and agricultural irrigation in the City or disposed of in a percolation basin. This present land disposal system provides about 666 million gallons (MG) per year of disposal capacity, or approximately 1.69 million gallons per day (mgd) based on average dry weather flow (ADWF). The Lathrop General Plan designates most of the agricultural land application areas (LAAs) and all but two of the storage ponds (which will still provide 129 MG of effluent storage), for commercial, residential, or urban development. Retaining this land for effluent storage and disposal would prevent development of the properties in accordance with the general plan land use designations. Moreover, the planned and approved influent ADWF rate at buildout in the CTF service area is projected to be 5.2 mgd. At buildout, effluent production at the CTF during the low-irrigation/non-irrigation months of October through April is projected to exceed the City's available land-based effluent storage, reuse, and disposal capacity (RBI 2020).

The Project has the following objectives based on the information in the BA (RBI 2020):

- Provide for planned City buildout and development based on the City's General Plan by providing effluent discharge to the San Joaquin River.
- Provide efficient and cost-effective wastewater services through buildout of the City.
- Maximize use of recycled water in the City presently and in the future.

1.3.4. Construction Actions Relate to the Project Elements

The construction of the outfall and cofferdam are described in various documents provided by the City of Lathrop including the BA (RBI 2020), two addendums to the BA (RBI 2021a,b), as well as the draft environmental impact report (DEIR) (Ascent 2020) and final EIR (Ascent 2021) for the Project.

1.3.4.1. Levee Pipeline Crossing

The Project will install approximately 250 linear feet (LF) of new 20-inch welded steel pressurized pipe connecting to an already existing pipeline routed along an existing road outside of the levee footprint to the east, to a new side-bank concrete outfall structure located on the waterside of the existing levee to the west (Figure 2). The new pipe will be trenched through the existing levee, generally following the levee contour.

The excavated trench will extend from the landside toe of the levee to the waterside outfall location. Before any construction on the waterside of the levee can occur, a sheet pile cofferdam will be erected using vibratory pile driving, and the area inside the cofferdam will be dewatered to provide a dry work area. Prior to complete dewatering, any entrapped fish will be captured and relocated to the adjacent river. After the work area is dewatered, a trench on the waterside of the levee will be excavated and the discharge pipe will be installed. Finally, the discharge pipe will be encased in concrete to resist uplift pressures and then backfilled with a minimum 2 feet of soil cover. The levee crown would also be reinforced with an 8-inch-thick concrete pad on its surface to prevent potential damage to the pipeline in the future from trucks or heavy equipment traveling along the levee crown. A portion of the pipe will be placed within an existing seepage berm on the dry side of the levee. The seepage berm will be reconstructed as necessary, consisting of replacement of filter material, drain rock, filter fabric and backfilled soil. Fill will also be placed along the dry side of the levee to grade a new asphalt pedestrian path (Figure 3).

Figure 2: Pipeline Route from the CTF to the river outfall (From RBI 2020)

An assortment of heavy construction equipment will be utilized to excavate the trenches, haul fill to and away from the construction site, bring concrete to the site, and prepare and grade the soils. These pieces of equipment include front loaders, dump trucks, concrete trucks, utility trucks, graders, water tank trucks, and soil compactors. Additional pieces of construction equipment such as trailers, welding machines, and cranes are also anticipated to be on site during construction.

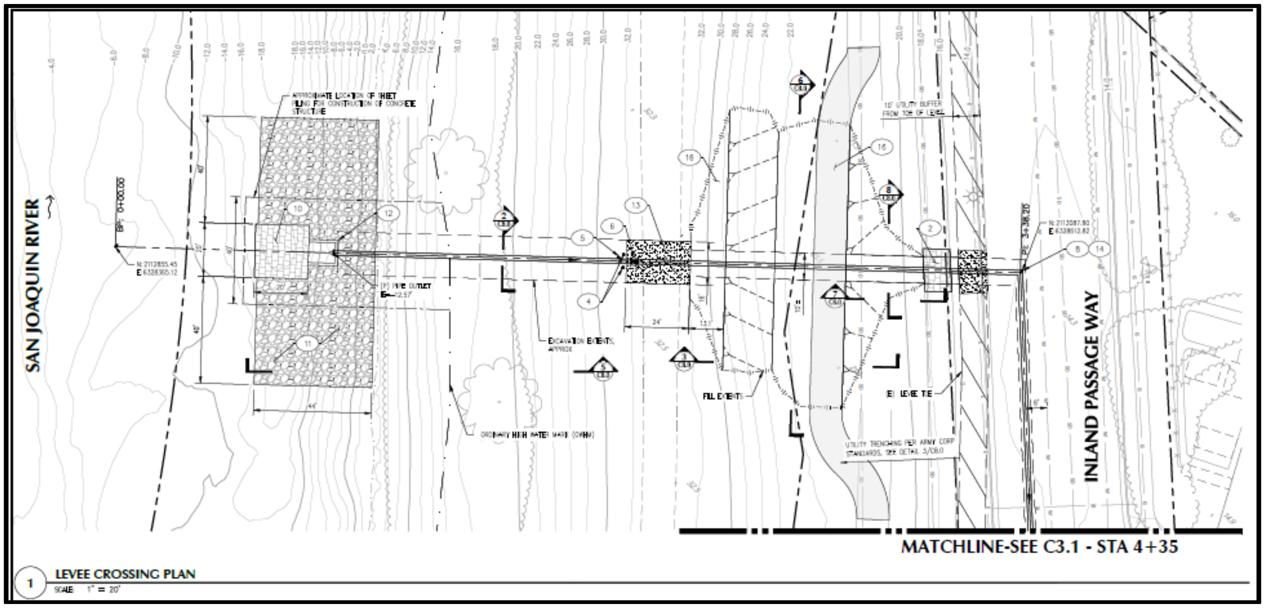


Figure 3: Plan view of pipeline crossing of the levee and outfall placement on the waterside of levee (From RBI 2020).

1.3.4.2. Outfall Construction

To install the headwall and outfall structure, a base course will be placed below the outfall location, and formwork with rebar reinforcement will be installed. Concrete would then be pumped into the formwork from concrete trucks on the landside of the levee. The end of the pipe will be connected to the new headwall structure and fitted with a check valve (e.g., duckbill valve) to further prevent backflow of river water into the pipe when the pipe is not discharging. The approximate dimensions of the outfall structure are a 9 foot by 10-foot base floor with a 9-foot tall headwall at the back. The wing walls slope down at an angle, following the approximate grade of the levee waterside slope. The outfall base floor is anchored into the levee face/ channel bottom with concrete foundation walls (Figure 4).

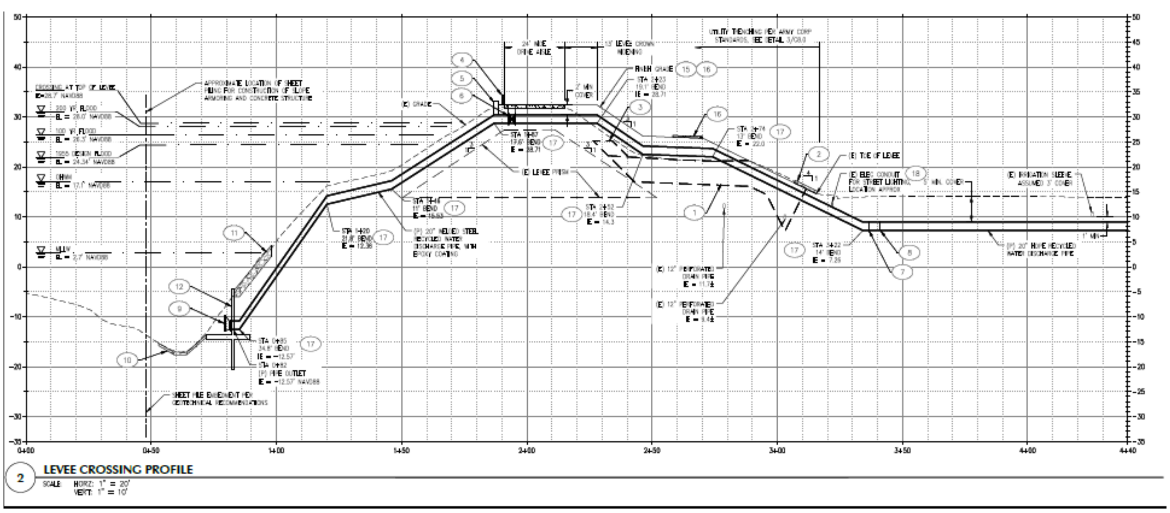


Figure 4: Profile view of levee crossing and outfall location in the river (From RBI 2020).

1.3.4.3. Articulated Concrete Block Mat Construction

Articulated concrete block mats will be installed along the river bottom below and approximately 10 feet upstream and downstream of the outfall and staked into the ground. The articulated mats are comprised of interlocking concrete blocks measuring approximately 17.5-inches x 15.5-inches, and 8.5 inches thick, connected together by a series of cables (Figure 5). The blocks are dry cast concrete with an average compressive strength of 4,000 PSI, weighing approximately 113 lbs per block. Each block contains open areas comprising approximately 20 percent of the block area. The interlocking mats will cover approximately 400 square feet (20 feet by 20 feet) of channel bottom along the thalweg of the San Joaquin River.

Placement of articulated concrete block mats will be done inside the cofferdam area. Installation consists of preparing the subgrade to conform to the elevations shown on the project construction documents (Figure 6). Grades will be compacted and shaped to facilitate the development of good contact between the articulated concrete block revetment system and grade. Subgrade will be raked, screeded, or rolled by hand or machine to achieve a smooth compacted surface free of loose material, rocks, and organic materials.

A geotextile fabric will be placed directly on top of the prepared subgrade. Fabric will be placed by hand along the surface, overlaid so that the upstream strips of fabric overlap the downstream strips. Strips will be overlapped a minimum of 3 feet when below the normal water surface. The geotextile fabric will be secured using anchoring pins or 11-gauge U-staples placed by hand.

Articulated concrete block mats will be moved into place by attaching a spreader bar onto large, interlocking mattresses and placed using a crane located on the dry side of the levee. Mats will be placed starting at the upstream end, with special care taken to avoid damage to the geotextile fabric. Blocks are designed to adhere to the surface by gravity alone, but are anchored at the top and bottom of the work area with termination trenches. Termination trenches consist of burying two block units a minimum of 2-feet deep and backfilling beneath concrete or grout poured into the open trench, cementing the blocks in place.

Mats are secured together with cables and the seams between mats filled with grout or concrete. After the mats have been placed, voids within the blocks will be backfilled with a mixture of rock and soil using a loader and compacted using hand-held equipment. These construction techniques are intended to prevent scour and fish entrapment because there will not be any gaps between mats or blocks that could create voids for fish to hold in or irregularities in the surface that could cause a concentration of flow velocities that foster scour to occur.

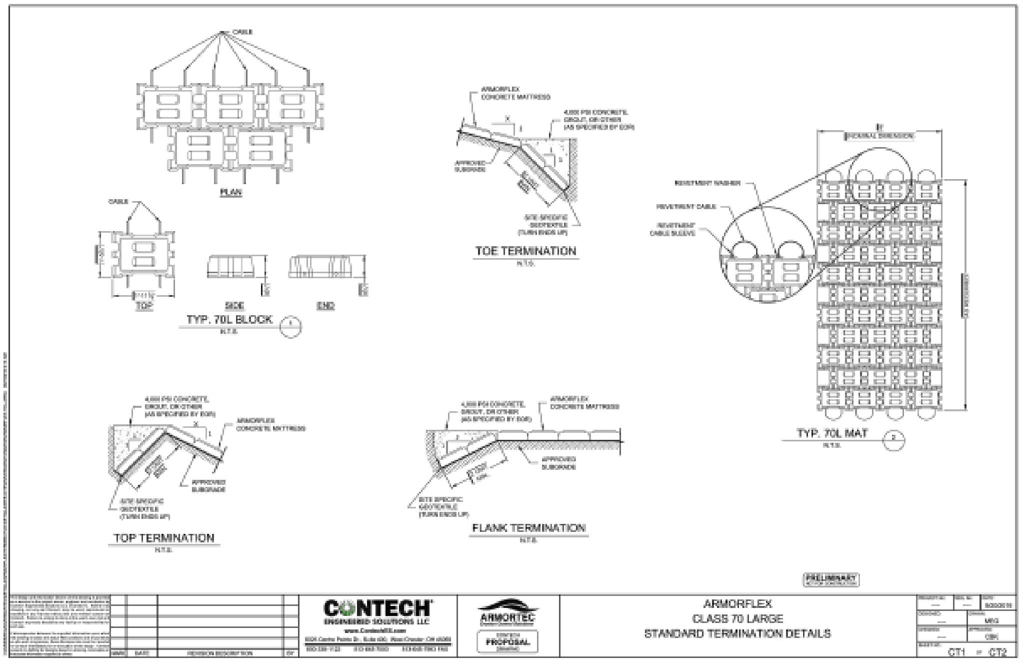


Figure 5: Detail of concrete mat for erosion protection (from RBI 2021a).

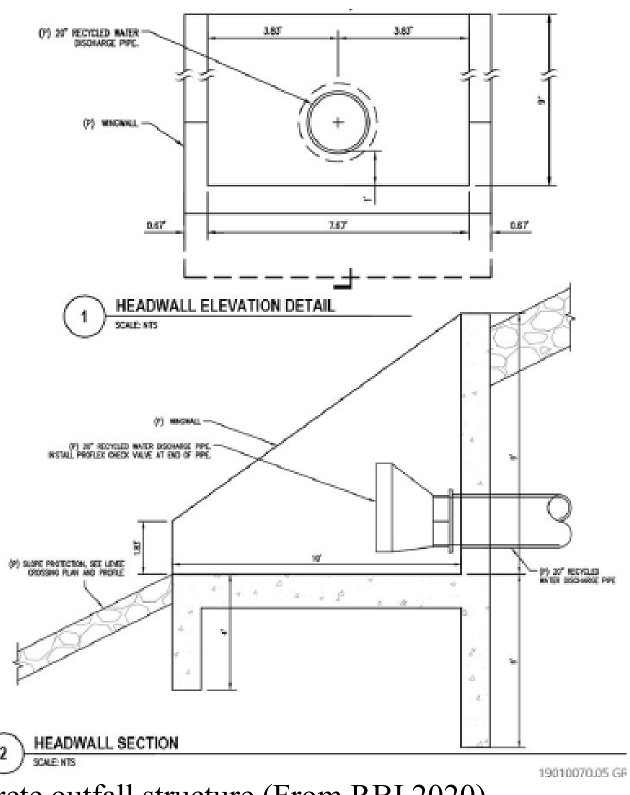


Figure 6: Detail of concrete outfall structure (From RBI 2020).

1.3.4.4. Rip Rap Slope Protection

The remaining riverbank above and below the outfall structure up to approximately 50 feet upstream and downstream of the outfall will be stabilized with 24-inch-minus riprap to a depth of 24-inches. Voids within the riprap slope will be filled with 10-inch-minus cobble and stones. The riprap will be placed from the channel invert up to an approximate elevation of 1.5 feet above mean lower low water (MLLW: 2.7 feet above sea level), encompassing approximately 44 feet of bank slope. The riprap will occupy a total footprint of approximately 4,400 square feet, and an approximate volume of 344 cubic yards. Riprap will be transported by truck to the site, where it will be placed by bucket load or clamshell from on top of the levee. Prior to placement, minimal clearing and grubbing will occur in the vicinity of the outfall to remove brush, stumps or other debris and materials to prepare the site for riprap placement.

1.3.4.5. Sheet Pile Cofferdam

Sheet piles are typically interlocking steel sheets that are about 2 feet wide and have a flattened "Z" shape. They come in multiple lengths. They are commonly used to construct walls and cofferdams in aquatic environments. These piles usually are installed using a vibratory driver/extractor. The edges of each sheet pile have an interlocking tongue and groove design so that sequential sheet piles can be driven forming a solid structure with a high degree of rigidity and strength.

The temporary cofferdam will be approximately 40 ft. long, parallel to the riverbank, and approximately 90 feet wide, perpendicular to the riverbank for a total linear length of 220 feet (Figure 3). The width of the San Joaquin River at the location of the cofferdam is approximately 270 feet, with the deepest portion of the channel occupied by the cofferdam. The cofferdam will be comprised of steel sheet pile "pairs" measuring approximately 4 feet wide and up to 18 inches deep in plain view. The top of the sheet piles will be just above the OHWM elevation. Steel sheet piles will be driven up to approximately 40 feet below the riverbed using a vibratory hammer connected to a track mounted crane that will be operated from the levee crown. Sheet piles will be placed sequentially from upstream to downstream. Interlock sealant, such as sawdust, will be applied to sheet pile joints to keep them watertight. Approximately 55 pairs of sheets (110 individual sheet piles) will be installed, with an anticipated production rate of 7 to 8 pairs (14 to 16 individual piles) per day, for a total of 6 to 7 days of driving. Sheets will be installed with a vibratory hammer, with a drive time of about 30 minutes per sheet pile pair.

Several rows of horizontal waler beams and horizontal internal bracing will be installed to help reduce the overall sheet pile size and embedment depth required. A few of the braces may need to connect to temporary vertical pipe piles. The Project description indicates that up to five (5) additional 30-inch diameter steel pipe piles, with 50 feet of embedment, may need to be installed inside the cofferdam to support the internal cofferdam bracing and waler beams. Installation of the piles will occur while the enclosed area behind the cofferdam is still flooded. These piles may be driven with an impact hammer and will take up to an hour each to install. If an impact hammer is required, a bubble curtain technique to push high-pressure air through the water column will be implemented to provide sound attenuation.

Once the sheets are fully installed, the water inside the cofferdam will be pumped down in phases and internal bracing installed as the water is being drawn down. Submersible pumps fitted with screens to prevent entrainment of fishes will be placed inside the cofferdam to dewater the area and create a dry work space. Water remaining inside the cofferdam will be pumped back over the levee into temporary ponds or Baker tanks on the landside of the levee for settling, and then the supernatant (clarified river water overlying material that has settled out) will be discharged to the river or pumped into the City storm drain system depending on water quality requirements. Fish relocation will occur once the water level has been sufficiently drawn down within the enclosed cofferdam area to allow this action. The cofferdam is expected to be in place for approximately 6 weeks out of the 8 weeks allotted for outfall construction during the in-water construction window of July 1 through October 31.

Once the outfall work inside the cofferdam is complete, water will be pumped back into the cofferdam at a controlled rate and the rows of internal bracing and associated vertical pipe piles will be removed in phases as the water level rises and eventually equalizes with the external river level. Pipe piles and sheet piles will be removed with a vibratory hammer. Pipe piles will be removed as the water level is increasing in the cofferdam and will be removed in one day. Sheet piles will be removed once the water level inside the cofferdam is level with the outside river level. Sheet piles will be removed at the rate of 8 to 10 pairs per day, for a total of 5 to 6 days to complete the work. All cofferdam work and construction within the dewatered area will occur over an 8-week period during the in-water construction window between July 1 and October 31.

1.3.5. Long Term Operations

Following completion of the proposed Project, the City of Lathrop would use the newly automated CTF system to control the effluent discharge to the river and maximize reuse by using the recycled water distribution system (Figure 7). In summer during peak demand for recycled water, chlorinated effluent would flow by gravity to Pond S5 and be used to supply the recycled water system. In late summer or early fall, when the pond level set points will be lowered to winter settings because of the decreased demands for recycled water, the Crossroads Pump Station will be activated as needed to discharge dechlorinated effluent in excess of recycled water demand to the river. During winter, when CTF inflow generally exceeds irrigation demand and river water temperatures are lower, most of the effluent will be dechlorinated, held temporarily in Ponds A, B, and C, or a subset of these, as needed, to provide effluent cooling, and then discharged via the Crossroads Pump Station to the river through the new effluent discharge pipe network and outfall structure. In spring, when minimum pond level set points are raised to maximize recycled water storage and reuse, discharge of dechlorinated effluent to the river will be reduced, and chlorinated effluent will be directed from the chlorine contact basins to fill Pond S5 and other storage ponds in the recycled water system.

Effluent discharge during the fall through late spring period of the year will be continuous, although not at a constant level. Discharge rates will be lower in the fall months due to continued use of recycled water from the CTF. All or most of the effluent treated at the CTF will be discharged to the river during the winter and early spring months when use of recycled water is at or near zero. Then in mid- to late spring, discharge rates will again be reduced over that of winter levels as demand for recycled water increases for that time of year. CTF discharge will reach a seasonal low of < 0.5 mgd when recycled water demand is at its seasonal high, which occurs annually during July.

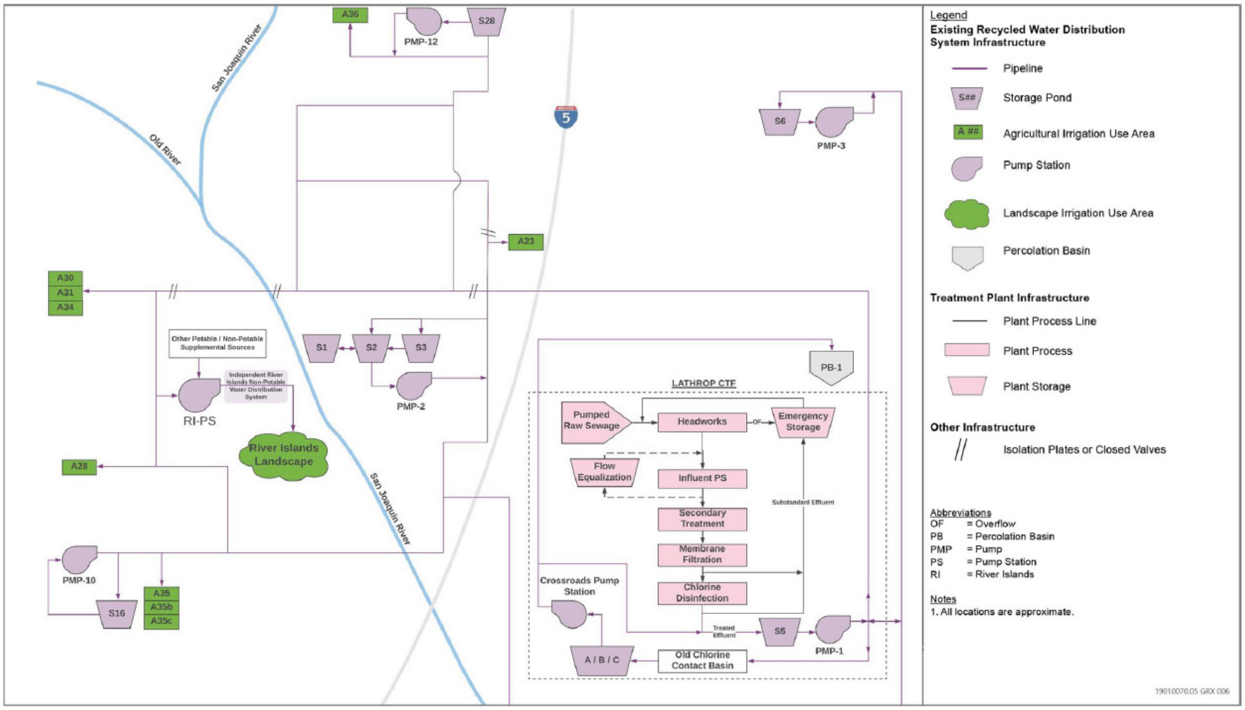


Figure 7: Current schematic of existing CTF and recycled water operations flow diagram (From RBI 2020).

Figure 8 depicts the seasonal discharge pattern from the CTF that will occur in both the near-term and the future. As shown, the CTF is expected to have continuous discharge, with discharges to the San Joaquin River approaching zero in July and being greatest during December and January. During the initial years of operation, it is possible for discharge to the San Joaquin River to be periodic during the summer months, if the demand for recycled water equals or exceeds the CTF production of treated wastewater.

The long-term post-construction monitoring of effluent constituents will consist of daily, weekly, and monthly monitoring of various constituents, as required by the Central Valley Regional Water Quality Control Board (Regional Board) issued National Pollutant Discharge Elimination System (NPDES) permit. Effluent constituents to be routinely monitored are expected to include pH, ammonia, turbidity and total suspended solids (TSS), electrical conductivity (EC), biochemical oxygen demand (BOD), coliform bacteria, chlorine, nitrate and nitrite, trihalomethanes (THMs), and mercury. This permit also will require weekly monitoring of receiving water temperature, dissolved oxygen, pH, and turbidity in the river, both upstream and downstream of the new outfall structure. Moreover, the NPDES permit will require routine whole effluent toxicity testing (WET testing), which will be required monthly. Finally, once during the 5-year term of the NPDES permit, the City will collect effluent data on all 125 U.S. EPA priority pollutants, as well as another 40-50 constituents. This effluent monitoring will occur over the course of one year, and is referred to by the Regional Board as an "effluent characterization study." During the effluent characterization study, most constituents are monitored monthly, others quarterly, and a few monitored once or twice during the year. This is standard practice for municipal NPDES permits in California. These data are then used to re-evaluate effluent quality upon permit renewal at 5-year intervals. As such, this large data collection effort occurs at approximately 5-year intervals.

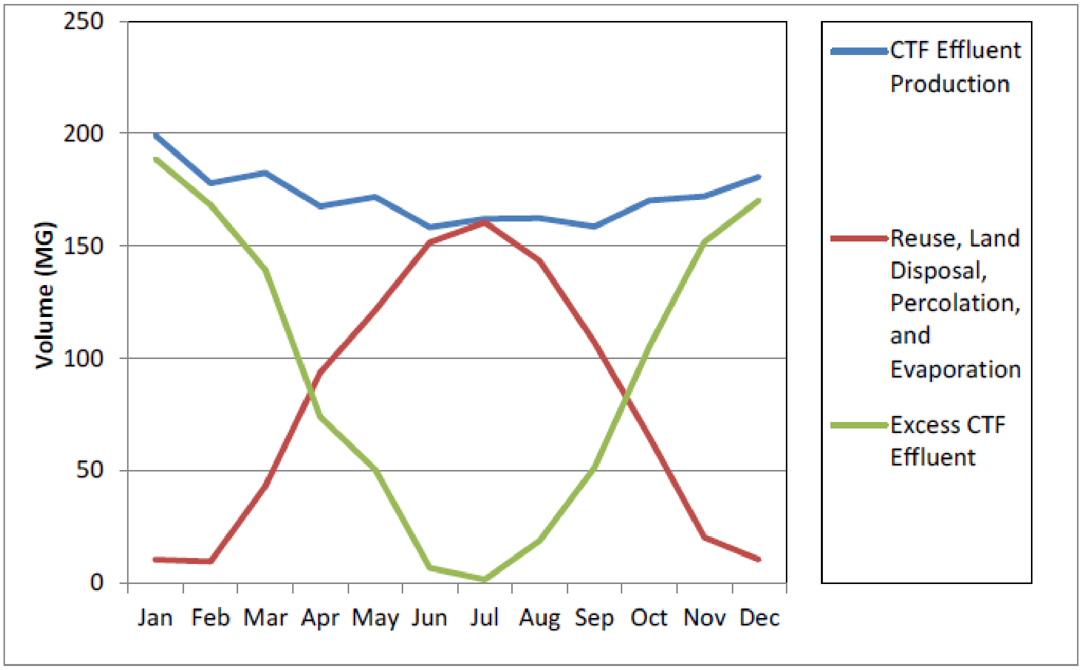


Figure 8: Monthly average Lathrop CTF effluent production at buildout and monthly average reuse, percolation, and evaporation for 620 acres of planned landscape irrigation area and 0 acres of agricultural land application area (From RBI 2021a).

1.3.6. Schedule of Construction for the Pipeline Levee Crossing and Outfall Installation

The City of Lathrop has stated that construction of the levee pipeline crossing and outfall structure will be conducted during the in-water construction window extending from July 1 through October 31. The installation of the cofferdam will take approximately 6 to 7 days, with removal requiring slightly less time (5 to 6 days). Work on the cofferdam will occur during the first and last week of the proposed construction schedule for the placement of the pipeline across the levee and constructing the outfall structure. Work on the levee pipeline crossing and construction of the outfall and channel armoring will occur after the cofferdam is dewatered and will take approximately 6 weeks to complete. The overall period of time for construction of the outfall and pipeline crossing of the levee, including installation and removal of the cofferdam is 8 weeks. Work on the construction of the outfall and pipeline crossing must commence by the first week of September to have sufficient time to complete the action by the end of October based on the proposed schedule. All construction actions will take place during the hours between 7 a.m. and 5 p.m. on weekdays. No work is anticipated to occur during nighttime hours or at any time on the weekends.

1.3.7. Conservation Measures

The following conservation measures (CM) have been incorporated into Project activities to reduce the potential for these activities to affect ESA-listed species or to result in the destruction or adverse modification of their critical habitats (RBI 2020). These CMs will mitigate potential environmental effects during construction.

1.3.7.1. Worker Training – CM1

All contractors and equipment operators will undergo Worker Environmental Awareness Program training to inform them of the ecological value of the site, including the potential for special status species and their habitats to be present near the Project site, and educate them on how to best avoid impacting ESA-listed fishes and avoiding the destruction or adverse modification of their critical habitats.

1.3.7.2. Erosion Control and Storm water Pollution Prevention – CM2

The City is implementing a stormwater pollution prevention plan (SWPPP) containing best management practices (BMPs) that the City and its contractors shall use to avoid and minimize potential adverse construction-related water quality effects. Construction designs and drawings, and contracts for construction activities refer to elements of the SWPPP. The SWPPP is included in the contractor contract specifications. Water quality, erosion, and sediment control measures are implemented in accordance with the SWPPP. The SWPPP also identifies responsibilities of construction contractors for implementation and inspection of BMPs, and training elements for the personnel responsible for installation and maintenance of the BMPs.

The SWPPP includes, as relevant, the following general categories of BMPs that have proven successful at reducing adverse water quality effects.

- Waste Management and Spill Prevention and Response: Waste management BMPs are designed to minimize exposure of waste materials at all construction sites and staging areas such as waste collection and disposal practices, containment and protection of wastes from wind and rain, and equipment cleaning measures. Spill prevention and response BMPs involve planning, equipment, and training for personnel for emergency event response.

- Erosion and Sedimentation Control: Erosion control BMPs are designed to prevent erosion processes or events including scheduling work to avoid rain events, stabilizing exposed soils; minimize offsite sediment runoff; remove sediment from onsite runoff before it leaves the site; and slow runoff rates across construction sites. Identification of appropriate temporary and long-term seeding, mulching, and other erosion control measures as necessary. Sedimentation BMPs are designed to minimize offsite sediment runoff once erosion has occurred involving drainage controls, perimeter controls, detention/sedimentation basins, or other containment features.

- Good Housekeeping and Non-Storm Water Discharge Management: Good housekeeping BMPs are designed to reduce exposure of construction sites and materials storage to storm water runoff, including truck tire tracking control facilities; equipment washing; litter and construction debris; and designated refueling and equipment inspection/ maintenance practices. Non-storm water discharge management BMPs involve runoff measures for contaminants not directly associated with rain or wind including vehicle washing and street cleaning operations.

- Construction Site Dewatering and Pipeline Testing: Dewatering BMPs involve actions to prevent discharge of contaminants present in dewatering of groundwater during construction, discharges of water from testing of pipelines or other facilities, or the indirect erosion that may be caused by dewatering discharges.

- BMP Inspection and Monitoring: Identification of clear objectives for evaluating compliance with SWPPP provisions, and specific BMP inspection and monitoring procedures, environmental awareness training, contractor and agency roles and responsibilities, reporting procedures, and communication protocols.

1.3.7.3. Hazards and Materials Safety – CM3

Project construction activities involve the use, storage, and transport of potentially hazardous products such as paints, solvents, glues, and cements. Petroleum hydrocarbon products such as gasoline, diesel, and lubricants are used in heavy equipment and construction vehicles. Standard accident and hazardous materials recovery training and procedures are enforced by the state and followed by private state-licensed, certified, and bonded transportation companies and contractors. Further, pursuant to 40 CFR 112, a spill prevention, containment, and countermeasures plan or, for smaller quantities, a spill prevention and response plan, that identifies BMPs for spill and release, and disposal of any spills or releases, has been established. As required under state and federal law, plans for notification and evacuation of site workers and local residents in the event of a hazardous materials release are in place and will continue to be throughout construction.

The Project also will conform to the specifications in the Project SWPPP to avoid spills and releases of hazardous materials and wastes. Inspections are conducted to verify consistent implementation of general construction permit conditions and BMPs are required to minimize the potential for spills and releases and help ensure the immediate cleanup and response thereto. BMPs include, for example, the designation of special storage areas and labeling, containment berms, coverage from rain, and concrete washout areas.

1.3.7.4. Fugitive Dust Control – CM4

The San Joaquin Valley Air Pollution Control District Regulation VIII (Fugitive Particulate Matter - 10 micron diameter [PM10] Prohibition) Rules 8011–8081 are designed to reduce PM10 emissions (predominantly dust and dirt) generated by human activity, including construction and demolition activities, road construction, bulk materials storage, paved and unpaved roads, carryout and track out, and landfill operations. Because compliance with Regulation VIII is mandatory, the Project proponent will reduce fugitive dust emissions. The construction contractor is required to comply with the following measures during specified phases of construction to reduce fugitive dust emissions.

- Apply water or a stabilizing agent to exposed surfaces in sufficient quantity and at adequate frequency to prevent generation of fugitive dust, but do not overwater to the extent that sediment flows off the site.

- Moisten or cover excavated soil piles to avoid fugitive dust emissions.

- Discontinue construction activities that generate substantial dust blowing on unpaved surfaces during windy conditions (i.e., when wind speeds exceed 20 miles per hour).

- Install and use a track out control device to remove bulk material from tires and vehicle undercarriages before vehicles exit the Project site.

- Remove any visible track out mud or dirt on public roads adjacent to the Project site.

- Cover or maintain at least two feet of freeboard space on dump trucks hauling soil, sand, or other loose materials. Any haul trucks that will be traveling on freeways or major roadways will be covered with tarps or other enclosures.

- Limit vehicle speeds on unpaved roads to 15 miles per hour.

- Clean up track out at least once a day. If located on a busy road or highway, clean up track out immediately.

The above dust control measures will control and minimize the transport of dust off the construction site and into the San Joaquin River.

1.3.7.5. Construction Site Cleanup – CM5

After completion of all construction activities, any temporary fill and construction debris will be removed, and wherever feasible, disturbed areas will be restored to pre-Project conditions. Restoration activities will include grading of disturbed areas to pre-Project contours and revegetation.

1.3.7.6. Cofferdam Area Fish Relocation – CM6

A fish relocation operation will be completed as water elevations within the enclosed cofferdam area reach low levels. Fish relocation will be completed by qualified biologists using dip and seine nets to remove any fish remaining within the cofferdam area. All fish relocated from inside the cofferdam will be placed in the San Joaquin River away from construction activities. Once the dewatered area has been deemed free of any entrapped fishes, the area will be completely dewatered using the submersible pumps. The fish relocation will be implemented as follows:

- First, upon the cofferdam area being enclosed, water will be pumped out of the enclosed area into tanks or a settling pond, with the hose intake being near the water surface. The intake of the hose will contain a screen that will prevent fish, including juvenile green sturgeon, from being entrained.

- Second, once water within the enclosed cofferdam area has been reduced to approximately 1-2 ft in depth, seining and dip-netting within the enclosed area will be performed by qualified biologists.

- Any captured fish will be put into 5-gallon buckets of river water and immediately placed back into the river on the down-current side of the cofferdam area.

- The remainder of the water will be pumped out of the enclosed area to the lowest level achievable. Finally, turbidity within the enclosed area will be allowed to settle-out and a fish biologist will conduct a visual inspection for any remaining fish prior to construction activities starting. Should pumping to remove water from the cofferdam area need to be performed periodically due to leakage, water removed from the enclosed area will be pumped into tanks or a settling pond.

1.3.7.7. Mitigation for Loss of Riparian and Riverine Habitat - CM7

In order to mitigate for anticipated, permanent losses of riparian forest and riverine perennial habitat associated with placement of the new outfall, the City will mitigate at a 3:1 ratio for perennial aquatic habitat and 1:1 for riparian habitat using on-site restoration of riparian habitat, restoration or enhancement of riparian habitat elsewhere on the river locally within the City's boundaries, purchase of mitigation credits at a USACE and NMFS-approved mitigation bank, or any combination thereof. The City of Lathrop will provide a cumulative total of 0.46 acres of mitigation; 0.30 acres of perennial aquatic habitat and 0.16 acres of riparian habitat due to impacts from the Project on habitat in the action area. NMFS-approved mitigation banks with service areas that include the proposed action area are the Bullock Bend Mitigation Bank, the Fremont Landing Conservation Bank, and the Liberty Island Conservation Bank.

The following additional conservation measures were added to the proposed Project description during discussions regarding the supplemental information requested by NMFS from the applicant (RBI 2021).

1.3.7.8. Preparation of a Pre-construction Report – CM8

This report will be prepared and issued to NMFS prior to the initiation of construction, and will address the following:

- Mapping of all riparian vegetation within the construction area and indicate type and amount of vegetation to be removed.

- Indicate whether there is emergent or submerged vegetation along the waterline and within the channel portion of the construction zone.

- Indicate any presence of woody debris within the construction area and whether it will be removed.

1.3.7.9. Prepare a Construction Report – CM9

This report will be prepared and issued to NMFS following the conclusion of construction, and will address the following:

- Map the location of erosion controls BMPs installed for the levee construction phase of the Project.

- Document daily cofferdam installation activities.

- Document daily cofferdam removal activities.

- Periodically monitor underwater noise during sheet pile installation and removal.

- Document turbidity monitoring results (also needed for Water Quality Certification).

1.3.7.10. Mitigation Plan – CM10

The City will provide NMFS a habitat mitigation plan prior to initiation of construction, which will address the following:

- Document area of aquatic habitat lost and riparian/shoreline habitat lost.

- Document proposed mitigation ratios for lost aquatic habitat and riparian/shoreline habitat.

- Identify whether mitigation will be in-place/in-kind or via mitigation credits, and if the latter, where credits are to be purchased.

1.3.7.11. Effluent Quality Monitoring and Reporting – CM11

The City will provide NMFS copies of the CTF effluent quality monitoring reports, which will include the following:

- Monthly NPDES permit self-monitoring reports filed with the Regional Water Board also will be sent to NMFS, or made available via the web, for the initial 2 years of discharge.

- Once during the 5-year term of the NPDES permit, the City will collect effluent data on all 125 U.S. EPA priority pollutants, as well as another 40-50 constituents. This effluent monitoring is required by the NPDES permit and is referred to by the Regional Water Board as an "effluent characterization study." This study will be conducted over the course of one year, with most constituents monitored monthly, some quarterly, and a few annually or bi-annually. Upon its completion, a copy of the effluent characterization study report will be provided to NMFS.

1.3.7.12. Acute Whole Effluent Toxicity Testing of CTF Effluent using Rainbow Trout as a Test Species - CM12

The City will conduct acute whole effluent toxicity (WET) testing using rainbow trout (*Oncorhynchus mykiss*) quarterly during the first year of discharge and quarterly during the first year under future NPDES permits that authorize increased discharge capacity beyond that authorized by the initial NPDES permit.

1.3.7.13. Biological Monitor - CM13

A biological monitor will be retained by the City to conduct activities as specified in the conservation measures in Addendum 1, dated April 15, 2021, and those specified below. The biological monitor will be knowledgeable of fish biology and ecology. At least 10 days prior to initiating Project activities, the City will submit to NMFS, in writing, the name(s) and resumes of all proposed biological monitors associated with the Project's conservation measures intended to protect listed fishes for which NMFS has jurisdiction. The biological monitor will ensure that all contractors understand the requirements of the Project's conservation measures and their importance to minimizing impacts to listed salmonids and green sturgeon in the action area.

1.3.7.14. Effluent Dispersion Study – CM14

Within six months of initiating discharge to the San Joaquin River, the City will initiate a dye tracer (or similar methodology) study to track the actual dispersion patterns of the effluent discharged from the outfall into the San Joaquin River. This study will ensure the inferences made in the BA for the Project prepared by the City, based upon modeled mixing of effluent with river flows, is representative of real-world conditions.

1.3.7.15. Chemicals of Emerging Concern – CM15

Within six months of initiating discharge to the San Joaquin River, the City will initiate a monitoring study of chemicals of emerging concern (CECs). This study will evaluate chemicals of concern to NMFS, but not yet regulated by the Regional Water Board. The study is proposed to monitor undiluted effluent and river water quarterly for two years. River monitoring will occur at a location(s) where the CTF discharge has fully mixed with river flows. The City's consultant will develop the list of CECs to monitor and route to NMFS staff for review and approval prior to study initiation.

1.3.7.16. Provide Support for Salmonid Survival and Transit Time Study – CM16

The City will purchase and provide to the Interagency Telemetry Advisory Group (ITAG) two acoustic tag receivers and any directly associated equipment required to detect acoustic-tagged salmonids passing the CTF outfall location. The equipment will be deployed, monitored and maintained by members of the ITAG as part of conducting other aspects of the ITAG's efforts to obtain data to determine salmonid survival and migration speed (i.e., transit time) throughout the river. The equipment provided by the City will enable additional data to be collected in the river reach where the outfall structure is located. This will leverage the ongoing salmonid studies being conducted by the ITAG to gather additional survival and transit time information for this river reach and will provide NMFS with the information needed to determine whether the outfall and associated effluent discharge affects salmonid survival or transit times.

1.3.8. Additional Activities also Caused by the Proposed Action

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would cause the following activities:

The construction of the wastewater outfall and discharge of the effluent to the lower San Joaquin River will allow the City of Lathrop to continue development and urbanization of the regional area in accordance with the City's Lathrop General Plan. Without the ability to discharge to the river, additional development and growth would be constrained or prevented by the inability to discharge the treated effluent and the City could not fulfill its projected level of development based on the City's Lathrop General Plan. By constructing the outfall and discharging the effluent to the river, the CTF will be able to accommodate the additional volume of wastewater generated by the projected growth under the City's Lathrop General Plan. Increased growth of urban and suburban development, as related to the implementation of the Lathrop General Plan, will lead to an increase in impervious surfaces and a decrease in infiltration of precipitation into the ground. This will result in an increased volume of stormwater runoff from the areas of development and urban growth within the City of Lathrop. Stormwater runoff within the City of Lathrop is typically routed into stormwater conveyances that discharge to the lower San Joaquin River. Additional volumes of stormwater will carry chemical and biological contaminants, further degrading the lower San Joaquin River over the currently existing conditions.

As described in the purpose for the Project, the discharge of treated effluent to the river is necessary to allow the City of Lathrop to accommodate CTF flows that will be generated at full City buildout under the Lathrop General Plan. The Lathrop General Plan designates most of the agricultural LAAs and all but two of the storage ponds, for commercial, residential, or urban development. Retaining this land for effluent storage and disposal would prevent development of the properties in accordance with the general plan land use designations.

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

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

2.1. Analytical Approach

2.1.1. General Approach to Analysis

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

CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion relies on the definition of “destruction or adverse modification,” which “means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species” (50 CFR 402.02).

The designations of critical habitats for CCV steelhead and sDPS green sturgeon uses the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a “destruction or adverse modification” analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The 2019 regulations define effects of the action using the term “consequences” (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44977), that definition does not change the scope of our analysis and in this opinion we use the terms “effects” and “consequences” interchangeably.

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

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach. Where quantifiable information does not exist, NMFS will use the best available information to make informed decisions regarding it effects analysis.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species, or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.1.2. Approach to Consideration of Mitigation Banking

Conservation (or mitigation) banks present a unique situation in terms of how they are used in the context of the Effects Analysis and the Environmental Baseline in ESA section 7 consultations.

When NMFS is consulting on a proposed action that includes conservation or mitigation or credit purchases, it is likely that physical restoration work at the bank site has already occurred and/or that a section 7 consultation occurred at the time of bank establishment. A traditional interpretation of Environmental Baseline might suggest that the overall ecological benefits of the conservation bank actions belong in the Environmental Baseline. Under this interpretation, where proposed actions include credit purchases, it would not be possible to attribute their benefits to the proposed action, without double-counting. Such an interpretation does not reflect the unique circumstances that conservation banks serve. Specifically, conservation banks are established based on the expectation of future credit purchases. Conservation banks would not be created and their net beneficial effects would not occur in the absence of this expectation.

For these reasons, it is appropriate to treat the beneficial effects of the bank as accruing in connection with and at the time of specific credit purchases, not at the time of bank establishment or at the time of bank restoration work. This means that, in formal consultations on projects within the service area of a conservation bank, the beneficial effects of a conservation bank should be accounted for in the Environmental Baseline after a credit transaction has occurred. More specifically, the Environmental Baseline section should mention the bank establishment (and any consultation thereon) but, in terms of describing beneficial effects, it should discuss only the benefits attributable to credits already sold. In addition, in consultations that include credit purchases as part of the proposed action, the proportional benefits attributable to those credit purchase should be treated as effects of the action. Conversely, where a proposed action does not credit purchases, it will not receive any direct offset associated with the bank. This approach preserves the value of the bank for its intended purposes, both for the value of the credits to the bank proponent and the net conservation value of the bank to listed species and their critical habitat.

This Opinion will analyze the beneficial effects of the credit transaction associated with the proposed action and recognizes the beneficial effects associated with the remainder of the credits at the bank that have not been subject to a transaction (and their associated ecological benefits) will not be considered in the Environmental Baseline.

2.2. Rangewide Status of the Species and Critical Habitat

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

Within the action area, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon are known to occur. Sacramento River winter-run Chinook salmon do not occur within the action area. The action area also contains designated critical habitat for CCV steelhead and sDPS green sturgeon. The action area does not contain designated critical habitat for either CV spring-run Chinook salmon or Sacramento River winter-run Chinook salmon. Tables 1 and 2 describe the current status of CV spring-run Chinook salmon, CCV steelhead, and the sDPS of North American green sturgeon and the designated critical habitats for CCV steelhead and sDPS green sturgeon that occur within the action area of the Project.

Table 1. Description of species, current Endangered Species Act (ESA) listing classifications, and summary of species status that are affected by this Project.

Species	Listing Classification and Federal Register Notice	Status Summary
Central Valley spring-run Chinook salmon ESU	Threatened, 70 FR 37160; June 28, 2005	The viability of CV spring-run Chinook salmon has deteriorated on balance since the 2011 and 2015 assessments (NMFS 2011a, 2016a) with weakening of all independent CV spring-run Chinook salmon populations. Mill, Deer, and Battle creeks changed from low/moderate to a high risk of extinction using one or more viability criteria. The total abundance of CV spring-run Chinook salmon for the Sacramento River watershed in 2019 is 26,553, approximately half of the population size in 2014 (N=56,023), and close to the decadal lows of ~14,000 fish which occurred as recently as the last two years (CDFW 2021). Recent declines of many of the dependent populations, high pre-spawn and egg mortality during the 2012 to 2016 drought, and uncertain juvenile survival during the drought are likely increasing the ESU's extinction risk. Furthermore, poor ocean conditions during these periods are likely to have decreased survival of juveniles entering the ocean and transitioning to the marine environment. Monitoring data showed sharp declines in adult returns from 2014 through 2018 from a high of nearly 24,000 adults in 2013 (CDFW 2021). However this trend was somewhat reversed in 2019, when over 20,000 adult CV spring-run Chinook salmon returned to the Central Valley river systems, compared to a 5-year average of approximately 5,800 fish from 2014 to 2018 (CDFW 2021). However, in 2020, total adult escapement to the Central Valley

Species	Listing Classification and Federal Register Notice	Status Summary
		again declined precipitously to 3,242 fish (CDFW 2021). The Central Valley is again experiencing drought conditions over the past two years (2020 – 2021) and these conditions are expected to negatively influence juvenile survival and the overall CV spring-run Chinook salmon population. The Central Valley-wide abundance is driven largely by the annual variation in Butte Creek returns. Butte Creek remains at low risk, yet all viability metrics are trending in a negative direction relative to the 2015 levels. The Butte Creek CV spring-run population has become the backbone of the CV spring-run Chinook salmon ESU in part due to extensive habitat restoration and the accessibility of floodplain habitat in the Butte Sink and Sutter Bypass for juvenile rearing in the majority of years. Finally, changes in ocean conditions have led to shifts in the forage base for adults in the marine environment. Consumption of unusually high numbers of anchovies has led to a nutritional deficiency in adults for thiamine, which has expressed itself in a lower survival rate of eggs, fry, and juveniles due to the thiamine deficiency. This phenomenon has manifested itself for at least the past two years in the Central Valley. Nevertheless, positive trends have been observed in the spatial diversity of the CV spring-run Chinook salmon ESU. Spatial diversity is increasing and CV spring-run Chinook salmon are present (albeit at low numbers in some cases) in all four diversity group regions. The persistence of CV spring-run Chinook salmon to Battle Creek and Clear Creek observed in some years is benefiting the viability of CV spring-run Chinook salmon. Similarly, the reappearance of early migrating Chinook salmon to the San Joaquin River tributaries may be the beginning of natural dispersal processes into rivers where they have previously been extirpated. The first returning adults from the reintroduction efforts by the San Joaquin River Restoration Program (SJRRP) have recently been observed below Friant Dam on the San Joaquin River (Sutphin et al 2019, Sutphin and Root 2021). The CV spring-run Chinook salmon ESU was

Species	Listing Classification and Federal Register Notice	Status Summary
		trending in a positive direction towards achieving at least two populations in each of the four historical diversity group regions necessary for recovery, with the Northern Sierra Nevada region necessitating four populations (NMFS 2014). However, return to drought conditions in 2020-2021, as well as poor adult survival due to warm stream temperatures in at least some of the watersheds within the ESU's range have created conditions that may hinder the rate of recovery.
California Central Valley steelhead DPS	Threatened, 71 FR 834; January 5, 2006	The CCV steelhead DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) originating below natural and manmade impassable barriers from the Sacramento and San Joaquin rivers and their tributaries. The DPS excludes such fish originating from San Francisco and San Pablo bays and their tributaries. The CCV steelhead DPS also includes steelhead from the following artificial propagation programs: Coleman National Fish Hatchery (CNFH); Feather River Hatchery (FRH); and Mokelumne River Hatchery (MRH; [85 FR 81822, December 17, 2020]). Population trend data remain extremely limited for the CCV steelhead DPS. The total hatchery populations from CNFH, FRH, and MRH have significantly increased since the 2010 and 2015 viability assessments. In fact, CNFH returns of adult steelhead have steadily increased 15% per year over the last decade. Most natural-origin CCV steelhead populations in the Central Valley tributaries are very small, are not well monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. CCV steelhead populations in these systems were evaluated using the viability criteria initially described in Lindley et al. (2007). Currently, no CCV steelhead populations satisfy the low extinction risk criteria. Chipps Island midwater trawl data provides information on the trend in abundance for the CCV steelhead DPS as a whole. Updated through 2019, the trawl data indicate that the production of natural-origin steelhead remains very low relative to hatchery production. Catch-per-unit

Species	Listing Classification and Federal Register Notice	Status Summary
		effort has fluctuated and generally increased over the past decade, but the proportion of the catch that is adipose fin-clipped (100% of hatchery steelhead production have been adipose fin-clipped starting in 1998) has increased steadily, exceeding 90 percent in recent years and reaching 96 percent during the drought in 2015. This suggests that the vast majority of CCV steelhead out-migrating from the Delta are of hatchery-origin. The viability of CCV steelhead appears to have slightly improved since the 2010 and 2015 viability assessments (NMFS 2011b, 2016b). This modest improvement is driven by an increase in adult returns to hatcheries from their recent lows. However, the state of natural-origin fish remains poor and largely unknown. Improvements to the total population sizes at CNFH, FRH, and MRH do not warrant a downgrading of the DPS extinction risk. Furthermore, the lack of improved natural production as estimated by juvenile migrants exiting the river systems at Chipps Island, and low abundances coupled with large hatchery influence in the Southern Sierra Nevada Diversity Group is cause for concern. Finally, the genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to natural-origin fish, particularly in tributaries with hatcheries producing steelhead. The life-history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates in CCV steelhead.
Southern DPS of North American green sturgeon	Threatened, 71 FR 17757; April 7, 2006	According to the NMFS 5-year species status review (NMFS 2015) and the 2018 final recovery plan (NMFS 2018), some threats to the species have recently been eliminated, such as take from commercial and recreational fisheries and removal of some passage barriers (i.e., Red Bluff Diversion Dam radial gates). Also, several habitat restoration actions have occurred in the Sacramento River Basin, and spawning was documented on the Feather River (Seeholtz et al 2015) and Yuba Rivers (CDFW 2018). Furthermore, verified observations by professional fisheries biologist of adult

Species	Listing Classification and Federal Register Notice	Status Summary
		green sturgeon in the San Joaquin River system upstream of the Delta have occurred recently (Stanislaus River [October 2017]) and within the mainstem of the San Joaquin River above the confluence with the Merced River (April 2020)]. However, the species viability continues to face a moderate risk of extinction because many threats have not been addressed, and the majority of spawning occurs in a single reach of the main stem Sacramento River. Current threats include poaching and habitat degradation. A recent method has been developed to estimate the annual spawning run and population size in the upper Sacramento River so species can be evaluated relative to recovery criteria (Mora *et al.* 2018).

Table 2: Description of critical habitat affected by this Project.

Critical Habitat	Designation Date and Federal Register Notice	Description
California Central Valley steelhead DPS	70 FR 52488, September 2, 2005	Critical habitat for CCV steelhead includes stream reaches of the Feather, Yuba and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, the Yolo Bypass, as well as most portions of the legal Delta and the San Joaquin River basin upstream to the confluence of the Merced River and major tributaries up to the first impassable dam. In addition, portions of the San Francisco Bay-San Pablo Bay-Suisun Bay estuarine complex (approximately 254 square miles, with the South San Francisco Bay hydrologic sub area being excluded; [70 FR 52531]) which provides rearing and migratory habitat for this ESU are included. Critical habitat also includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation. In estuarine areas, the extreme high water is the best descriptor of lateral extent. This is the area inundated by extreme high tide and encompasses habitat areas typically inundated and regularly occupied during the winter, spring and summer when juvenile salmonids are migrating in the nearshore zone and relying heavily on forage, cover, and refuge qualities provided by these occupied habitats. PBFs considered essential to the conservation of the species include: 1) freshwater spawning habitat with adequate water quality and substrate to support spawning, egg incubation, and

Critical Habitat	Designation Date and Federal Register Notice	Description
		larval development; 2) freshwater rearing habitat with floodplain connectivity supporting sheltering, movement, feeding, and growth; 3) freshwater migration corridors free of obstructions, and providing sheltering and holding for both adults and juveniles, and adequate prey resources for juvenile foraging; and 4) estuarine areas free of obstructions with adequate water quality to support adult and juvenile physiological transitions, shelter to provide protection, and prey for juvenile and adult foraging to sustain growth and maturation. Although the current conditions of PBFs for CCV steelhead critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable. In particular, the lower San Joaquin River upstream of the Delta, which contains the location of the Project, is of particular value as it is the only route available for CCV steelhead to migrate into the San Joaquin River Basin and its tributaries.
Southern DPS of North American green sturgeon	74 FR 52300, October 9, 2009	Critical habitat includes the stream channels and waterways in the legal Delta to the ordinary high water line. Critical habitat also includes the main stem Sacramento River upstream from the I Street Bridge to Keswick Dam, the Feather River upstream to the fish barrier dam adjacent to the Feather River Fish Hatchery, and the Yuba River upstream to Daguerre Dam. Critical habitat in coastal marine areas include waters out to a depth of 60 fathoms, from Monterey Bay in California, to the Strait of Juan de Fuca in Washington. Coastal estuaries designated as critical habitat include San Francisco Bay, Suisun Bay, San Pablo Bay, and the lower Columbia River estuary. Certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor) are included as critical habitat for sDPS green sturgeon. PBFs considered essential to the conservation of the species for freshwater and estuarine habitats include food resources, substrate type or size, water flow, water quality, migration corridor; water depth, sediment quality. In addition, PBFs include migratory corridor, water quality, and food resources in nearshore coastal marine areas. Although the current conditions of PBFs for sDPS green sturgeon critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable. In particular, the lower San Joaquin River upstream of the Delta, which contains the location of the Project, is of particular value as it is the only route available for sDPS green sturgeon to migrate into the San Joaquin River Basin and its tributaries.

2.2.1. Climate Change

One factor affecting the range-wide status of CCV steelhead, CV spring-run Chinook salmon, and the sDPS of the North American green sturgeon, and aquatic habitat at large is climate change.

The world is about 1.3°F (0.72ºC) warmer today than a century ago and the latest computer models predict that, without drastic cutbacks in emissions of carbon dioxide and other gases released by the burning of fossil fuels, the average global surface temperature may rise by two or more degrees in the 21st century (IPCC 2001, 2007). Much of that increase likely will occur in the oceans, and evidence suggests that the most dramatic changes in ocean temperature are now occurring in the Pacific (Noakes et al. 1998). Using objectively analyzed data Huang and Liu (2001) estimated a warming of about 0.9°F per century in the Northern Pacific Ocean.

Sea levels are expected to rise by 0.5 to 1.0 meters (1.6 to 3.3 feet) in the northeastern Pacific coasts in the next century, mainly due to warmer ocean temperatures, which leads to thermal expansion much the same way that hot air expands. This will cause increased sedimentation, erosion, coastal flooding, and permanent inundation of low-lying natural ecosystems (e.g., salt marsh, riverine, mud flats) affecting listed salmonid and green sturgeon PBFs. Increased winter precipitation, decreased snow pack, permafrost degradation, and glacier retreat due to warmer temperatures will cause landslides in unstable mountainous regions and destroy fish and wildlife habitat, including salmon-spawning streams. Glacier reduction could affect the flow and temperature of rivers and streams that depend on glacier water, with negative impacts on fish populations and the habitat that supports them.

Summer droughts along the West Coast and in the interior Central Valley of California will mean decreased stream flow in those areas, decreasing salmonid survival and reducing water supplies in the dry summer season when irrigation and domestic water use are greatest. Global warming may also change the chemical composition of the water that fish inhabit: the amount of oxygen in the water may decline, while pollution, acidity, and salinity levels may increase. This will allow for more invasive species to overtake native fish species and impact predator-prey relationships (Petersen and Kitchell 2001, Stachowicz et al. 2002).

In light of the predicted impacts of global warming, the Central Valley has been modeled to have an increase of between 2ºC and 7ºC (3.6ºF and 12.6ºF) by 2100, with a drier hydrology predominated by rainfall rather than snowfall (Dettinger et al 2004, Hayhoe et al. 2004, Van Rheenen et al 2004, Stewart et al. 2005). This will alter river runoff patterns and transform the tributaries that feed the Central Valley from a spring and summer snowmelt dominated system to a winter rain dominated system. It can be hypothesized that summer temperatures and flow levels will become unsuitable for salmonid survival. The cold snowmelt that furnishes the late spring and early summer runoff will be replaced by warmer precipitation runoff. This will truncate the period of time that suitable cold-water conditions exist downstream of existing reservoirs and dams due to the warmer inflow temperatures to the reservoir from rain runoff. Without the necessary cold-water pool developed from melting snow pack filling reservoirs in the spring and early summer, late summer and fall temperatures downstream of reservoirs, such as Lake Shasta, could potentially rise above thermal tolerances for juvenile and adult salmonids that must hold and/or rear downstream of the dam over the summer and fall periods.

Projected warming is expected to affect Central Valley Chinook salmon. Because the runs are restricted to low elevations as a result of impassable rim dams, if climate warms by 5°C (9°F), it is questionable whether any Central Valley Chinook salmon populations can persist (Williams 2006). Based on an analysis of an ensemble of climate models and emission scenarios and a reference temperature from 1951- 1980, the most plausible projection for warming over Northern California is 2.5°C (4.5°F) by 2050 and 5°C (9°F) by 2100, with a modest decrease in precipitation (Dettinger 2005). Chinook salmon in the Central Valley are at the southern limit of their range, and warming will shorten the period in which the low elevation habitats used by naturally producing Chinook salmon are thermally acceptable. This would particularly affect fish that emigrate as fingerlings, mainly in May and June, and especially those in the San Joaquin River and its tributaries.

In summary, observed and predicted climate change effects are generally detrimental to the species (McClure 2011, Beechie et al 2012,Wade et al. 2013), so unless offset by improvements in other factors, the status of the species and critical habitat is likely to decline over time. The climate change projections referenced above cover the time period between the present and approximately 2100. While there is uncertainty associated with projections, which increases over time, the direction of change is relatively certain (McClure et al. 2013).

2.3. Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area is not the same as the project boundary area because the action area must delineate all areas where federally listed populations of salmon, steelhead, and green sturgeon may be affected by the implementation of the action.

The aquatic portion of the action area is defined as the San Joaquin River from 1.9 miles upstream (south) of the CTF outfall to 1.7 miles downstream (northwest) of the outfall. The extent of the upstream reach affected by the outfall effluent is defined by the anticipated maximum range of tidal movement in the mainstem channel of the San Joaquin River during a flood tide, which will move the effluent plume upstream of the outfall location. Both thermal and constituent quality effects become less measureable the farther upstream the effluent plume moves due to attenuation and ultimately because the effluent plume does not reach more distant upstream locations. Similarly, thermal and constituent quality effects become less measurable the farther downstream the effluent plume moves due to additional attenuation and dilution within the waters of the mainstem of the river.

In addition, as described in the purpose for the Project, the discharge of treated effluent to the river is necessary to allow the City of Lathrop to accommodate CTF flows that will be generated at full City buildout under the Lathrop General Plan. Increased growth of urban and suburban development as related to the implementation of the Lathrop General Plan, will lead to an increase in impervious surfaces and increased volumes of stormwater runoff within the geographic area associated with the full buildout of the City of Lathrop under the General Plan. Stormwater runoff within the City of Lathrop is typically routed into stormwater conveyances that discharge to the San Joaquin River. Therefore, the terrestrial portion of the action area includes the area that will be developed under the Lathrop General Plan that is facilitated by the construction of the proposed outfall structure (Figure 9).

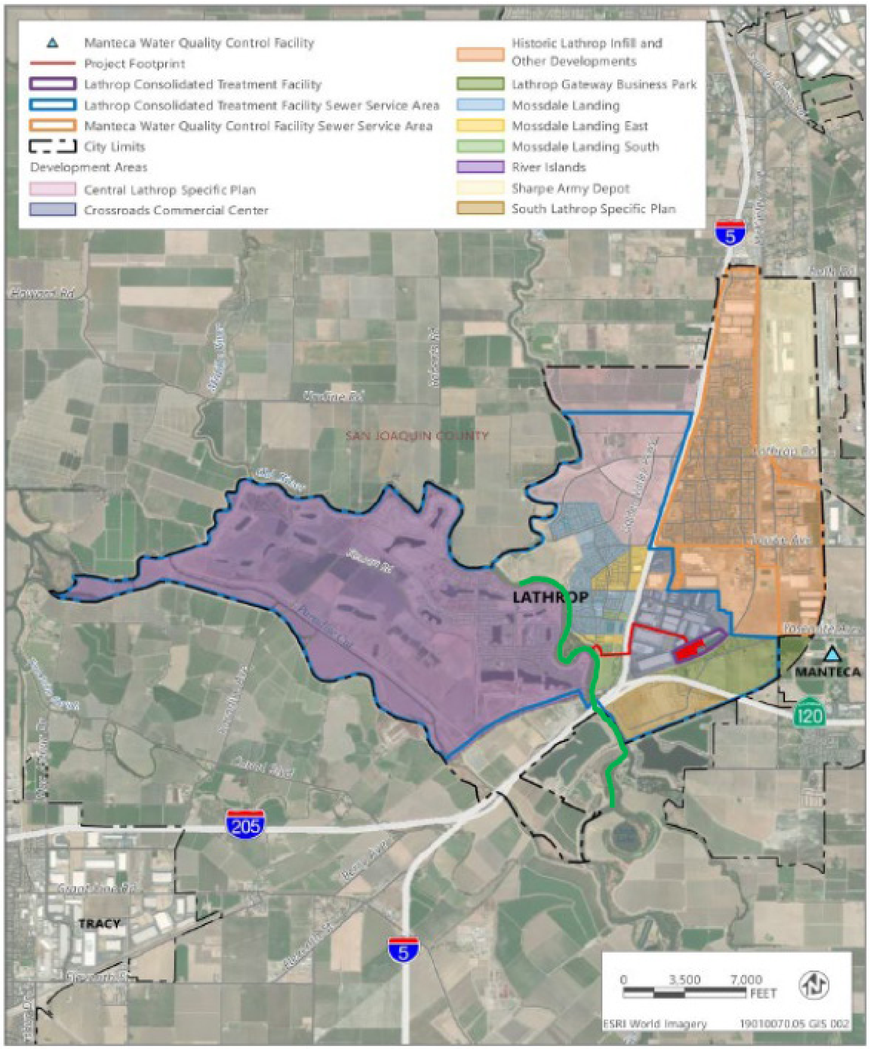


Figure 9: Action area of Project, which includes the City of Lathrop General Plan land use area. Blue line is the perimeter of the City of Lathrop's General Plan for terrestrial development serviced by the new outfall. The green line represents the aquatic portion of the action area within the lower San Joaquin River (From RBI 2020).

The City of Lathrop has also indicated that it may purchase mitigation credits from a conservation bank or the in-lieu fee program to compensate for impacts to CCV steelhead and sDPS green sturgeon critical habitat. Therefore, the action area also includes the mitigation banks from which the City will purchase these credits. Mitigation banks that have service areas within the Project area include: (1) Bullock Bend Mitigation Bank, a 119.65-acre floodplain site along the Sacramento River at the confluence of the Feather River; (2) Fremont Landing Conservation Bank, a 100-acre bank on the floodplain adjacent to the Sacramento River at its confluence with the Feather River; and (3) Liberty Island Conservation Bank, a 186-acre conservation bank located at the southern end of the Yolo Bypass in the Sacramento-San Joaquin River Delta.

2.4. Environmental Baseline

The “environmental baseline” refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency’s discretion to modify are part of the environmental baseline (50 CFR 402.02).

2.4.1. Local and Regional Characteristics

The Project is located in the southeastern portion of the Sacramento-San Joaquin Delta, upstream of the Port of Stockton to the north, and the Old River/ Middle River complex to the west (Figure 1), with the Project construction site located along the eastern bank of the mainstem San Joaquin River. This freshwater habitat provides critical habitat for CCV steelhead and sDPS green sturgeon. The Lower San Joaquin River channel is tidally influenced in the action area, although reversal of flow may not occur in portions of the action area when the mainstem San Joaquin River flows are elevated. This typically occurs during winter high-flow events on the San Joaquin River. Changes in water surface elevations due to tidal variation occurs within the San Joaquin River channel that contains the Project location.

The land adjacent to the action area is undergoing rapid urban development replacing agricultural land with industrial, commercial, and residential structures (i.e., City of Lathrop and City of River Islands). Some agricultural land remains in the southern and northern portions of the action area. Levees armored with rock riprap protect lands to both the east and west of the San Joaquin River from flooding during high water events. These existing levees were initially built in the late 1800s and are maintained by local Reclamation Districts, but are also part of the Federal Flood Control Project authorized by Congress in 1917, and completed in 1960 by the USACE.

At the Mossdale Bridge near the Project location, the water gage monitoring station (MSD), is 31 feet (9.4 meters) above sea level. Monitoring of the river stage for flood conditions starts when the MSD gage has a river height that is over 19.5 feet (5.9 meters) above sea level. The San Joaquin River is in flood stage when the river stage measures 28.5 feet (8.7 meters) above sea level, and considers that the levees are in danger of being overtopped when the river stage is at or over 29.5 feet [9.0 meters, California Data Exchange (CDEC) 2021]. During dry water years, such as 2012 through 2016, SJR stage elevations at MSD have read a maximum of 8 feet (2.4 meters) or less above sea level, with summer time lows dipping below 3 feet (0.9 meters) above mean sea level. During the especially wet winters/springs of 2011 and 2017, river stages reached peaks of more than 17 feet (5.2 meters) and 21 feet (6.4 meters) above sea level, respectively.

During the two recent river stage peaks of 2011 and 2017, maximum San Joaquin River flow was recorded at over 22,500 and 32,800 cfs, respectively. Typically, winter/spring maximum flows are regulated to remain between 2,500 and 5,000 cfs when possible. Releases from Friant Dam, as well as tributary reservoir dams, are made to provide flood control, as well as to provide water from storage for other purposes later on.

Ambient water temperatures in the river range from a low of 42ºF (5.6ºC) in December to a high of 85ºF (29.4ºC) in July. This is typically driven by the ambient air temperatures.

2.4.1.1. Water Development

Within the action area and the immediate vicinity of the Project, emigrating juvenile salmonids are exposed to numerous small agricultural diversions located along the levee banks. Although efforts have been made in recent years to screen some of these diversions, many remain unscreened. Depending on the size, location, and season of operation, these unscreened diversions entrain and kill many life stages of aquatic species, including juvenile salmonids and green sturgeon.

2.4.1.2. Water Conveyance and Flood Control

The development of the water conveyance system in the San Joaquin River basin has resulted in the construction of armored levees to increase channel flood capacity elevations and flow capacity of the channels (Mount 1995). Levee development on the historic floodplains of the Central Valley, including the lower San Joaquin River and its tributaries, affects spawning habitat, freshwater rearing habitat, freshwater migration corridors, and freshwater riverine habitat PBFs within the action area. As Mount (1995) indicated, there is an "underlying, fundamental conflict inherent in this channelization." Natural rivers strive to achieve dynamic equilibrium to handle a watershed's supply of discharge and sediment. The construction of levees disrupts the natural processes of the river, resulting in a multitude of habitat-related effects; including isolation of the watershed's natural floodplain behind the levee from the active river channel and its fluctuating hydrology.

The levees bordering the lower San Joaquin River within the action area use angular rock (rip rap) to armor the bank from erosive forces. The effects of channelization, and riprapping, include the alteration of river hydraulics and riparian vegetative cover along the bank as a result of changes in bank configuration and structural features (Stillwater Sciences 2006). These changes affect the quantity and quality of nearshore habitat for juvenile salmonids and have been thoroughly studied (USFWS 2000, Schmetterling et al. 2001, Garland et al. 2002). Simple slopes protected with rock revetment generally create nearshore hydraulic conditions characterized by greater depths and faster, more homogeneous water velocities than occur along natural banks. Higher water velocities typically inhibit deposition and retention of sediment and woody debris. These changes generally reduce the range of habitat conditions typically found along natural shorelines, especially by eliminating the shallow, slow-velocity river margins used by juvenile fish as refuge and escape from fast currents, deep water, and predators (Stillwater Sciences 2006).

2.4.1.3. Land Use Activities

Urban stormwater and agricultural runoff may be contaminated with pesticides, oil, grease, heavy metals, polycyclic aromatic hydrocarbons (PAHs), and other organics and nutrients (Regional Board 1998), which can destroy aquatic life necessary for salmonid survival (NMFS 1996a, b) and are also expected to negatively impact the different green sturgeon life stages also present. Point source (PS) and non-point source (NPS) pollution occurs at almost every point that urbanization activity influences the watershed. Impervious surfaces (i.e., concrete, asphalt, and buildings) reduce water infiltration and increase runoff, thus creating greater flood hazard (NMFS 1996a, b). A flashy discharge pattern results in increased bank erosion with subsequent loss of riparian vegetation, undercut banks and stream channel widening. In addition to the PS and NPS inputs from urban runoff, juvenile salmonids and green sturgeon are exposed to increased water temperatures as a result of thermal inputs from municipal, industrial, and agricultural discharges.

2.4.1.4. Water Quality

Water quality in the action area have been negatively impacted over the last 150 years. Increased water temperatures, decreased dissolved oxygen (DO) levels, and increased turbidity and contaminant loads have degraded the quality of the aquatic habitat for the rearing and migration of salmonids and sDPS green sturgeon. Some common sources of pollutants include effluent from agricultural drain water, which can contribute substantial amounts of inflow during the low-flow period of a dry year. The Regional Board, in its Clean Water Act §303(d) list characterized the southern Delta (which includes the San Joaquin River within the action area) as an impaired waterbody having elevated levels of chlorpyrifos, dichlorodiphenyltrichlor (i.e., DDT), diazinon, electrical conductivity, Group A pesticides [aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexanes (including lindane), endosulfan and toxaphene], mercury, and unknown toxicities (Regional Board 1998, 2001; California State Water Resources Control Board 2010).

2.4.1.5. Hydrology

Historically, the Southern Sierra Nevada watersheds had hydrographs dominated by the spring snowmelt runoff period and had their highest flows in the late spring/early summer period with substantially reduced flows during the summer (The Bay Institute 1998). Since the construction of numerous dams in the mountains surrounding the San Joaquin Valley, the variability in seasonal and inter-annual runoff has been substantially reduced and the peak flows muted, except in exceptional runoff years. As a result, current average winter/spring flows in the action area are typically reduced compared to natural conditions, while summer/fall flows have been artificially increased by reservoir releases. Wintertime releases are coordinated for preserving flood control space in the San Joaquin Valley’s large terminal storage dams, and typically do not reach the levels necessary for bed load transport and reshaping of the river channels below the dams. Summertime flows have been scheduled for meeting water quality goals and consumptive water demands downstream.

2.4.1.6. NMFS Salmon and Steelhead Recovery Plan Action Recommendations

The NMFS Recovery Plan that includes CV Spring-run Chinook salmon and CCV steelhead (NMFS 2014) identifies recovery goals for the Sacramento River and San Joaquin River basin populations that utilize the waterways of the Delta for aspects of their life history. These waterways include the action area for the proposed Project. Recovery efforts have focused on addressing several key stressors that are vital to CV spring-run Chinook salmon, and CCV steelhead: (1) Altered natural riverine flows entering the Delta from the San Joaquin River basins affecting adult and juvenile migration and holding, (2) Altered hydrodynamics due to operations of the CVP and SWP export facilities affecting migratory cues of migrating juveniles, (3) Altered riparian and marsh habitats due to levee construction and marshland reclamation efforts, and (4) Increased exposure to non-native predation within the waterways of the southern Delta and San Joaquin River. The NMFS Recovery Plan (NMFS 2014) identified the following key stressors that include the action area:

- Altered hydrographs of the San Joaquin River entering the Delta due to upstream operations of reservoirs that does not represent the historic natural unimpaired inflow pattern used by fish for attraction and migratory behavioral cues.

- Loss of natural ecological function in the majority of the southern Delta and lower San Joaquin River mainstem landscape due to human activities.

- Limited quantity and quality of rearing and migratory habitat in the southern Delta and lower San Joaquin River due to human actions related to levee construction.

- Loss of extensive marshland and riparian habitats in freshwater habitats used for rearing and holding of migrating salmonids due to human activities.

- Unscreened or poorly screened agricultural diversions in the southern Delta and lower San Joaquin River mainstem.

- Increased predation risks to juvenile salmonids from non-native predators in both the southern Delta and lower San Joaquin River mainstem.

- Lack of floodplain habitat for juvenile salmonids migrating downstream in the lower San Joaquin River.

Two of the recovery actions identified in the Recovery Plan for the Delta, DEL-2.20 and DEL-2.31, are relevant to this consultation. These two recovery actions pertain to wastewater treatment plant effluents and the reduction of ammonia in those discharges. For the lower San Joaquin River, several recovery actions identified in the Recovery Plan for the San Joaquin River are relevant to this consultation. Recovery actions SJR 1.8, 1.9, 1.10 and 2.2 pertain to wastewater and agricultural drain water effluents and improving water quality in the San Joaquin River. Recovery actions 2.9 through 2.12 concern the reduction of predation upon CCV steelhead and CV spring-run Chinook salmon occurring in the San Joaquin River Basin. The Project does not propose any actions that address any of the key stressors mentioned in the Recovery Plan.

2.4.1.7. NMFS sDPS Green Sturgeon Recovery Plan Action Recommendations

The NMFS Recovery Plan for sDPS green sturgeon (NMFS 2018) identifies recovery goals for this population that utilize the waterways of the Delta for different components of their life history. These waterways include the action area for the proposed Project (lower San Joaquin River). Recovery efforts focus on addressing several key stressors that are vital to sDPS green sturgeon:

- Barriers to migration of juveniles, subadults, and adults within the San Francisco Bay-Delta Estuary (SFBDE).
- Altered water flows, and water temperatures within the SFBDE.
- Take associated with water diversions, poaching, commercial and recreational fisheries bycatch, within the SFBDE.
- Alterations to the prey base due to contaminants and identification of trophic transfer of contaminants through the different life stages of green sturgeon.
- Predation impacts to green sturgeon due to native and non-native species.
- Competition for habitat between native and non-native species and green sturgeon.
- Effects of climate change on habitat usage and availability for green sturgeon.

Recovery action 5a (RA5a) is relevant to this consultation. This recovery action seeks to improve compliance and implementation of BMPs to reduce input of point and non-point source contaminants within the Sacramento River Basin and the SFBDE. The Project does not propose any actions that address any of the key stressors mentioned in the Recovery Plan.

2.4.2. Status of the Species and Critical Habitat in the Action Area

2.4.2.1. Status of the Species within the Action Area

The action area functions primarily as a migratory corridor for CV spring-run Chinook salmon from the San Joaquin River Restoration Program's (SJRRP) experimental population, CCV steelhead from the Southern Sierra Nevada Diversity Group, and potentially the sDPS of North American green sturgeon, but it also provides some use as holding and rearing habitat for each of these species as well. Juvenile salmonids may use the area for rearing for several weeks during the winter and spring before migrating to the marine environment. Green sturgeon may use the area for rearing and potentially migration into/out of the San Joaquin River Basin year-round. Generally, as flows increase in the fall and through the winter, adult salmon, CCV steelhead, and sDPS green sturgeon migrate upstream through the Delta into the mainstem rivers and watershed tributaries. Juvenile salmonids migrate downstream in the winter and spring, while juvenile green sturgeon have a protracted downstream migration that lasts from summer into winter with eventual rearing within the waters of the Delta. Adult CV spring-run Chinook salmon migrate through the Delta between January and June (Table 3). Adult CCV steelhead migration typically begins in August, with a peak in October and November for the San Joaquin River basin fish, and extends through the winter to as late as May (Table 4). Adult green sturgeon enter the Delta and start to migrate upstream to spawning reaches in the Sacramento River basin in February and their migrations can extend into July (Table 5), but may also be found holding in waters of the Delta year-round. Less is known regarding the potential use of the San Joaquin River basin upstream of the Delta, but sturgeon report card information and the observation of a live green sturgeon in the Stanislaus River in October 2017, and also within the mainstem of the San Joaquin River in April of 2020 above the confluence of the Merced River indicate that there is opportunistic use of this watershed to some degree.

2.4.2.1.1. CV Spring-run Chinook salmon

Currently there are no documented natural populations of CV spring-run Chinook salmon in the San Joaquin River basin that would likely occur in the action area. However, there is anecdotal evidence of Chinook salmon occurring in the Stanislaus and Tuolumne rivers that may represent residual populations of CV spring-run Chinook salmon or individuals that have strayed from other river basins and use the Stanislaus and Tuolumne rivers for spawning based on their run timing and the presence of fry and juveniles that show traits characteristic of spring-run populations such as hatching dates and seasonal sizes. Furthermore, the SJRRP goal of re-establishing an experimental population of CV spring-run Chinook salmon in the San Joaquin River basin will create the potential that CV spring-run Chinook salmon will be present in the action area over the Project's lifetime due to the continued presence of the outfall structure and discharge of effluent to the river. Presence of adult or juvenile CV spring-run Chinook salmon in the action area during the proposed construction window of July 1 through October 31 over the construction period is unlikely based on the following life history characteristics.

There are no spawning areas in the action area that could be used by adult CV spring-run Chinook salmon; therefore, the potential that eggs will be present in the action area is nonexistent. Likewise, the potential for alevins to be present in the action area is also unlikely, since only extreme precipitation events in the fall and early winter resulting in high river flows in the San Joaquin River basin could flush alevins out of their natal tributaries into the action area. Fry and parr are more likely to be present in the action area in response to high river flows due to the timing of winter storms and the progressive maturation of the fish. This period will be from approximately November through March. By April, juvenile CV spring-run Chinook salmon are reaching the size that smoltification occurs, and the majority of smolts will be moving downriver to enter the Delta on their emigration to the ocean. CV spring-run Chinook salmon smolt outmigration is essentially over by mid-May with only a few late fish emigrating in early June. There is the potential that some juvenile CV spring-run Chinook salmon will remain in the tributaries through the summer and out migrate the following fall and winter as yearlings, but until the experimental population has had time to establish itself, this behavior is uncertain to occur (Table 3). Adult CV spring-run Chinook salmon are expected to be migrating upstream through the action area from January to June with a peak presence from February to April (Table 3). Adult migration is also likely to be strongly influenced by the flow levels in the San Joaquin River basin that provides access to the upstream holding and spawning areas. The broodstock for the CV spring-run Chinook salmon experimental population came from the Sacramento River basin (FRH CV spring-run Chinook salmon) and are expected to exhibit similar migration timing behavior for both adult and juvenile life stages in the San Joaquin River basin.

The proposed construction period for the Project is from July 1 through October 31. This will not overlap with the adult CV spring-run Chinook salmon migration period in the San Joaquin River basin (i.e., the months of January through June). The construction window will also avoid overlapping with juvenile CV spring-run Chinook salmon emigration during late winter and spring. However, the long-term operations of the Project's outfall, including permanent structures and riprap and discharge of effluent from the CTF and stormwater sources will overlap with both adult migration upstream and juvenile migration downstream every year.

Table 3. Temporal occurrence of CV spring-run Chinook salmon in the southern Delta- lower San Joaquin River action area with darker shades indicating months of high presence and lighter shades indicating months of low presence.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult SR[1]	M	H	H	H	M	L	N	N	N	N	N	N
Juvenile SR[2]	L	L	L	H	M	N	N	N	N	N	N	L
Salvaged SR[3]	L	L	M	H	M	N	N	N	N	N	N	N

H	High	M	Med	L	Low	N	None

[1]Adults enter the Bay late January to early February (CDFW 1998) and enter the Sacramento River in March (Yoshiyama *et al.* 1998). Adults travel to tributaries as late as July (Lindley *et al.* 2004). Spawning occurs September to October (Moyle 2002).
[2]Juvenile presence in the Delta based on DJFMP data.
[3]Juvenile presence in the Delta based on salvage data (NMFS 2016c).

2.4.2.1.2. CCV Steelhead

Small, but persistent populations of CCV steelhead are present in the Calaveras River and San Joaquin River basins and are part of the Southern Sierra Nevada Diversity Group. Both adults and smolts are detected by monitoring efforts in these basins, indicating that spawning is occurring in the basin's tributaries. There are no spawning areas in the action area that could be used by adult CCV steelhead; therefore, the potential that eggs will be present in the action area is nonexistent. All adult CCV steelhead originating in the San Joaquin River basin will pass through the action area to reach their spawning grounds in the Stanislaus, Tuolumne, and Merced rivers, and the tailwater section of the San Joaquin River below Friant Dam, and return to the ocean following spawning through these same waterways. CCV steelhead smolts leaving the San Joaquin River basin during their emigration pass through the action area. The waterways in the action area are expected to be used primarily as migration corridors for adult steelhead and emigrating steelhead smolts, but may also provide some rearing benefits to the emigrating smolts.

CCV steelhead smolts are expected to appear in the action area waterways as early as January, based on observations in tributary monitoring studies on the Stanislaus River, but in very low numbers. The peak emigration in the lower San Joaquin, as determined by the Mossdale trawls near the Head of Old River (which are in close proximity to the action area), occurs from April to May, but with presence of fish typically extending from late February to late June.

Adult CCV steelhead are expected to start moving upstream from the Delta through the action area into the lower San Joaquin River as early as September, with the peak migration period occurring later in the fall from October through November. Approximately half of the assumed steelhead moving upriver annually into the Stanislaus River do so between mid-October and the end of November, based on Stanislaus River fish weir counts. However, in some years, the peak of migration occurs in December and January. Adult CCV steelhead will continue to migrate upriver through March, with post spawn fish, "kelts", moving downstream potentially through spring and early summer, although most are expected to move back downstream earlier than later (Table 4).

The proposed construction period for the Project's actions on the mainstem San Joaquin in the action area is from July 1 through October 31. This will overlap with the adult CCV steelhead migration period in the San Joaquin River basin (i.e., the months of September and October) but will avoid most of the peak of spawning migration from mid-October through the end of November. However, the long-term operations of the Project's outfall and discharge of CTF effluent as well as stormwater discharges to the San Joaquin River will overlap with both adult migration upstream and juvenile migration downstream every year.

Table 4. Temporal occurrence of steelhead in the southern Delta – lower San Joaquin River action area with darker shades indicating months of high presence and lighter shades indicating months of low presence.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult SH[1]	M	M	M	M	H	N	L	M	M	H	H	M
Juvenile SH[2]	L	M	M	H	H	L	L	N	L	N	N	L
Salvaged SH[3]	M	H	H	M	L	L	N	N	N	N	L	L

H	High	M	Med	L	Low	N	None

[1]Adult presence was determined using information in Moyle (2002), Hallock et al. (1961), and CDFW (2015).
[2]Juvenile presence in the Delta was determined using DJFMP data.
[3]Months in which salvage of wild juvenile steelhead at State and Federal pumping plants occurred; values in cells are salvage data reported by the facilities (NMFS 2016c).

2.4.2.1.3. Southern DPS of North American Green Sturgeon

Adult green sturgeon begin to enter the Sacramento – San Joaquin Delta in late February and early March during the initiation of their upstream spawning run (Moyle et al. 1995, Heublein et al. 2009). Data on green sturgeon distribution are extremely limited and out-migration appears to be variable occurring at different times of year. Seven years of recreational fishing catch data for adult green sturgeon (CDFW sturgeon fishing report cards) show that they are present in the Delta during all months of the year (Figure 10) and thus potentially within the action area (southern Delta and lower San Joaquin River). Although the majority of green sturgeon are expected to be found along the Sacramento River corridor and within the western Delta, observations of green sturgeon occur in the San Joaquin River and upstream of the action area based on the information provided in the CDFW sturgeon fishing report cards and the two recent confirmed encounters with green sturgeon in the Stanislaus River and the mainstem San Joaquin River near Hills Ferry. Presence of fish occurs during all seasons of the year, but primarily from fall through spring. Few fish are caught during the summer period in the San Joaquin River.

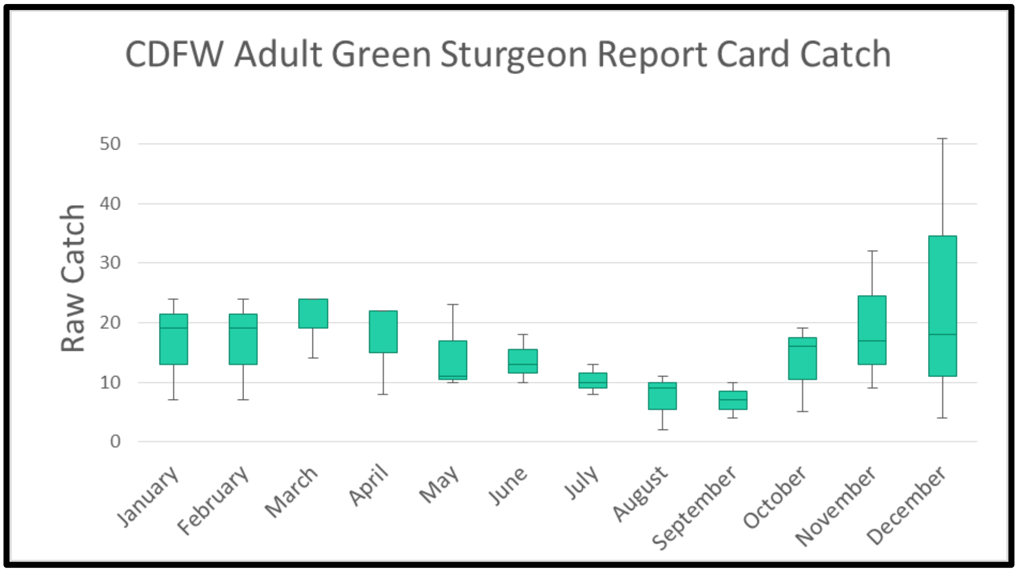


Figure 10: CDFW adult raw catch data for green sturgeon in the Delta from 2008-2014. This data indicates presence year round. The monthly median is marked by a horizontal line splitting each box. The upper and lower whiskers show the maximum and minimum values for each month over all years.

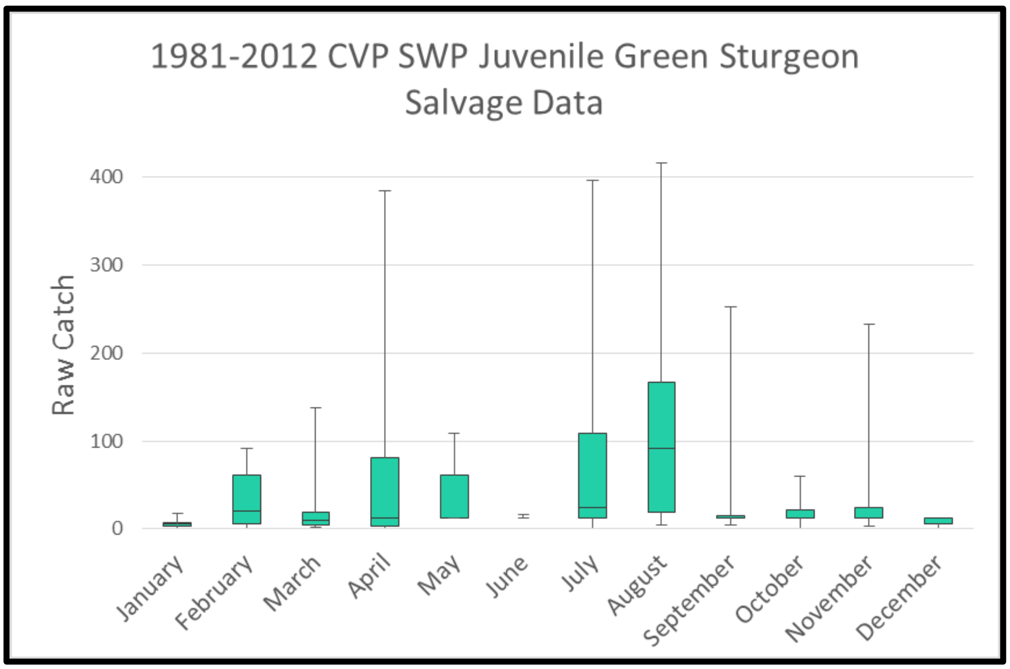


Figure 11: Monthly raw salvage data for juvenile green sturgeon by month at the SWP and CVP export facilities (1981-2012). The monthly median is marked by a horizontal line splitting each box. The upper and lower whiskers show the maximum and minimum values for each month over all years.

Juvenile green sturgeon migrate to the sea when they are 1 to 4 years old (Moyle et al. 1995) after rearing within the Delta or other areas of the estuary. According to Radtke (1966), juveniles were collected year round in the Delta during a 1-year study in 1963-1964. The DJFMP rarely collected juvenile green sturgeon at the seine and trawl monitoring sites, although these gear types are not expected to be highly effective in capturing sturgeon. From 1981 to 2012, 7,200 juvenile green sturgeon were reported at the State and Federal export facilities (Figure 11), which indicates a higher presence of juvenile green sturgeon during the spring and summer months in the south Delta where the export facilities are located. Based on the above information, adult and juvenile green sturgeon were determined to be present in Delta waters year-round (Table 5).

Table 5. Temporal occurrence of green sturgeon in the Delta waterways, including the action area, with darker shades indicating months of high presence and lighter shades indicating months of low presence.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
*Adult GS[1]	MED	MED	MED	MED	MED	MED	MED	MED	MED	MED	MED	MED
*Juvenile GS[2]	MED	MED	MED	MED	MED	MED	MED	MED	MED	MED	MED	MED
Salvaged GS[3]	LOW	LOW	LOW	LOW	LOW	NONE	MED	HIGH	LOW	LOW	LOW	LOW

HIGH HIGH MED MED LOW LOW NONE NONE

[1]Adult presence was determined to be year round according to information in CDFW sturgeon report cards (2008-2014), Heublein *et al.* (2009), and Moyle (2002).
[2]Juvenile presence in the Delta was determined to be year round by using information in USFWS DJFMP data, Moyle *et al.* (1995) and Radtke (1966).
[3]Months in which salvage of green sturgeon at State and Federal pumping plants occurred; values in cells are salvage data reported by the facilities (1981-2012 CDFW daily salvage data).
*Not enough catch data to determine percent presence by month for adults or juveniles, except for salvaged green sturgeon.

2.4.2.2. Status of Critical Habitat within the Action Area

The PBFs for steelhead critical habitat within the action area include freshwater rearing habitat and freshwater migration corridors. The features of the PBFs included in these different sites essential to the conservation of the CCV steelhead DPS include the following: sufficient water quantity and floodplain connectivity to form and maintain physical habitat conditions necessary for salmonid development and mobility, sufficient water quality, food and nutrients sources, natural cover and shelter, migration routes free from obstructions, no excessive predation, holding areas for juveniles and adults, and shallow water areas and wetlands. Habitat within the action area is primarily utilized for freshwater rearing and migration by CCV steelhead smolts and for adult freshwater migration. No spawning of CCV steelhead occurs within the action area.

In regards to the designated critical habitat for the sDPS of North American green sturgeon, the action area includes PBFs which provide: adequate food resources for all life stages utilizing the freshwater portions of the Delta; water flows sufficient to allow adults, sub-adults, and juveniles to orient to flows for migration and normal behavioral responses; water quality sufficient to allow normal physiological and behavioral responses; unobstructed migratory corridors for all life stages utilizing the Delta; a broad spectrum of water depths to satisfy the needs of the different life stages present in the Delta; and sediment with sufficiently low contaminant burdens to allow for normal physiological and behavioral responses to the environment.

The general condition and function of the aquatic habitat has already been described in the *Rangewide Status of the Species and Critical Habitat* section of this Opinion. The substantial degradation over time of several of the PBFs has diminished the function and condition of the freshwater rearing and migration habitats in the action area.

Even though the habitat has been substantially altered and its quality diminished through years of human actions, its conservation value remains high for the CCV steelhead DPS and the sDPS of North American green sturgeon. All juvenile CCV steelhead smolts originating in the San Joaquin River basin will likely pass downstream through the action area within the San Joaquin River mainstem channel. Some CCV steelhead smolts may enter Paradise Cut under high flows. Likewise, adult CCV steelhead migrating upstream to spawn are likely to pass through the action area within the main stem of the San Joaquin River to reach their upstream spawning areas in the San Joaquin River basin. Therefore, it is of critical importance to the long-term viability of the CCV steelhead to maintain a functional migratory corridor and freshwater rearing habitat through the action area to sustain the Southern Sierra Nevada Diversity Group, and provide the necessary spatial diversity to achieve recovery.

Due to a deficit of monitoring data directed at this species, an unknown fraction of the sDPS green sturgeon population utilizes the San Joaquin River upstream of the Delta. However, designated critical habitat occurs in the action area and includes the San Joaquin River upstream to the limits of the legal Delta (Airport Way Bridge) on the San Joaquin River. Preservation of the functionality of the PBFs within this region is important to the long-term viability of the sDPS green sturgeon population by providing suitable habitat for the rearing of juveniles, and the foraging and migratory movements of adults.

2.4.3. The San Joaquin Restoration Program

The SJRRP is the result of a settlement that was reached in 2006 on an 18-year lawsuit between federal agencies, the Natural Resources Defense Council, and the Friant Water Users Authority (SJRRP 2018). The settlement stipulates that sufficient fish habitat must be provided in the SJR below Friant Dam so that two primary goals are met: (1) Fish populations must be maintained and restored to “good conditions” in the mainstem of the San Joaquin River from Friant Dam to the confluence of the Merced River, including self-sustaining populations of CV spring-run Chinook salmon; and (2) Water management must reduce or avoid adverse water supply impacts to all Friant Division long-term contractors that may result from interim and restoration flows provided for fish and wildlife restorations.

As previously identified, some critical recovery actions identified in the NMFS recovery plan are achieved through the implementation of the settlement goals. Though this settlement and the SJRRP actions are restricted to the recovery area, i.e., the San Joaquin River mainstem from Friant Dam to the Merced River confluence, the achievement of volitional fish passage from the Delta to the base of Friant Dam would increase the use of the San Joaquin River mainstem within the action area of this Project by both adult and juvenile salmonids during their upstream and downstream migrations.

2.4.4. Mitigation Banks

As described in the analytical approach (Section 2.1.2), mitigation banking requires a unique approach to assessing Project effects and the environmental baseline. Typically, physical restoration work at the bank site has already occurred and/or a section 7 consultation has occurred at the time of bank establishment, thus this component is part of the environmental baseline. However, the ecological benefits of the conservation or mitigation bank are not realized until the credits have been purchased. Thus, credits which have already been purchased for prior actions become part of the environmental baseline and their beneficial effects accounted for there. Unpurchased credits and their environmentally beneficial effects are not included in the baseline. Accordingly, as credits are purchased as part of a current proposed action undergoing consultation, the environmental benefits are associated with that Project and are treated as part of the effects of the proposed action.

There are several conservation or mitigation banks approved by NMFS with service areas that include the action area. These banks may offer CCV steelhead credits or credits that would benefit CCV steelhead; however, mitigation bank credits are not available for sDPS green sturgeon. Information was updated from the USACE's Regulatory in-lieu Fee and Bank Information tracking System (RIBITS).

Bullock Bend Mitigation Bank: Established in 2016, the Bullock Bend Mitigation Bank is a 116.15-acre floodplain site along the Sacramento River at the confluence of the Feather River (Sacramento River Mile 80) and is approved by NMFS to provide credits for impacts to Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead. There are salmonid floodplain restoration, salmonid floodplain enhancement, and salmonid riparian forest credits available. To date (August 2021), there have been 17 of the 98.72 released credits sold, and the ecological value (increased rearing habitat for juvenile salmonids) of the sold credits are part of the environmental baseline. All features of this bank are designated critical habitat for CCV steelhead, but not sDPS green sturgeon.

Fremont Landing Conservation Bank: Established in 2006, the Fremont Landing Conservation Bank is a 100 acre site near the confluence of the Feather River and the Sacramento River, at river mile 78 through 80, on the west bank of the Sacramento River. It is approved by NMFS to provide credits for impacts to Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead. To date (August 2021), out of 100 acres of potential credits, 76.033 acres have been sold/withdrawn and the ecological value (increased rearing habitat for juvenile salmonids) of these credits are part of the environmental baseline. All features of this bank are designated critical habitat for CCV steelhead, but not sDPS green sturgeon.

Liberty Island Conservation Bank: Established in 2010, the Liberty Island Conservation Bank is a 186-acre site located at the southern end of the Yolo Bypass on Liberty Island in the Delta. To date (August 2021), out of the credits relating to salmonid restoration or preservation, 74.03 acres have been sold/withdrawn out of the 139.11 acres released. It is approved by NMFS to provide credits for impacts to Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead. There are riparian shaded aquatic, salmonid preservation, and salmonid restoration credits available, and the ecological value of the sold credits (increased rearing habitat for juvenile salmonids) are part of the environmental baseline. All features of this bank are designated critical habitat for CCV steelhead, but not sDPS green sturgeon.

2.5. Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

To evaluate the impacts of the Project upon listed fish and designated critical habitat within the action area, NMFS examined the effects of the proposed action. We analyzed construction-related impacts associated with the installation of the outfall structure as well as the long-term impacts of the presence of the structure and discharge of the treated effluent from the CTF into the San Joaquin River and increases in storm water discharge due to development associated with the General Plan. We also reviewed and considered the City of Lathrop's proposed conservation measures for construction activities and future operations.

Our assessment considers the nature, duration, and extent of the action relative to the rearing, and migration timing, behavior, and habitat requirements of all life stages of federally listed fish in the action area. Effects of the Project on aquatic resources included both short- and long-term impacts. Short-term impacts include the impacts of construction during the installation of the outfall structure, including erecting and removal of the cofferdam. Long-term impacts include the discharge of treated effluent into the San Joaquin River, presence of the outfall structure below the waterline, alterations to the channel thalweg and bottom composition related to erosion prevention actions, armoring of the waterside levee slope, as well as increases in the volume of storm water discharged to the region's waterways, all of which will continue into the foreseeable future. Where quantifiable information does not exists, NMFS will use a qualitative approach to its analysis, based on the best available information. In regards to the additional activities to the Project (stormwater discharges), NMFS reviewed the General Plan for the City of Lathrop as well as the Post-construction stormwater standards manual (Multi Agency 2015) to frame its analysis. Prediction of variable events in the future, such as frequency and volume of precipitation from storms, is not possible, therefore a qualitative approach is required to assess the effects of the stormwater discharges related to the Project's actions.

Adverse effects can include any impact that reduces the quality or quantity of critical habitat, and may include any physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components associated with the action. In addition, adverse effects can include any impact to an individual fish that results in take. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). The proposed action includes installation and removal of a steel sheet pile cofferdam using a vibratory hammer, installation and removal of steel piles within the cofferdam to support the sheet piling using an impact hammer, dewatering the area within the sheet pile cofferdam with subsequent fish relocation, armoring of the waterside face of the levee and the channel bottom adjacent to the outfall structure with rock and concrete, construction of a concrete outfall structure, and ongoing discharge of treated wastewater from the CTF into the San Joaquin River that may impact NMFS-listed species and critical habitat.

Construction activities may increase the level of ambient noise and vibrations in the surrounding aquatic environment, increase turbidity and suspended sediment in adjacent waterways from erosion and airborne sources, all of which may disrupt feeding, temporarily displace fish from preferred habitat, or impair normal behavior. Some of these effects may occur at a distance from the construction activities because noise and sediment may be propagated away from their point of origin in both an upstream and downstream direction from the construction sites under riverine and tidal conditions. Discharge of treated effluent from the CTF may alter the chemical and physical characteristics of the water column within the San Joaquin River due to thermal loading from the discharge, and addition of chemical constituents contained within the effluent. The physical structure of the outfall will result in the loss of aquatic habitat due to erosion control materials placed upon the levee face and channel bottom, and will modify existing habitat by creating holding structure for local predators along the levee bank below the ordinary mean waterline.

The approach used for this analysis was to identify which ESA-listed species would be likely to be present in the action area adjacent to the Project's construction site from July 1 through October 31 during the in-water construction activities (Table 6). Furthermore, NMFS conducted a review of nearby CDFW and USFWS monitoring locations, run timing, and fish salvage data to determine the likelihood of ESA-listed fish presence during long term discharge of effluent and storm water to the river (Tables 3-5). Based on studies of acoustic tagged hatchery fish, travel time for actively migrating juvenile Chinook salmon and steelhead through the action area is on the order of half a day on average, ranging from a few hours to several days (Buchanan et al. 2018, Buchanan 2018). Juvenile sDPS green sturgeon may spend from 1-3 years rearing and maturing in the action area. Sub-adults may spend from several days to several months holding, feeding, or migrating through the action area.

Table 6: Presence of ESA-listed species in the action area adjacent to the Project construction site during in-water construction (July 1 through October 31).

Species	Jul	Jul	Aug	Aug	Sep	Sep	Oct	Oct
Age	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile
CV Spring-run Chinook salmon	No	No	No	No	No	No	No	No
CCV Steelhead	No	No	No	No	Yes (Low[a])	No	Yes (Medium[a])	No
sDPS Green Sturgeon	Year-round	Year-round	Year-round	Year-round	Year-round	Year-round	Year-round	Year-round

[a] Based on the data from the Stanislaus Fish Weir, adult CCV steelhead begin to migrate through the lower San Joaquin River region starting in September, and increasing to higher levels in October and November.

[b] Based on the DJFMP Sacramento trawl and Chipps Island trawl data, very low levels of juvenile steelhead have been observed in July, September, October, and November in the Delta region. Fall pulse flows on the San Joaquin River tributaries and fall storms in the San Joaquin River basin may stimulate out migration of steelhead smolts from the San Joaquin River Basin due to elevated flows similar to the emigration behavior observed in Sacramento River basin fish.

2.5.1. Construction-Related Effects

NMFS expects that adult CCV steelhead as well as low numbers of juvenile and adult green sturgeon are likely to be present in the vicinity of the City of Lathrop outfall location during the in-water construction work window. There is a very low probability that juvenile CCV steelhead may be present during the work-window. It is not expected that there is any potential for the presence of adult or juvenile CV spring-run Chinook salmon at the outfall location during the in-water construction window for the Project. No spawning habitat for CV spring-run Chinook salmon, CCV steelhead, or green sturgeon is present in the action area, therefore no adverse effects to spawning adults, incubating eggs, alevins, fry or parr are expected.

2.5.1.1. Acoustic Stress – Pile Driving

Construction activities are described in the draft EIR (Ascent 2020), Final EIR (Ascent 2021), Project BA (RBI 2020), and Addendum to the BA (RBI 2021). The installation of the cofferdam will require approximately 55 pairs of steel sheets (110 individual sheet piles, each measuring approximately 24 inches in width), with an anticipated production rate of 7 to 8 pairs (14 to 16 individual piles) per day, for a total of 6 to 7 days of driving. Sheets will be installed with a vibratory hammer, with a drive time of about 30 minutes per sheet pile pair. The overall dimensions of the installed cofferdam will be approximately 40 feet long, parallel to the river bank, and approximately 90 feet wide, perpendicular to the river bank for a total linear length of 220 feet. Up to five (5) additional 30-inch diameter steel pipe piles, with 50 feet of embedment, may need to be installed inside the cofferdam to support the internal cofferdam bracing and wale beams. These piles may be driven with an impact hammer and will take up to an hour each to install. An air bubble curtain is anticipated to be deployed during any impact pile driving. Pile driving will occur Monday through Friday, from 7 am to 5 pm. The cofferdam is expected to remain in place for 6 weeks. Removal of the sheet piles and bracing piles is expected to take 5 to

6 days and will use a vibratory hammer to initially loosen the piles prior to pulling them out. The total work window for installation through removal of the cofferdam is 8 weeks.

Installing piles with either a vibratory or impact hammer is expected to result in adverse effects to salmonids and sturgeon due to high levels of underwater sound, but to differing degrees. NMFS considers using a vibratory hammer to be less harmful to fish than that of an impact hammer because of the continuous characteristics of the sound wave produced by a vibratory hammer with lower peak sound pressures (Buehler et al. 2015). While exposure to continuous sound for a long duration could harm fish, noise from an impact hammer is an impulsive sound source with a high intensity and rapid rise time and is known to injure or kill fish.

Driving sheet and pipe piles creates a wave of energy that propagates from the pile location. Sheet and steel pipe piles are driven into the substrate until the hammer encounters a predetermined level of resistance. As the pile is driven into the substrate and meets resistance, a wave of energy travels down the pile, causing it to resonate radially and longitudinally, much like a large bell. Most of the acoustic energy results from the outward expansion and inward contraction of the walls of the steel pile as the compression wave moves down the pile from the hammer to the end of the pile buried in the substrate. Because water is virtually incompressible, the outward movement of the pile followed by the pile walls pulling back inward to their original shape sends an underwater pressure wave that propagates outward from the pile in all directions. The pile resonates, sending a succession of pressure waves as it is pushed several inches deeper into the substrate with each strike (Burgess and Blackwell 2003).

The physical injury or damage to body tissues associated with very high sound level exposure and drastic changes in pressure are collectively known as barotraumas. Fish can survive and recover from some barotrauma, but in other cases, death can be instantaneous, occur within minutes after exposure, or occur several days later. The degree to which an individual fish is affected by underwater sound exposure depends on a number of variables, including differences in sensitivity to acoustic pressure, fish species, presence of a swim bladder, hearing sensitivity, the proximity and linkage of the swim bladder to the inner ear, and fish size (Popper et al. 2003; Ramcharitar et al. 2006; Braun and Grande 2008; Deng et al. 2011). Because the air within a fish's swim bladder is less dense than water or the fish body, the air and swim bladder can be easily compressed by sound pressure waves traveling through the fish's body. As sound pressure waves pass through the fish's body, the swim bladder routinely expands and contracts with the fluctuating sound pressures, resulting in injury through the routine expansion and contraction of the bladder. The characteristics of the sound source also play an important role in its effect to fish. For high sound pressure level exposure, such as impact hammer pile driving, the swim bladder may rapidly and repeatedly expand and contract and pound against the internal organs. This pneumatic pounding may result in hemorrhage and rupture of blood vessels and internal organs, including the swim bladder, liver, and kidneys. External damage, such as loss of scales or hematoma in the eyes or at the base of fins, has also been documented (Yelverton et al. 1975; Wiley et al. 1981; Linton et al. 1985; Gisiner 1998; Godard et al. 2008; Carlson et al. 2011; Halvorsen et al. 2012a; Halvorsen et al. 2012b; Casper et al. 2012).

The severity of injury sustained by a fish may also be dependent upon the amount of air in the swim bladder during sound exposure, which characterizes the state of buoyancy (Govoni et al. 2003; Halvorsen 2012a; Stephenson et al. 2010; Carlson 2012), and the physiological state of fish at the time of exposure. For example, a deflated swim bladder (i.e., negatively buoyant) could put the fish at a lower risk of injury from the sound pressure exposure compared to a fish with an inflated swim bladder (i.e., positively buoyant). Given the rapid rise time of impact hammer pile driving, however, the inability of fish to quickly regulate buoyancy and the inability to know the buoyancy state of the fish during exposure to these sound sources, NMFS assumes the worst-case scenario: that swim bladders are positively buoyant, and, therefore, exposed fishes could be subjected to the highest degree of trauma.

Besides injuries to the soft tissues surrounding the swim bladder, additional acoustic-related injuries can occur within the auditory structures of fish exposed to high intensity sounds. Injury from exposure to high levels of continuous sound manifests as a loss of hair cells of the inner ear (Popper and Hastings 2009), which may result in a temporary decrease in hearing sensitivity or temporary threshold shift (TTS). TTS is considered a temporary reduction in hearing sensitivity due to exposure durations lasting a few minutes to hours. This type of noise-induced hearing loss in fishes is generally considered recoverable because fish, unlike mammals, are able to regenerate damaged hair cells (Smith et al. 2006).

Beyond barotrauma-related tissue damage, additional direct physiological effects to fishes from exposure to sound include increases in stress hormones or changes to other biochemical stress indicators (Sverdrup et al. 1994; Santulli et al. 1999; Wysocki et al. 2006; Nichols et al. 2015). These effects can affect both predation risk by compromising predator evasion and feeding success by affecting prey detection, leading to reduced fitness or survival success.

Besides direct physical injury because of the sound pressure wave, underwater sounds have also been shown to alter the behavior of fishes (see review by Hastings and Popper 2005; Hawkins et al. 2012; Popper et al. 2014; Popper and Hawkins 2018; Popper, Hawkins, and Halvorsen 2019). There is significant variation among species. The potential for adverse behavioral effects will depend on a number of factors, including the sensitivity to sound, the type and duration of the sound, and the life stages of fish present. Observed behavioral responses to anthropogenic sounds may include startle responses, changes in swimming directions and speeds, increased group cohesion, and bottom diving (Engas et al. 1995; Wardle et al. 2001; Mitson and Knudsen 2003; Boeger et al. 2006; Sand et al. 2008; Neo et al. 2014), and “alarm” as detected by Fewtrell et al. (2003) and Fewtrell and MacCauley (2012).

The startle response in fishes is a quick burst of swimming that may be involved in avoidance of predators (Popper 1997). Other potential changes in behavior in response to underwater sounds include reduced predator awareness and reduced feeding (Voellmy et al. 2014a,b; Simpson et al. 2015) and changes in distribution in the water column or schooling behavior (e.g., Skalski et al. 1992; Feist et al. 1992; Engås et al. 1996; Engås and Løkkeborg 2002; Slotte et al. 2004). A fish that exhibits a startle or other behavioral response may not necessarily be injured, but is exhibiting behavior that suggests it perceives a stimulus that indicates potential danger in the immediate environment. Therefore, these types of responses likely do not have a fitness consequence for the individual unless the reaction increases susceptibility to predation or some other negative effect.

The tolerance of sound pressure levels causing either direct injury or behavioral responses varies among species and life stage. Adult salmonids, because of their large size, can usually tolerate higher pressure levels (40 to 50 pounds per square inch [psi]) (Hubbs and Rechnitzer 1952), so immediate mortality rates for adults are expected to be less than those for juvenile salmonids. However, some uncertainty regarding the relative sensitivity of larger fishes remains (Halvorsen et al. 2012b). Given that adult green sturgeon are on average significantly larger than salmon, they could, presumably, tolerate higher levels of sound pressure and be less affected by pile-driving activities. Similarly, juvenile green sturgeon are typically between 200 to 600 mm long (Radtke 1966) by the time, they inhabit the Delta. Because of the similarity in size to adult salmonids, juvenile green sturgeon are expected to be more tolerant than juvenile salmonids of temporary sound disturbances associated with pile driving. Green sturgeon are vulnerable to injury or death from pile driving, however, especially if within close proximity, as demonstrated by the lethal sound pressure levels (SPLs) resulting in the death of a white sturgeon (likely a juvenile) documented during the construction of the Benicia-Martinez Bridge.

Criteria have been established to support assessing acoustics effects to west coast fish species. The Fisheries Hydroacoustic Working Group (FHWG), which consists of representatives from NMFS, USFWS, the Federal Highway Administration, and the West Coast Departments of Transportation, established interim thresholds to assess physical injury to fish exposed to underwater sound produced during impact pile driving (FHWG 2008). Thresholds include a single strike peak sound pressure level of 206-dB (re: 1 micro pascal [μPa]) and an accumulated sound exposure level (SEL) of 187-dB (re: 1 μPa^2-sec) for fish greater than 2 grams and 183-dB (re: 1 μPa^2-sec) for fish less than 2 grams. Physical injury is assumed to occur if either the peak or SEL threshold is exceeded. The SEL limit referred to as “effective quiet,” however, can be used to identify the distance beyond which no physical injury is expected from a single strike, regardless of the number of strikes. The effective quiet currently assumed for fish is 150-dB (re: 1 μPa^2-sec). When the received SEL from a single individual pile strike is below this level, the accumulated energy from multiple strikes is not expected to contribute to injury, regardless of how many pile strikes occur. The effective quiet level is used to identify the maximum distance from the pile where injury to fishes is expected to occur. It is the distance at which the sound from a single strike to a piling attenuates to 150-dB using the SEL measurement metric. At this distance, the cumulative sound exposure, as referenced by the number of strikes to the pile, is calculated to reach the 187-dB $SEL_{accumulated}$ threshold. In addition, the distance at which sound attenuates to a level in which no adverse behavioral effects are anticipated to occur is when the measured sound is less than 150 dB (RMS).

In areas where we have limited information, we have developed assumptions about fish behavior and the recovery time of affected tissue to determine fish response (i.e., avoidance, injury, and death) based on the limited available information. Although fish (including Atlantic salmon) exhibit a startle response during the first few acoustic exposures, they do not move away from areas of very loud underwater sounds and can be expected to remain in the area unless they are carried away by currents or normal movement patterns. Therefore, NMFS assumes that fish will remain in the vicinity of a construction site unless currents or behavior patterns unrelated to loud underwater sound avoidance would indicate that movement is likely to occur.

Although there may be some tissue recovery between the completion of one pile and the beginning of driving at the next, given the level of uncertainty that exists, NMFS will sum the underwater sound energy produced during the installation of all piles on any given day until a break of 12 hours or longer occurs to determine potential physical effects to listed salmonids and sturgeon each day pile driving occurs. NMFS assumes that normal behavior patterns will move any actively migrating salmonids and green sturgeon out of the affected area within 1 day, and therefore, underwater sound energy will not be summed over consecutive days. This would not be the case if the construction site was located in an area where either adult salmonids or sturgeon were spawning or juveniles were rearing for extended periods of time in the action area, in which case they could experience repeated exposures.

2.5.1.1.1. Assessment of Pile Driving Acoustic Effects

Noise modeling was conducted separately by NMFS with the NMFS Underwater Noise Calculation Spreadsheet model (NMFS spreadsheet model; NMFS 2009) and the information provided in the BA regarding the number of sheet and pipe piles, size and composition, and water depth at the Project location. In addition, the California Department of Transportation Compendium of Pile Driving Sound Data (Caltrans Compendium; Buehler et al 2015) provides sound level data on a variety of pile sizes and driver types and this information will be incorporated into the analyses of sound exposure. NMFS used the following sound level data from the Caltrans Compendium for AZ style sheet piles and 30–inch diameter steel pipe piles driven in less than 5 meters of water, if data was available for this depth, as the starting reference values for pile driving sound characteristics.

Sheetpiles: NMFS used the data from the Port of Oakland, Berths 23, 30, and 35/37 as described in the Caltrans Compendium, for the steel sheet piles used in this Project (Table 7).

Table 7: Source sound level characteristics for 24-inch steel sheet piles driven with a vibratory hammer for the Port of Oakland Berth's 23, 30, and 35/37 Projects– unattenuated, measured at 10 meters from piling.

Berth	Depth meters (feet)	Distance meters (feet)	Peak dB	RMS dB	$SEL_{accumulated}$ dB
23	15 (49)	10 (33)	177	163	162
30	15 (49)	10 (33)	175	162	162
35/37	15 (49)	10 (33)	177	163	163
Average			176	163	162

Notes:
24 inch AZ steel sheet piles
Water Depth = 15 meters (49 feet)
SEL measured for 1 second

The use of a vibratory pile-driving hammer is unlikely to cause sound that is sufficiently intense to cause physical injury or death to exposed fish under typical conditions. This is related to the intrinsic characteristics of the waveform and rise time to peak for continuous broadband sound generated by the vibratory hammer. When the swim bladder is excited with continuous broadband sound, the acoustic energy is spread out over a broader range of frequencies and the oscillations cannot synchronize with the continuous signal. Hence, SEL can accumulate to higher levels without harming non-auditory tissues (Hastings 2010). NMFS has not set thresholds for physical injury to non-auditory or auditory tissues or TTS in hearing at this time for broadband sound (i.e., vibratory pile driving generated sound). However, thresholds for behavioral alterations are still valuable in ascertaining the potential for adverse impacts from the pile driving activity. For the proposed sheet pile driving action using a vibratory hammer, the calculated distances to the acoustic parameters for behavioral effects to fish were calculated for each day of pile driving. NMFS current interim standard for behavioral effects is 150 dB RMS. Sound levels below this should not cause behavioral alterations. Recent literature, as described in the addendum to the BA (RBI 2021), suggest that a higher threshold be used (163 dB RMS based on Popper et al [2019]).

The following table (Table 8) provides information regarding the distances in feet or meters to both the 150 dB RMS and 163 dB RMS thresholds for behavioral alterations, based on the information collected for the driving of sheet piles for the Port of Oakland Berths 23, 30, and 35/37 Project. Installing the sheet piles for the cofferdam is anticipated to take 6 to 7 days to complete, with 14 to 16 individual sheet piles installed per day. Removal of the cofferdam is anticipated to take 5 to 6 days, with 16 to 20 sheet piles removed per day. The cofferdam will be in place for approximately 6 weeks between July 1 and October 31. Installation of the sheet piles must take place prior to the beginning of September to allow for the projected schedule of work, and complete removal of the sheet piles by October 31.

Table 8: Distances to 150 dB or 163 dB RMS sound levels for 24-inch steel sheet piles driven with a vibratory hammer based on Port of Oakland data.

Distance to Behavioral Alterations

dB RMS	150 dB RMS	150 dB RMS	163 dB RMS	163 dB RMS
Berth	meters	Feet	meters	feet
23	74	241	10	33
30	63	207	9	28
35/37	74	241	10	33
Average	70	230	10	31

Using the sound values for the three Port of Oakland Berth Projects, the average range that a fish could experience behavioral alterations under the 150 dB threshold will be 70 meters (240 feet). Using the less stringent threshold of 163 dB, the average range for behavioral alterations from the typical sound values will be ~10 meters (31 feet). If the maximum sound values for the sheet piles are used, then the average distance to reach the 150 dB threshold increases slightly to 74 meters (241 feet). Similarly, the distance to the 163 dB threshold increases to 10 meters (33 feet) using the maximum sound values.

The bank to bank width of the San Joaquin River at the location of the outfall structure where the cofferdam will be installed is approximately 75 meters (246 feet). The cofferdam extends approximately 15 meters (50 feet) into the channel from the eastern shoreline at the mean lower low water level (MLLW), and therefore the distance from the outer wall of the cofferdam to the opposite shoreline is approximately 60 meters (~200 feet). Thus, under the more stringent threshold of 150 dB and using the sound values found in the Port of Oakland Berth Projects, essentially the entire width of the San Joaquin River would exceed the threshold values. The deepest part of the channel, the thalweg, where most fish will be expected to be located during their migratory movements is positioned closest to the cofferdam and will be exposed to the highest levels of sound during any installation of sheet piles. The less stringent threshold of 163 dB would extend approximately 10 meters (33 feet) away from the outside wall of the cofferdam and thus extend 25 meters (82 feet) into the channel. This would occupy most of the channel deeper than approximately 1 meter (3.3 feet). The western side of the river channel shoals rapidly from the deeper thalweg and would provide relatively shallow water for any fish passage during the installation of sheet piles.

Steel Pipe Piles: The description for the cofferdam installation also includes the potential use of an impact pile driver to install up to 5 additional 30-inch diameter steel pipe piles to support internal bracing of the cofferdam. The cofferdam will not be dewatered prior to the installation of these bracing support pilings. A bubble curtain will be utilized around each pile during installation to reduce the sound. Buehler et al. (2015) recommends using a 5 dB reduction for air bubble curtains due to the uncertainty associated with the degree of attenuation that will be provided by the air bubble curtain. Likewise, a 5 dB reduction for cofferdams is also recommended due to the uncertainties in attenuation performance. Cofferdams that are not dewatered offer limited attenuation of underwater sound outside of the cofferdam. NMFS will use both a 5 dB and a 10 dB reduction in sound levels to reflect the uncertainties described in Buehler et al. (2015). The Caltrans Compendium provides the following values for a 30-inch diameter steel pipe pile driven by an impact hammer in approximately 3 meters of water (Table 9).

Table 9: Source sound level characteristics for 30-inch steel pipe pile driven with an impact hammer – unattenuated, measured at 10 meters from piling.

Assumed Source Levels (dB) measured at 10 meters, single strike

Water depth measured	Peak	$SEL_{accumulated}$	RMS
± 3 meters	210	177	190

Each Steel piles is assumed to take one hour to be driven into place, in which 15 minutes are assigned to actual pile driving, the remaining 45 minutes are associated with positioning and set up of the pile and hammer. The Project description indicates that up to 5 piles will be needed. NMFS assumes this will occur in one day. NMFS also assumes that there will be one strike per second of the impact hammer, and that a total of 900 strikes per pile will occur to drive the pile to depth. The total number of strikes in one day will be 4,500 strikes. The following table (Table 10) provides the sound characteristics for the cumulative 5 piles without attenuation, and with a -5 dB and -10 dB attenuation reflecting the use of the air bubble curtain and cofferdam.

Table 10: Distances to Threshold Sound Pressure Criteria using NMFS Spreadsheet Model

Attenuation (dB)	Distance to threshold in meters (feet)			
	Onset of Physical Injury	Onset of Physical Injury	Onset of Physical Injury	Behavioral Alterations
	Peak dB	Cumulative SEL dB	Cumulative SEL dB	RMS dB
	All Sizes	Fish ≥ 2g	Fish < 2 g	All Sizes
	206 dB	187 dB	183 dB	150 dB
0 dB	18 (59)	587 (1,926)	631 (2,070)	4,642 (15,230)
-5 dB	9 (29.5)	273 (896)	293 (961)	2,154 (7,067)
-10 dB	4 (13.1)	127 (417)	136 (446)	1,000 (3,281)

Based on these calculations, there is potential for behavioral modifications to fish that remain within a 1,000 meter (3,281 feet) radius of the pile being driven during installation of the bracing support piles within the cofferdam with a 10 dB attenuation. This distance increases to 2,154 meters (7,067 feet) if only 5dB of sound attenuation occurs. There is the potential to exceed the threshold for physical injury if fish larger than 2 grams remain within a 127 meter (417 feet) radius of the pile driving actions (187 dB $SEL_{accumulated}$) or 136 meters (446 feet) if fish are smaller than 2 grams (183dB $SEL_{accumulated}$) for the 10 dB attenuation. If attenuation is only 5 dB, this distance increases to 273 meters for fish larger than 2 grams (187 dB $SEL_{accumulated}$) or 293 meters (961 feet) for fish less than 2 grams (183dB $SEL_{accumulated}$). However, only larger fish greater than 2 grams are expected during the pile driving actions. Single strike injury would extend only 4 meters (13.1 feet) from each pile during installation for any size fish if a 10 dB attenuation was achieved. If attenuation was only 5 dB, then the radius of single strike injury would extend out to 9 meters (29.5 feet) from the pile. Given that the steel pipe piles will be driven adjacent to the sheet pile cofferdam to provide bracing support while still immersed in water, the extent of single strike injury effects would extend out into the river channel and encompass the thalweg of the channel. In addition, significant levels of sound are expected to be transferred through the sediment horizons into the river channel from pile driving actions originating from within the cofferdam. The modeled zone of effects for larger fish (> 2 g) potentially resulting in injury from accumulated sound exposure would cover 100% of the channel width of the San Joaquin River (~75 meters; 246 feet). Any fish swimming through this reach during the impact hammer use would likely suffer some degree of injury and potentially mortality. Likewise, behavioral effects would cover the entire width of the river channel and extend considerable distances upstream and downstream of the cofferdam location until the alignment of the river channel provided natural attenuation of the sound levels through bends in the river channel.

At the end of the levee crossing and outfall construction period, the cofferdam and steel pipe pilings will be removed using a vibratory hammer. This process is anticipated to take 5 to 6 days to complete. Cofferdam removal must begin at least one week prior to the end of October to complete all in-water work by October 31. Acoustic effects are anticipated to be the same as during the installation of the cofferdam for the use of a vibratory hammer.

Fish moving upstream or downstream through the San Joaquin River must pass through the location of the outfall and would be exposed to any pile driving that is simultaneously occurring with their passage. This reach of river is the only route available to salmonids and green sturgeon moving into or out of the San Joaquin River basin upstream of the south Delta under all but flood conditions that overtop the Paradise Cut weir. Flood conditions are highly unlikely to occur during the construction window. In light of the timing of the in-water construction actions, only adult CCV steelhead and adult and juvenile sDPS green sturgeon are likely to be present in the action area adjacent to the pile driving and therefore may be exposed to pile driving related noise. Based on the observations of steelhead passage at the Stanislaus fish weir, adult CCV steelhead begin to be observed moving into San Joaquin River basin tributaries in September, but do not arrive in any substantial numbers until after the middle of September to early October. By mid-October and through the end December, the frequency of adult CCV steelhead observations at the Stanislaus River weir increases. Observation of adult CCV steelhead passage into the Stanislaus River is artificially truncated in most years by the installation of the weir in early September and its removal by the end of December or early January. Adult fish may migrate into and out of the basin, as represented by the Stanislaus River data, outside of the period when the weir is operational. There is a very low probability that juvenile CCV steelhead may be present in the action area during the construction window and thus be exposed to construction related noise. Presence of juvenile CCV steelhead would likely only occur if significant increases in river flows occur either through dam releases or strong fall storms. The occurrence of large dam releases or strong fall storms prior to the end of October is unlikely. Thus, NMFS does not expect that there will be any juvenile CCV steelhead present in the action area during pile driving. Since both juvenile and adult sDPS green sturgeon are observed year–round in the Delta, it is assumed that small numbers of these life stages of green sturgeon will be present in the action area during the entire construction window.

No life stages of CV spring-run Chinook salmon will be directly affected by construction associated noise during the in-water work window since they are not present in the action area associated with the Project’s construction actions during this period of time.

2.5.1.2. Acoustic Stress – Construction Equipment, Bank Work

In addition to the construction and removal of the cofferdam, the Project will entail the construction of a pipeline to carry the treated effluent across the levee crown and down the waterside face of the levee to the outfall structure. This will require trenching and use of heavy construction equipment along the levee road and upon the waterside and landside banks of the levee to transport soils, excavate and grade the foundation areas for the outfall structure and concrete matting, transport rock rip rap, and supply concrete for the construction of the outfall structure and to encase the new pipeline as it crosses the levee prism. The movements of the construction equipment as well as the different construction activities will create noise, both transient and semi-continuous in nature.

Sounds can enter water through a variety of pathways. Sounds may enter from the air, although with strong attenuation of the signal, at the surface of the water (for example shipping and waves), and within the water column itself. In addition, sound may be generated within the substrate, especially by human activities such as pile driving, dredging, and the passage of vehicular traffic along adjacent highways and bridges (Popper and Hawkins 2018). Construction activities such as excavation and grading, as well as vehicular traffic of heavy construction equipment is expected to create vibrations and airborne sounds on the levee adjacent to the San

Joaquin River. These vibrations and sounds are expected to alter the soundscape of the aquatic environment in the adjacent river channel. Vibrations from construction activities and vehicular traffic will create compression waves in the soil of the levee prism that will rapidly propagate through this dense medium to the adjacent river channel. When the compression wave meets the interface between the soil and the overlying water body, a wave is created at the interface. This wave creates both a sound pressure wave that radiates away from the soil-water boundary as well as a localized acceleration of particles in the water (particle motion) (Popper and Hawkins 2018). Fish are able to detect both the sound pressure wave as well as the particle motion (Popper and Hastings 2009, Radford et al. 2012, Hawkins, Pembroke, and Popper 2015, and Popper and Hawkins 2018). The propagation of sound in the shallow-water environment of the San Joaquin River channel is likely to be highly complex, reflecting off of the water surface, from the substrate, discontinuities in the water, and any immersed objects.

Direct effects upon listed fish in the San Joaquin River are associated with the aforementioned construction work, and will produce the underwater sound pressure waves, and particle motion described above, thereby temporarily altering in-river conditions. Noise generated by construction activities are expected to take two main forms: sharp, transient spikes in noise caused typically by metal (such as an excavator bucket or bulldozer blade) striking a hard object, or by rocks falling on top of each other when armoring the levee face with stone rip rap (levee adjacent to the outfall location); and lower frequency or infrasonic sound caused by the movement of construction equipment and their earthmoving and excavation activities. Transient noise spikes that occur in the upland areas of the construction sites will be much lower in magnitude when they reach the water, losing energy as the sound travels through the soil and through the soil/water interface into the active channel. There is a very low potential for direct injury or mortality due to the short duration of transient spikes and the nature of their wave rise form. Transient noise is more likely to result in behavioral reactions in exposed fish, such as a startle response. Low frequency or infrasonic noise is also likely to have a low potential for causing direct injury to exposed fish. It is more likely to cause behavioral responses, such as avoidance or movement away from the noise source, or a delay in migration past the location of the noise source.

Only those fish that are holding adjacent to or migrating past the cofferdam and outfall construction site will be directly exposed or affected by construction related noise. Those fish that are exposed to the effects of construction activities will encounter short-term construction-related noise for several hours during the day adjacent to the outfall location. The Project will only have construction work occurring during the day, with a period of relative quiet during the night when construction activities are halted. No work is anticipated to occur on weekend days. Although direct injury or harm is unlikely, behavioral avoidance may cause injury or harm by increasing the susceptibility of some individuals to predation by temporarily disrupting normal sheltering behaviors. These changes may also impair feeding behaviors, which in turn impact their ability to grow and survive. Fish, especially adults, often respond to construction activities by quickly swimming away from the construction sites, resulting in the majority escaping direct physical injury. Avoidance of the reach of river with construction related noise may prolong or inhibit migratory behavior through that reach. This is considered a form of harassment that results in the "take" of exposed fish.

Based on the timing of the construction actions, a medium numbers of adult CCV steelhead and a small number of adult and juvenile sDPS green sturgeon are likely to be present in the action area during the construction window of July 1 through October 31, and therefore will be exposed to construction related noise as explained in the previous section. It is very unlikely that juvenile life stages of CCV steelhead will be present during the construction window. No life stages of CV spring-run Chinook salmon will be directly affected by construction associated noise during the construction work window since they are not present in the action area during this period of time.

2.5.1.3. Increased Turbidity

Excavation of the levee crown and waterside levee face for the effluent pipeline will create conditions that can increase the amount of local water turbidity through erosion of exposed soils through precipitation runoff and by soils dislodged by winds during construction being carried into adjacent San Joaquin River waters. In addition, resuspension of channel sediment during the installation and removal of the sheet piles used for the cofferdam will also create localized turbidity. Finally, placement of rock rip rap in the waterside of the levee which has not been previously washed can introduce fine soils to the river as water washes through the rip rap when inundated.

Responses of salmonids to elevated levels of suspended sediments often fall into three major categories: physiological effects, behavioral effects, and habitat effects (Bash et al. 2001). Salmonids exposed to slight to moderate increases in turbidity exhibited avoidance, loss of station in the stream, reduced feeding rates and reduced use of overhead cover. Reaction distances of rainbow trout to prey were reduced with increases of turbidity of only 15 NTUs over an ambient level of 4 to 6 NTUs in experimental stream channels (Barret et al. 1992). While juvenile steelhead seem to prefer foraging in slightly turbid waters (Sigler et al., 1984; Gregory, 1988), juvenile steelhead display reduced growth rates in 25 NTU (Berg, 1982), and mobile juvenile steelhead tend to avoid areas with turbidities over 167 NTU (Sigler, 1980). CV spring-run Chinook juveniles are assumed to have similar reactions to turbidity.

Increased turbidity, used as an indicator of increased suspended sediments, also is correlated with a decline in primary productivity, a decline in the abundance of periphyton, and reductions in the abundance and diversity of invertebrate fauna in the affected area (Lloyd 1987, Newcombe and MacDonald 1991). These impacts to the aquatic environment decrease the availability of food resources for salmonids and sturgeon through trophic energy transfers from the lowest trophic levels (i.e., phytoplankton and periphyton) through intermediate levels (e.g., invertebrates) to higher trophic levels (i.e., salmonids and sturgeon).

Based on the timing of construction, it is unlikely that any other listed salmonid other than adult CCV steelhead, will be present during the construction window. It is expected that any adult steelhead will move away from any turbidity plume and seek waters that are more acceptable to their preferences. It is very unlikely that any juvenile CCV steelhead will be present during the construction window and thus be exposed to construction related turbidity. Furthermore, NMFS anticipates adherence to the BMPs described above in the Proposed Action section will greatly minimize the risk of injury or death caused by increases in turbidity. The Project description indicates that a SWPPP will be developed and implemented for the Project that identifies specific

BMPs to avoid and minimize Project effects on water quality, and that the Project will have all appropriate NPDES permits in place before construction starts. Thus, effects of short-term turbidity increases associated with construction will be minor.

Evaluation of hourly ambient turbidity levels at the Mossdale water quality monitoring gage (MSD) from the California Data Exchange Center (CDEC) website for the in-water work window of July 1 through October 31 covering the years 2017 through 2020 shows that ambient turbidity is typically low (less than 30 NTU) with rare spikes to 45-60 NTU during these months. Previous consultations with the USCOE on projects in the Delta have shown that project related turbidity effects are usually confined to 100 – 200 meters downstream of the project location.

It is expected that both juvenile and adult sDPS green sturgeon will be present during the construction window. Increases in turbidity and sedimentation events are not expected to affect visual feeding success of green sturgeon, as they are not believed to utilize visual cues (Sillman et al. 2005). Green sturgeon, which can occupy waters containing variable levels of suspended sediment and thus turbidity, are not expected to be impacted by the increases in the turbidity levels anticipated from the proposed project directly, but would suffer secondary effects due to impacts on the habitat (i.e., invertebrate forage base populations).

2.5.1.4. Contaminants

Based on the timing of the construction window, a medium number of adult CCV steelhead, and a small number of adult and juvenile sDPS green sturgeon are expected to be present during the period of construction activities that might cause the release of contaminants. As stated previously, it is very unlikely that juvenile CCV steelhead will be present during the construction window. It is also not expected that any life stages of CV spring-run Chinook salmon will be present during the construction window and thus potentially be exposed to any spill of contaminants related to the construction of the Project.

Toxic substances used at construction sites, including gasoline, lubricants, and other petroleum-based products, could enter the waterway as a result of spills or leakage from machinery and injure listed salmonids and green sturgeon exposed to these substances. Petroleum products also tend to form oily films on the water surface that can reduce the exchange of oxygen between the atmosphere and the water, thus reducing the concentration of dissolved oxygen available to aquatic organisms. The exposure to these substances can kill fish directly in high enough concentrations through acute toxicity or suffocation from lack of oxygen. These chemicals may also kill the prey of listed fish species, reducing their ability to feed and therefore grow and survive.

However, due to adherence to BMPs that dictate the use, containment, and cleanup of contaminants, the use of toxic substances within the action area is unlikely to negatively impact listed fish species. NMFS expects that in the unlikely event a spill does occur, that it will not reach the river due to the implementation of the construction BMPs. The risk of exposure to any contaminants from a spill is extremely small and not expected to occur.

2.5.1.5. Cofferdam Dewatering and Fish Relocation

The cofferdam is located within the channel of the San Joaquin River adjacent to the eastern levee bank. It extends out into the channel approximately 50 feet from the mean water level elevation and includes a substantial portion of the thalweg, including the deepest portions of the channel cross section at this location. Most fish, including adult CCV steelhead and adult and juvenile sDPS green sturgeon will move along the deepest part of the channel during their migrations. The placement of the cofferdam will cause the outer wall to intercept upstream migrating fish during construction and before closure because much of the thalweg is inside of the outer wall of the cofferdam. This is more likely to happen at night when construction activities and pile driving are suspended per the project description and the ambient sound levels are much lower surrounding the installation site. Any fish within the cofferdam at day break has the potential to be exposed to the start of pile driving and its associated sound if it has not already vacated the enclosed space. At the conclusion of the cofferdam installation, the remaining opening to the outside river waters will be closed off. Fish within the enclosed waters of the cofferdam would likely move to the farthest end of the cofferdam seeking quieter sound levels away from the pile driving activities, resulting in the entrapment of any fish remaining within the cofferdam's enclosed waters.

After closure of the cofferdam, but before dewatering starts, the Project description indicates that up to 5, 30-inch diameter steel pipe pilings will be driven into the enclosed space behind the cofferdam walls with an impact pile driving hammer. The level of sound generated by the impact pile driver within the enclosed space of the cofferdam, even with the sound attenuation proposed, is likely to injure or kill any fish within the space. The farthest distance a fish could be to avoid the sound is approximately 60 feet (the length of the enclosure's diagonal. There is a high likelihood that fish will be within range of the single strike peak sound levels that can cause injury or death during the impact pile driving (Table 10). Likewise, the cumulative sound levels that may cause injury or death encompass the entire area behind the cofferdam (Table 10).

During the period it takes to install the support piles and the dewatering of the cofferdam, the water quality conditions within the enclosed space will begin to deteriorate. It is expected that water temperatures will increase and dissolved oxygen (DO) levels will diminish, as the enclosed water is isolated from the main channel. In addition, the proposed period of in-water construction occurs during a period of the year where average daily air temperatures in the region are in the range of 64° F to 77 ° F (17.8° C to 25.0° C) with maximums in the upper 90°F to low 100°F ranges (~32° C to 40.5° C). Higher water temperatures and low DO levels will be deleterious to the survival of any listed CCV steelhead or sDPS green sturgeon within the confined space behind the cofferdam.

Dewatering will occur in phases using screened hoses to the pumps to avoid entrainment of fish. The Project description indicates that the screened inlets to the hoses will be oriented near the surface to further avoid entrainment of any fish present. As the water level within the cofferdam is reduced, the construction of bracing will proceed in incremental steps so as to provide structural support to the cofferdam walls. Thus, the rate of water drawdown within the cofferdam is controlled by the progress of the bracing construction. This phased approach to dewatering will add additional stress to any surviving fish as the water surface elevation decreases and the volume of water available to fish diminishes over a prolonged period, with construction work within the cofferdam area occurring simultaneously.

The procedures for carrying out the fish relocation for any fish entrapped in the cofferdam enclosed area is described in the BA and the addendum to the BA (RBI 2020, 2021) for CM6 (Cofferdam Area Fish Relocation). The process of the fish relocation will cause stress and potential injury and death as any surviving fish are pursued in the attempt to capture them. Low DO and elevated water temperatures will exacerbate the physiological stress induced by the pursuit and capture in the seines and dip nets. There is the potential for fish that are captured and transported to the river to undergo shock and lose their ability to maintain equilibrium and swimming capacity, as well as having diminished respiratory capacity and gill ventilation. Fish in this state are unlikely to survive following their release into the river without proper resuscitation efforts.

As stated previously, it is very unlikely that juvenile CCV steelhead will be present during the construction window. It is also not likely that any life stages of CV spring-run Chinook salmon will be present during the construction window and thus potentially be exposed to any entrapment related to the construction of the Project. Based on the timing of the construction window, adult CCV steelhead, and adult and juvenile sDPS green sturgeon are expected to be present and thus become entrapped within the cofferdam. For the small numbers of steelhead and sDPS green sturgeon entrapped behind the cofferdam and exposed to dewatering and relocation, NMFS expects that the majority will die due to exposure to very high sound levels from the impact pile driving in an enclosed space and the degradation of the water quality within the confined space behind the cofferdam wall and the levee face during dewatering. For those fish that do survive pile driving and dewatering, high stress levels resulting from pursuit and capture are likely to cause mortality prior to or immediately after release into the lower San Joaquin River.

2.5.1.6. Outfall Structure - Concrete Leaching

The use of concrete in water can cause environmental concerns, including the releases of hydroxylated ions, such as aluminum, calcium, chromium, magnesium, sodium, potassium, and zinc hydroxides, into surrounding waters resulting in the increase of the pH of the water due to leaching from concrete (Law and Evans 2013). When the pH of freshwater becomes more alkaline, it can become toxic to fish and other aquatic organisms. The higher pH can injure the skin, gills, and eyes of exposed organisms. In fish, exposure of the gills to higher pH increases the secretion of mucus on the gill lamellae, which interferes with the exchange of oxygen and other gases across the cell membranes. In addition, even relatively small changes in the pH of the ambient water can change the speciation of ions. For example, ammonia will become 10 times more toxic when the pH changes from pH 7 to pH 8 (Law et al 2013, Law and Evans 2013). The increase in pH from concrete leachate is due to the leaching of hydroxyl ions (OH^-) into the surrounding water from the internal cement matrix as part of the long term curing process.

When fresh concrete is exposed to water, there is an initial sharp increase in pH, which is attributed to the hydration process. In Portland cement concrete, the cement undergoes hydration upon addition of the mix water to form calcium-silicate-hydrate gel (C-S-H gel) and calcium hydroxide ($Ca(OH)_2$). As the concrete cures, less unreacted concrete is present, and the $Ca(OH)_2$

is leached from the concrete, followed by dissolution of the C-S-H gel, both of which are long-term processes. The initial sharp rise in fresh concrete is attributed to the higher level of unreacted concrete, but the presence of the C-S-H gel and $Ca(OH)_2$ over the longer term sustains the release of OH^- ions and the increased pH in surrounding waters (Law et al 2013). Studies examining the effect of old weathered concrete used as highway ballast on leachate pH has also shown that pH will increase following exposure to water (Steffes 1999). Thus, the concrete outfall structure will serve as a source for OH^- ions into the future.

The impacts of the increased pH on surrounding waters will be reduced due to the constant flow and dilution of the water moving past the structure. However, changes in pH will occur immediately adjacent to the surfaces of the outfall's concrete surfaces, and may affect the speciation of compounds within the effluent stream passing over these surfaces. The changes in speciation may cause compounds and chemical constituents in the effluent to change their level of toxicity or bioavailability to organisms exposed to the immediate effluent plume within and in close proximity to the concrete outfall structure.

Based on the timing of the construction window, medium numbers of adult CCV steelhead, and small numbers of adult and small numbers of juvenile sDPS green sturgeon are likely to be present during the period of construction activities that are likely to cause the initial release of OH^- ions from the fresh concrete. Fish response to exposure is expected to include depression of respiratory function and gas exchange across the gills as well as exposure to potentially more toxic forms of contaminants due to changes in speciation from the higher pH levels surrounding the outfall structure. This will lead to reduced fitness and health in exposed fish. As stated previously, it is very unlikely that juvenile CCV steelhead will be present during the construction window. It is also not likely that any life stages of CV spring-run Chinook salmon will be present during the construction window and thus potentially be exposed to any initial increase in pH related to the construction of the outfall. However, as complete curing of concrete can be a prolonged process, all life stages of CCV steelhead, sDPS green sturgeon, and CV spring-run Chinook salmon are expected to be exposed to less elevated levels of pH caused by the diminishing release of OH^- ions from curing concrete in the outfall structure. This may occur over several weeks to months, and is expected to result in reduced fitness and health of exposed fish, but at a level lower than fish exposed to fresh concrete.

2.5.2. Long-term Effects from Structures and Operations of the Project

During the long-term actions of this Project, adult and juvenile life stages of CCV steelhead, CV spring-run Chinook salmon, and sDPS green sturgeon will present in the San Joaquin River channel adjacent to the Project's outfall. Since spawning areas for all three species do not occur within the action area, no eggs are expected to be present at any time. There is no documented spawning of sDPS green sturgeon in the San Joaquin River basin, therefore no larval life stages are anticipated to be present in the action area. The timing of the three different species' presence in this region has been described in Section 2.4.2 *Status of the Species and Critical Habitat in the Action Area*.

2.5.2.1. Effluent Discharge to the San Joaquin River

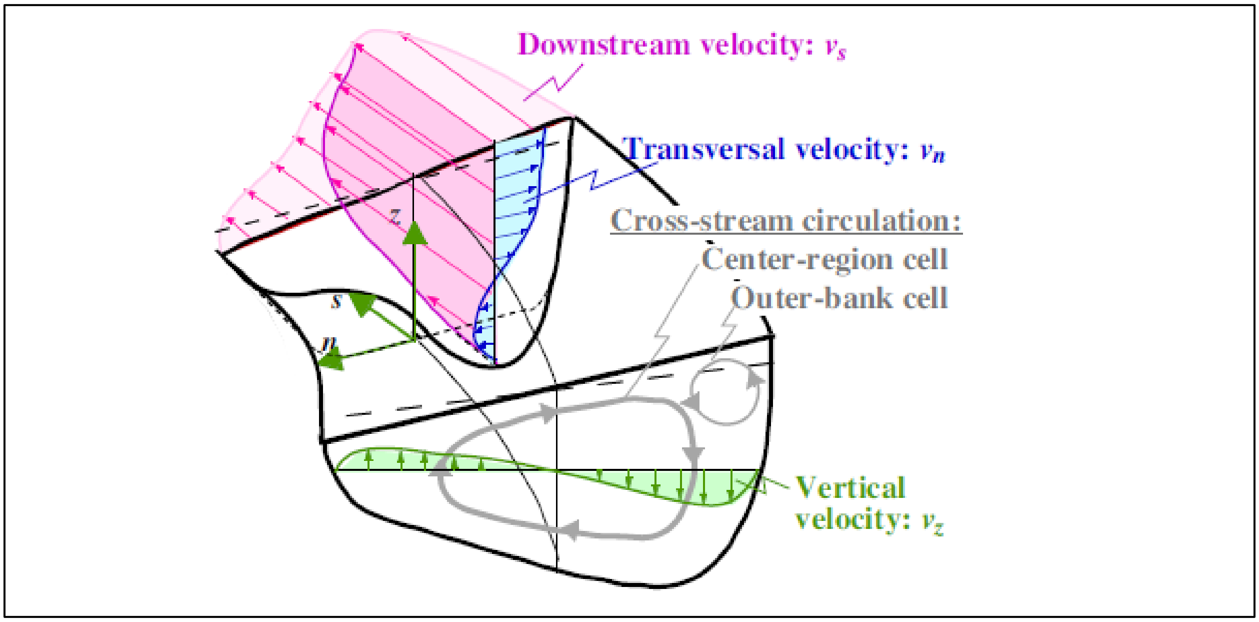
The effluent discharged from the City of Lathrop's outfall has the potential to affect the physio-chemical properties of the lower San Joaquin River. The effluent will carry chemical constituents from the wastewater treatment plant into the lower San Joaquin River that can adversely affect aquatic life in the river following exposure. Likewise, differences in temperatures between the effluent and receiving waters will cause local increases in the river's water temperature prior to mixing and dilution. In order to minimize potential negative effects, the effluent discharge relies on dilution and mixing in the river to lower constituent concentrations below criteria protective of aquatic life and minimize the effects of thermal loading.

2.5.2.1.1. Circulation Patterns at River Bends

The circulation patterns of the river water within the San Joaquin River adjacent to the location of the outfall is complex, and is not as simple as modeled for the effluent discharge using the CORMIX model as provided in the BA (i.e., a straight channel with uniform flow patterns). This complexity will change the way the effluent is diluted and the spatial cross section of the plume within the river channel. Although the CORMIX model provides a reasonable approach to modeling the dilution of the effluent over a large area, it cannot model the complexity of circulation that will occur at the outfall location and to which fish will be exposed.

The outfall location is on an outside bend of the river, with the channel's deepest sections immediately adjacent to the outside bend of the river (i.e. the thalweg). As described in Graf and Blanckaert (2002), the downstream velocity increases in an outwards direction towards the outside bank and the core of maximum velocities is found in the lower part of the water column close to the outer bank. The cross-stream motion contains two cells of circulation: the classical helical motion of the center region and a weaker, counter-rotating cell along the outer bank at the surface (Figure 12). When taken together with the normal downstream direction of flow, the pattern of circulation is similar to a spiral or helix, with the water and any materials carried with it moving downstream in this pattern.

Figure 12: Conceptual diagram of flow circulation in an open channel bend (from Graf and Blanckaert 2002).



Therefore, the effluent stream discharged from the outfall would move across the bottom of the channel towards the opposite inside bank before surfacing and moving back across the channel towards the outside bank, following the helical circulation pattern. This would disperse the effluent plume in a shorter distance than modeled, with more of the channel's cross section involved. This circulation pattern has the potential to create a greater gradient in the dilution of the effluent's constituents, across a shorter distance, as compared to the more gradual dilution modeled in the BA. Fish are expected to be exposed to a sharper gradient of the effluent plume that covers a wider width of the river channel, resulting in behavioral avoidance of the plume and exposure to higher ambient concentrations of chemical constituents in the plume before dispersion into the receiving waters of the river channel.

2.5.2.1.2. Chemical Constituents

The discharge of treated effluent from the CTC will be regulated by a new NPDES permit issued by the Regional Board for discharge to the San Joaquin River. To support the City's request for an NPDES permit, the CTF effluent was monitored for priority pollutants and other constituents of concern typically required in Regional Board NPDES permits. These permits stipulate limits on the discharge regarding permissible total maximum daily loads (TMDLs) present in the receiving waters and for aquatic life criteria for constituents in the wastewater effluent as appropriate (USEPA 2018). While these aquatic life criteria have helped to improve water quality regarding specific toxins and chemical constituents, often this system is not sufficiently protective for listed species that may be more sensitive than the sampled/experimental species used to establish the criteria. In addition, treated wastewater effluent delivers a wide variety of chemical constituents to aquatic ecosystems, many of which are not listed by the USEPA or SWRCB, and thus have no aquatic criteria associated with them. Therefore, discharge of such pollutants often goes unregulated and uncontrolled and can have detrimental impacts on exposed aquatic life, including anadromous listed species in the receiving waters.

The BA provides baseline data for San Joaquin River water quality for the commonly detected constituents observed in the CTF effluent monitored under current permits. The data used for this baseline condition was collected by the City of Manteca for compliance with its NPDES permit that regulates its CTF discharges to the river (Table 11). The data is applicable for the baseline conditions for this Project as the monitoring location for the City of Manteca is a short distance upriver of the Project's outfall location.

With implementation of the Project, the CTF will discharge effluent to the San Joaquin River. This discharge does not occur under the baseline condition. The additional discharge will minimally add to the flow, wetted perimeter, and depth of the San Joaquin River, compared to current ambient river flows. At 2.5 mgd ADWF (3.1 cfs; near-term under the City's initial NPDES permit), the CTF discharge averages 0.2-0.8 percent of river flow, depending upon the month. At 6.0 mgd ADWF (9.3 cfs; at City buildout under the General Plan), the CTF discharge averages 0.5-1.9 percent of river flow, depending upon the month. As such, the Project will have minimal effects on river flow and flow-associated physical channel characteristics including flow velocity, scour, and river bed substrate transport due to the minor increase in total river discharge. Addition of the discharge will have negligible effects on water surface elevations downstream of the outfall location.

The BA assessed the impacts of the effluent discharge on the fully mixed river concentrations downstream of the discharge point, based on the anticipated concentrations in the effluent at the outfall derived from current operating conditions. For the following constituents, aluminum, copper, and selenium, the measured effluent concentrations under current operations have concentrations that were below the aquatic criteria for acute and chronic concentrations. These constituent concentrations were further reduced upon full mixing in the river (Tables 12, 13, and 14). Thus, the effluent was determined to not contribute to any exceedances of the applicable water quality criterion for these three constituents.

Table 11: Baseline San Joaquin River water quality summary statistics for constituents generally detected in CTF effluent (From RBI 2020).

Constituent [1]	Units	MinimumDetected Concentration	Average Concentration [2]	MaximumDetected Concentration
1,2-Dibromo-3-chloropropane (DBCP)	µg/L	n/a	0.07	n/a
Aluminum	µg/L	277	1232.5	4200
Ammonia (as N)	mg/L	0.02	0.15	0.5
Antimony	µg/L	n/a	0.2	n/a
Arsenic	µg/L	1.3	1.58	1.9
Barium	µg/L	20.5	39.23	76.5
Bis (2-Ethylhexyl) Phthalate	µg/L	n/a	0.55	n/a
BOD (5-Day)	mg/L	0.7	1.72	5.1
Boron	µg/L	23.7	81.2	257
Bromoform	µg/L	n/a	0.04	n/a
Cadmium	µg/L	0.06	0.06	0.07
Chloride	mg/L	5.5	23	77.7

Constituent [1]	Units	MinimumDetected Concentration	Average Concentration [2]	MaximumDetected Concentration
Chlorodibromomethane	µg/L	n/a	0.05	n/a
Chloroform	µg/L	0.23	0.1	0.23
Chromium	µg/L	1.2	3.92	9.2
Chromium (VI)	µg/L	0.028	0.04	0.062
Copper	µg/L	1.1	2.8	8.6
Dichlorobromomethane	µg/L	n/a	0.05	n/a
Dissolved Organic Carbon	mg/L as C	2.5	3.35	5.3
Dissolved Oxygen	mg/L	6.2	10.3	17.7
Electrical Conductivity	µmhos/cm	69.8	525	1140
Fluoride	mg/L	0.05	0.07	0.09
Foaming Agents (MBAS)	mg/L	n/a	0.01	n/a
Hardness (as CaCO3)	mg/L	26	133	253
Iron	µg/L	499	1683.75	5430
Lead	µg/L	0.2	0.95	4
Manganese	µg/L	38.3	94.52	303
Mercury	ng/L	1.46	4.91	17.9
Methyl Mercury	ng/L	0.04	0.15	0.456
Molybdenum	µg/L	0.8	1.09	2.1
Nickel	µg/L	1.3	3.59	11.5
Nitrate (as N)	mg/L	0.07	0.56	1.49
Phosphorus (as P)	µg/L	0.1	0.14	0.31
pH	standard units	5.7	7.5	9.7
Selenium	µg/L	0.4	0.42	0.4
Silver	µg/L	n/a	0.05	n/a
Sulfate	mg/L	5.8	22.08	68.7
Sulfite (as SO3)	µg/L	n/a	0.5	n/a
Thallium	µg/L	0.2	0.21	0.2
Total Dissolved Solids (TDS)	mg/L	28	245	653
Total Organic Carbon	mg/L as C	2.8	3.64	6.2
Turbidity	NTU	2.18	13.17	62.3
Zinc	µg/L	1.6	7.43	18.1

Notes:
1 Parameters reported as total unless otherwise noted.
2 For data sets with a mix of detect and non-detect results, or all non-detect results, the average was calculated by using one-half thedetection limit of each non-detect sample result. This approach is consistent with the handling of non-detect results described in the Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California, State Water Resources Control Board 2005.
n/a – not applicable

Table 12: Concentrations of total aluminum in the CTF effluent and San Joaquin River under Project conditions (From RBI 2020).

Scenario	Maximum CTF Effluent Concentration a (µg/L)	River Concentration (µg/L)	River Concentration (µg/L)	River Concentration (µg/L)	Incremental Change	Incremental Change	Lowest Applicable Water Quality Criterion [e] (µg/L)
		Baseline [b]	Project at 2.5 MGD [c]	Project at 6.0 MGD [c]	Project at 2.5 MGD [d]	Project at 6.0 MGD [d]	
Acute Conditions							
Minimum River Background Concentration	186	277	271	264	-6	-13	660 (CMC)
Maximum River Background Concentration	186	4,200	3,957	3,630	-243	-570	660 (CMC)
Chronic Conditions							
Minimum River Background Concentration	186	277	271	264	-6	-13	280 (CCC)
Maximum River Background Concentration	186	4,200	3,957	3,630	-243	-570	280 (CCC)

CCC = criterion continuous concentrationCMC = criterion maximum concentration

[a] From monitoring conducted by the City of Lathrop in 2017 – 2020.

[b] Baseline concentrations represented by data from the City of Lathrop at RSW-001.

[c] Modeled concentration.

[d] Project minus Baseline.

[e] USEPA (2018) national recommended ambient water quality criterion; based on the lowest concurrent pH (6.5) and hardness (58 mg/L $CaCO_3$) and a minimum measured dissolved organic carbon in the San Joaquin River (2.5 mg/L).

Table 13: Concentrations of total copper in the CTF effluent and San Joaquin River under Project conditions (From RBI 2020).

Scenario	Maximum CTF Effluent Concentration a (µg/L)	River Concentration (µg/L)	River Concentration (µg/L)	River Concentration (µg/L)	Incremental Change	Incremental Change	Lowest Applicable Water Quality Criterion e (µg/L)
		Baseline b	Project at 2.5 MGD c	Project at 6.0 MGD c	Project at 2.5 MGD d	Project at 6.0 MGD d	
Acute Conditions							
Minimum River Background Concentration	0.97	1.1	1.48	1.98	0.38	0.88	4.6 – 17 (CMC; in-stream); d
Maximum River Background Concentration	7.33	8.6	8.52	8.42	-0.08	-0.18	15 – 36 (in effluent) e
Chronic Conditions							
Minimum River Background Concentration	0.97	1.1	1.48	1.99	0.8	0.89	3.4 – 11 (CCC; in-stream)d
Maximum River Background Concentration	7.33	8.6	8.52	8.42	-0.08	-0.18	9.9-22 (in effluent);e

CCC = criterion continuous concentration
CMC = criterion maximum concentration
[a] From monitoring conducted by the City of Lathrop in 2017 – 2020.
[b] Modeled concentration.
[c] Project minus Baseline.
[d] California Toxics Rule criterion; based on modeled minimum hardness of 31 mg/L (as CaCO3) and maximum of 126 mg/L (as CaCO3)with Project at 2.5 MGD and for hardness adjusted effluent.
[e] California Toxics Rule criterion; based on minimum effluent hardness of 107 mg/L (as CaCO3) and maximum of 275 mg/L (as CaCO3).

Table 14: Concentrations of total selenium in the CTF effluent and San Joaquin River under Project conditions (From RBI 2020).

Scenario	Maximum CTF Effluent Concentration [a] (µg/L)	River Concentration (µg/L)	River Concentration (µg/L)	River Concentration (µg/L)	Incremental Change	Incremental Change	Lowest Applicable WaterQuality Criterion (µg/L)
		Baseline [b]	Project at 2.5 MGD [c]	Project at 6.0 MGD [c]	Project at 2.5 MGD [d]	Project at 6.0 MGD [d]	
Minimum River Background Concentration	0.717 (Maximum)	0.40	0.42	0.45	0.02	0.05	5.0 (CTR CCC) 3.1 [e] (chronic; lotic systems)
Maximum River Background Concentration	0.717 (Maximum)	0.40	0.42	0.45	0.02	0.05	
Average River Background Concentration	0.561 (Average)	0.42	0.43	0.44	0.01	0.02	--

CCC = criterion continuous concentration

[a] From monitoring conducted by the City of Lathrop in 2017 – 2020.

[b] Measured concentrations for the maximum and minimum values; average determined by using half the detection limit for non-detects.

[c] Modeled concentration.

[d] Project minus Baseline.

[e] USEPA (2016) National Ambient Water Quality Criteria for Selenium; lotic water column criterion. Not yet adopted for California.

Additional constituent were also assessed (Table 15) which include arsenic, cadmium, chromium (total and hexavalent), iron, lead, mercury (total and methyl-mercury), nickel, silver, and zinc. Fully mixed concentrations of arsenic, cadmium, and chromium (total and hexavalent) downstream of the outfall will be minimally higher than baseline concentrations with the Project, by a magnitude of <1 µg/L. However, all concentrations for these constituents in the fully mixed river will be less than the constituent's applicable water quality criteria for the protection of aquatic life (Table 15). Concentrations of iron, mercury (total and methylmercury), lead, and nickel with the Project will be lower than baseline concentrations, because the effluent concentrations are lower than ambient baseline river concentrations, and with full mixing will result in further dilution of the ambient river concentrations for those constituents. Furthermore, all effluent concentrations for these constituents will be less than the lowest applicable water quality criterion for that constituent.

Table 15: Concentrations of trace metals in the CTF effluent and San Joaquin River under Project conditions (From RBI 2020).

Constituent	Maximum CTF Effluent Concentration [a] (µg/L)	Maximum River Concentration (µg/L)	Maximum River Concentration (µg/L)	Maximum River Concentration (µg/L)	Incremental Change	Incremental Change	Lowest Applicable WaterQuality Criterion (µg/L) [e]
		Baseline [b]	Project at 2.5 MGD [c]	Project at 6.0 MGD [c]	Project at 2.5 MGD [d]	Project at 6.0 MGD [d]	
Acute Conditions –							
Arsenic	8.42	1.9	2.3	2.8	0.4	0.9	340
Cadmium	0.178	0.07	0.08	0.09	0.01	0.02	1.2 [f]
Chromium	14.5	9.2	9.5	10.0	0.3	0.8	665 [f,g]
Chromium VI	0.103	0.062	0.065	0.068	0.03	0.06	16
Iron	60.2	5430	5017	4598	-323	-742	None
Lead	1.18	4	3.83	3.60	-0.17	-0.40	18 [f]
Mercury (total)	0.0036	0.0179	0.0170	0.0159	-0.0009	-0.0020	1.4
Mercury (methyl)	0.000042	0.00046	0.00043	0.00040	-0.00003	-0.00006	None
Nickel	2.390	11.5	10.9	10.2	-0.6	-1.3	174 [f]
Silver	0.969	<0.25	0.29	0.35	0.04	0.10	0.54 – 6.0 (in-stream); [h] 4.6 – 23 (in effluent) [i]
Zinc	93.4	18.1	22.7	28.8	4.6	10.7	44 – 146 (in-stream) [h] 126 – 282 (in effluent) [i]
Chronic Conditions							
Arsenic	8.42	1.9	2.3	2.8	0.4	0.9	150
Cadmium	0.178	0.07	0.08	0.09	0.01	0.02	1.0 [f]
Chromium	14.5	9.2	9.5	10.0	0.3	0.8	79 [f,g]
Chromium VI	0.103	0.062	0.064	0.068	0.02	0.06	11
Iron	60.2	5430	5020	4590	-320	-750	1,000
Lead	1.18	4	3.83	3.60	-0.17	-0.40	0.72 – 4.3 (in-stream); [h] 3.5 – 11.5 (in effluent) [i]
Mercury (total)	0.0036	0.0179	0.0170	0.0159	-0.0009	-0.0020	0.77
Mercury (methyl)	0.0000419	0.000456	0.00043	0.00040	-0.00003	-0.00006	None
Nickel	2.390	11.5	10.9	10.2	-0.6	-1.3	19.4 [f]
Silver	0.969	<0.25	0.29	0.35	0.04	0.10	None
Zinc	93.4	18.1	22.7	28.8	4.6	10.7	44 – 146 (in-stream); [h] 126 – 282 (in effluent) [i]

[a] From monitoring conducted by the City of Lathrop in 2017 – 2020.

[b] Maximum measured concentrations from RSW-001; averages determined by using half the detection limit for non-detects.

[c] Modeled concentration.

The Project could also result in small increases in silver and zinc concentrations, relative to baseline conditions as the effluent concentrations are higher than the ambient river concentrations. Although effluent concentrations were near the acute and chronic water quality criteria for silver and zinc, they were always below these thresholds when adjusted for sample specific water hardness. Likewise, riverine concentrations would not exceed applicable water quality criteria based on the lowest measured water hardness in the receiving water.

NMFS however cautions that the margin of safety between effluent concentrations for aluminum, copper, silver, and zinc and their respective aquatic criteria are not large. Small perturbations in either the effluent concentration of these constituents, or a reduction in the ambient water hardness or dissolved organic carbon (DOC) levels could lead to adverse physiological or behavioral outcomes to exposed fish. For example, very low concentrations of copper (< 5 µg/L levels) have been shown to alter and decrease the olfactory response of salmonids, including Chinook salmon and rainbow trout (Kennedy et al 2012, Baldwin et al. 2003, Sandahl et al. 2007, Hecht et al. 2007). This sensitivity can be ameliorated by increasing water hardness or DOC, which creates metal ion complexes with the copper ions reducing their bioavailability. Small changes in the ambient levels of water hardness or DOC in the San Joaquin River could increase the toxicity of these metals, increasing the percentage of fish that may be at risk of exhibiting detrimental effects.

The Project will produce tertiary treated effluent with very low ammonia concentrations compliant with the NPDES permit effluent limitations for ammonia. Ammonia concentrations in the CTF effluent were at or below detection limits (≤0.2 mg/L) in all samples. With the Project achieving compliance with the anticipated ammonia effluent limitations in the undiluted effluent, the CTF discharge could not cause exceedances of the acute or chronic criteria for aquatic life protection in the San Joaquin River. Because ammonia concentrations in the CTF effluent average 0.05 g/L as N, they will remain below water quality criteria and are expected to be lower that river background levels, which average 0.15 g/L, as N.

Effluent discharged from the CTF is expected to have a pH that remains within the range of 6.5 to 8.5 to comply with the facility's NPDES permit. The facility has maintained the effluent pH within this range with minimum and maximum effluent pH of 7.2 and 8.15, respectively.

DO levels within the discharged effluent are expected to remain high. Due to the low ammonia levels in the effluent, there is little biological oxygen demand (BOD) associated with the treated effluent. Ammonia levels in the effluent exert the greatest oxygen consumption demand to convert ammonia to nitrate in the river. The CTF is designed to provide reliable compliance with ammonia effluent limitations through tertiary treatment. Consequently, under the Project, levels of BOD in the CTF effluent (4.3 mg/L maximum, 1.37 mg/L average) will be lower than BOD levels in the San Joaquin River (5.1 mg/L maximum, 1.72 mg/L average). This will result in either no change in river DO levels or somewhat higher DO levels downstream of the discharge.

Chloride levels in the effluent discharged to the river are substantially higher than the ambient levels in the receiving waters of the river. The Project will result in an increase in chloride concentration in the river relative to baseline conditions. However, river chloride concentrations will not exceed the USEPA recommended criteria for the chronic and acute protection of freshwater aquatic life (Table 16).

Table 16: Concentrations of chloride in the CTF effluent and San Joaquin River under Project conditions (From RBI 2020).

Scenario	Maximum CTF Effluent Concentration [a] (mg/L)	River Concentration (mg/L)	River Concentration (mg/L)	River Concentration (mg/L)	Incremental Change	Incremental Change	Lowest Applicable Water Quality Criterion [e] (mg/L)
		Baseline [c]	Project at 2.5 MGD [c]	Project at 6.0 MGD [c]	Project at 2.5 MGD [d]	Project at 6.0 MGD [d]	
Acute Conditions							
Minimum River Background Concentration	249	5.48	20	40	14	34	860 (CMC)
Maximum River Background Concentration	249	77.7	88	102	10	24	
Chronic Condition							
Minimum River Background Concentration	249	5.5	20	40	14	34	230 (CCC)
Maximum River Background Concentration	249	78	88	102	10	24	

CCC = criterion continuous concentration
CMC = criterion maximum concentration
[a] From monitoring conducted by the City of Lathrop in 2017 – 2020.
[c] Modeled concentration.
[d] Project minus Baseline.
[e] USEPA national recommended ambient water quality criterion.

In summary, NMFS anticipates that there will be minimal adverse effects to listed fish species under most conditions based on the USEPA's aquatic life criteria. However, there are situations where adverse impacts may occur to an increasing proportion of the exposed population. When water hardness or DOC levels decline in ambient receiving waters, several of the metal ion constituents become more toxic (i.e., copper, aluminum). These fluctuations in water hardness and DOC occur normally in the lower San Joaquin over the year. In addition, exposures to a broad mixture of chemical constituents, including pesticides and herbicides, may cause synergistic effects that are not adequately captured by single constituent toxicity tests. These synergistic effects between the chemical constituents in the effluent stream enhance the adverse effects exhibited by the exposed fish, particularly in a sensitive individual, or one that has pre-existing conditions that would be more susceptible to an adverse outcome. NMFS expects that some individuals within the population will be more sensitive and exhibit adverse effects resulting in a diminished physiological state or changes in behavior even at concentrations that would appear safe. Although direct mortality from exposure to the effluent is unlikely, the reduced physiological status of the exposed fish may result in secondary effects including mortality. For example reduced olfactory responses in salmonids due to copper exposure may reduce the ability to detect predators and thus increase the risk of predation after exposure to the effluent plume.

2.5.2.1.3. Water Temperature Effects

The effects of the thermal plume related to the effluent discharge were assessed in Section 7.2.3 of the BA for the Project (RBI 2020). Two modeling efforts were employed. The first effort used DWR's Delta Simulation Model 2 (DSM2) to characterize the temperature response in the fully mixed river. The second effort used the CORMIX model to provide a finer three dimensional representation of the thermal plume behavior in a theoretical open channel with uniform depth, width and flow patterns.

2.5.2.1.3.1. DSM2 Modeling

The DSM2 is a one-dimensional computer model for simulating hydrodynamic and water quality in the Delta. The model uses a grid representing the network of channels covering the major Delta waterways, the Sacramento River upstream to the City of Sacramento, and the San Joaquin River upstream to Vernalis. The grid is further divided into a series of individual sections separated by nodes. The model provides simulation data output at each node. Node 7 of the DSM2 grid is located in close proximity to the outfall location and this node was used to quantify the amount of effluent discharged into the river at this location. To provide a conservative assessment, the DSM2 model assumes that the effluent discharged at the outfall location instantaneously mixes across the channel. Because the modeling assumed no downstream temperature attenuation prior to full effluent mixing across the river channel, which would actually occur, the modeled temperature output at the outfall location is conservative for assessment purposes. The next closest node in the DSM2 model upstream of the outfall location is located 1.9 miles upstream of the outfall. Likewise, the next closest data output node in the DSM2 model downstream of the outfall is located 1.7 miles downstream of the outfall. Temperature output at these nodes accounts for temperature attenuation that occurs between the outfall and these nodes. The period modeled for the DSM2 effort used data from January 1, 2008, through December 31, 2016. The three scenarios modeled were:

- No Discharge: Historical data for the Delta with no CTF discharge.
- 2.5 mgd ADWF Discharge: Historical data for the Delta, and CTF effluent discharge rates associated with the plant's current 2.5 million gallons per day (mgd) ADWF treatment capacity.
- 6.0 mgd ADWF Discharge: Historical data for the Delta and CTF discharges rates associated with a future cumulative City build-out discharge rate of 6.0 mgd ADWF.

The monthly effluent temperatures are provided in Table 17. DSM2 modeling results for ambient water temperature at the location of the outfall are provided in Table 18.

Modeling results for the 2.5 mgd ADWF condition at the outfall and downstream locations resulted in very minor effects on fully mixed daily river temperatures throughout the year. Moreover, the 2.5 mgd ADWF condition would not increase the maximum fully mixed river temperature that would occur in any month by more than approximately 0.2°F (0.11°C), and would not change the frequency with which any given temperature would occur during any month of the year. This is largely because at 2.5 mgd ADWF, the CTF discharge averages 0.2-0.8 percent of river flow, which corresponds to an average dilution ratio of 455:1 to 125:1, depending upon the month. There were no modeled water temperature changes for the location upstream of the outfall location, indicating the effluent discharge had no effect at this location.

Table 17: Maximum, median, and minimum CTF daily effluent temperatures, by month. Data are for the April 14, 2017 through May 18, 2020 period of record (From RBI 2020).

Month	Minimum	Median	Maximum
January	68.5	70.6	73.2
February	65.9	69.9	73.4
March	68.6	71.4	74.6
April	71.4	73.3	76.7
May	72.6	75.0	78.5
June	74.5	77.8	81.8
July	77.2	80.3	81.8
August	79.0	80.7	83.4
September	77.9	80.1	84.3
October	72.9	78.1	79.9
November	72.2	75.0	77.4
December	68.1	72.0	74.6

Table 18: Ambient river temperatures near the outfall location by month as modeled by DSM2 (from RBI 2020).

Outfall Location No Discharge												
Statistic	Daily Average Temperature (Degrees F)											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Probability of Exceedance												
0.1%	74.4	63.9	58.9	55.1	61.5	68.3	72.9	75.3	81.6	85.0	81.7	78.4
1%	73.4	63.6	57.9	54.4	61.1	67.6	72.1	74.5	80.9	83.7	81.2	78.0
5%	72.5	62.9	56.6	53.4	60.1	65.5	69.3	72.8	79.8	81.8	80.4	77.7
10%	71.3	62.1	55.7	52.6	59.0	64.3	67.8	70.7	78.6	80.8	79.7	76.8
25%	67.9	60.0	53.3	51.2	56.1	62.4	65.1	67.4	75.9	79.2	78.6	74.8
50%	64.0	56.8	49.1	49.7	53.8	59.1	62.0	65.2	73.0	77.6	77.2	73.0
75%	62.4	54.7	46.9	48.1	52.1	56.9	60.0	62.5	69.0	75.3	75.7	71.2
99.9%	54.5	46.7	42.3	43.2	49.0	50.5	57.0	57.6	58.8	65.9	65.4	64.0
Full Simulation Period[a]	65.0	57.1	50.0	49.6	54.3	59.5	62.8	65.4	72.4	76.8	76.3	72.8
Water Year Types[b]												
Above Normal and Wet (25%)	64.5	58.0	50.9	50.5	52.9	56.3	60.4	61.2	66.1	71.8	71.2	69.9
Below Normal (11%)	64.5	57.9	48.5	49.2	53.4	59.4	62.6	67.5	72.2	76.3	76.9	73.6
Dry and Critical (64%)	65.4	56.4	56.4	49.3	55.0	60.6	63.6	66.4	74.5	78.5	77.8	73.6

a Based on the 2008-2016 simulation period.
b As defined by the San Joaquin Valley 60-20-20 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999).

At a 6.0 mgd ADWF discharge rate, the addition of the effluent would only cause small (i.e., ≤ 0.5°F; 0.28ºC) increases in the long-term average river temperature on any given day at the outfall location during the November through February period, and no more than 0.2°F (0.11ºC) long-term average increases from March through October. These incremental increases at the outfall location would attenuate with increasing distance downstream of the outfall. Differences in the downstream location were typically ≤ 0.4°F (0.22ºC) for the period from November through February and ≤ 0.2°F (0.11ºC) for the period between March and October. Simulated fully mixed river temperature output for the nearest DSM2 node upstream of the outfall location (i.e., 1.9 miles upstream of the outfall) showed no incremental increases in fully mixed river temperatures. At 6.0 mgd ADWF, the CTF discharge averages 0.5–1.9 percent of river flow, which corresponds to an average dilution ratio of 200:1–50:1, depending upon the month.

The modeled fully mixed water temperatures do not approach levels that will be lethal or harmful to exposed listed salmonids or sDPS green sturgeon based on the addition of the effluent discharge. The maximum (i.e., 0.1 percent exceedance level) baseline fully mixed river temperature would range from 81.6ºF (27.6ºC) in June, to 85.0ºF (29.4ºC) in July, back to 78.4 ºF (25.8ºC) in September without the addition of the effluent. The addition of the effluent thermal load at 6.0 mgd would typically have no effect or at most raise the fully mixed water temperature by 0.1 ºF (0.05ºC). In July, addition of the effluent actually cools the fully mixed water by 0.1ºF (0.05ºC) at the 0.1 percent exceedance level. However, since the ambient baseline levels are already at levels that may cause physiological or behavioral impacts to listed salmonids or green sturgeon from June through September, any negative thermal impacts are caused by already existing thermal conditions and not the addition of thermal load from the discharge. The addition of the effluent thermal load does not cause these conditions to deteriorate further in any demonstrable way, and thus exacerbate any negative impacts to fish. Based on these modeling results in section 7.2.3.1 of the BA (RBI 2020), NMFS anticipates that there will be minor effects upon migrating or rearing listed salmonids or green sturgeon from the thermal plume entering the river once it is fully mixed.

2.5.2.1.3.2. Temperature Effects based on CORMIX Modeling

In contrast to the "coarse" resolution of the DSM2 modeling, the CORMIX modeling displays finer scale effluent plume mixing behavior as it enters the river channel from the outfall. As stated earlier, the CORMIX model simulates the mixing of a discharge within a uniform straight open channel that has a fixed width and depth as well as a fixed flow. It models the dispersion of a discharge that enters the channel from a source point and then disperses within the channel as it move downstream along the longitudinal axis of the channel, including the effects of channel boundaries (shore, bottom, and water surface) and vertical and lateral mixing of the effluent. However, this model is an idealized depiction of plume dispersion that is seldom reflective of real world conditions.

The CORMIX modeling conducted for the BA produced graphical representations of the 2.5 mgd and 6.0 mgd ADWF CTF discharge rates for each month of the year in section 7.2.3.4 of the BA (RBI 2020). RBI (2020) assessed these graphical representations to determine whether CTF worst-case and median-case thermal plumes would cause blockage or delay of adult immigration, juvenile/larval emigration, or cause lethality or any chronic, harmful, sublethal thermal effects to fish passing the plume.

Temperature differentials between the CTF effluent and ambient river conditions are not expected to exceed 20°F (11.1ºC) in the fall and winter months because this will be a requirement of the CTF's NPDES permit. The BA (RBI 2020) assesses the modeling results in section 7.2.3.4 using the CORMIX model for thermal dispersion and reaches the conclusion that the plume occupies a relatively small portion of river channel within the action area, thus fish exposure to the plume is brief. Typically, the BA expects that exposures will last seconds to minutes and thus constitute short-term acute exposures as they migrate through the plume rather than long-term, chronic thermal exposure scenarios as was considered and assessed for the fully mixed river condition. The BA's conclusions about spatial distributions are based on the graphical representations of the CORMIX model in a theoretical channel (see above). In addition, the BA assumes that fish will migrate consistently in an upstream and downstream direction with little deviation from their course, or behavioral adjustments to their migrations. It assumes that any given fish will continue to migrate along its course once it encounters the plume with little alterations in its behavior or responses to the plume's temperature gradient. If a fish does deviate from its original path, it will find ample space within the channel that is unaffected by the plume's dispersion to continue its migratory movements.

NMFS finds that the conclusions in the BA do not adequately reflect the real world conditions within the channel where the effluent is discharged. The actual bathymetry of the channel is not represented by the open uniform channel used in the CORMIX modeling with uniform depth and width and will strongly influence the characterization of the plume mixing. The outfall is located on an outside bend of the San Joaquin River; with the deepest part of the river channel (thalweg) immediately adjacent to the foot of the eastern bank, and the riprapped face of the levee. The inside bend on the western side of the river is characterized by a shallow shelf that covers more than half of the river width. Once effluent is discharged from the outfall pipe, it will encounter the opposite side of the channel in approximately 40 feet (12 meters) and be forced to move towards the surface both due to a physical boundary and thermal buoyancy.

Circulation patterns on the outside portion of the river bend are characterized by down welling with subsequent movement towards the western bank along the bottom of the channel. This is likely to force the plume to contact the bottom of the channel, thus reducing or eliminating any area along the channel bottom immediately adjacent to the outfall that is not impacted by the thermal plume. Thus any fish moving along the channel bottom is likely to encounter the plume with a high temperature gradient before it can mix. NMFS anticipates that this circulation pattern will create a shorter reach of river required to fully mix the effluent plume. However, it will also create a stronger gradient between the original temperature of the effluent and the mixed river waters where the temperature approaches background level. It is also likely to influence a greater proportion of the water column and the channel width due to the helical circulation pattern at the channel bend. This will reduce the areas of passage for migrating fish that is not influenced by the effluent plume.

NMFS believes that this mixing pattern based on actual bathymetry and river bend circulation at the location of the outfall will impact migrating fish. Since most adult and juvenile fish, except those that are located at the extreme margins of the channel, will be exposed to some portion of the dispersing effluent plume and likely encounter a steep temperature gradient, NMFS expects that some inhibition of migratory behavior will occur as a result. This is a form of harassment. For CCV adult steelhead, CV spring-run Chinook salmon, and juvenile and adult green sturgeon moving upstream along the thalweg, close to the channel bottom, they will encounter the temperature gradient as it disperses downstream. Once these fish reach the location of the outfall, they are likely to be exposed to the highest gradient along the bottom of the channel, with a temperature differential of 6-8ºF (3.3 – 4.4ºC) or more between the plume and the surrounding water column. Some fish may continue to swim through the plume, while others will drop back and search for more favorable water temperatures to continue their upstream migration.

Temperature has been shown to be one of the more important factors in selecting favored habitat (Jobling 1981, Cocherell et al. 2014, and Baird et al. 2018) and fish will actively seek out those temperatures representing the preferred habitat if provided with choices. Slight delays will have minor effects on migrating adult fish. However, longer delays can increase exposure to predators, increasing the risk of predation. Furthermore, longer delays also increases the duration of exposure to any chemical constituents present in the effluent stream, which may degrade fish health and condition following exposure.

Juvenile salmonids, including both CCV steelhead and CV spring-run Chinook salmon, migrating downstream would tend to be positioned along the outer bend of the river, occupying the upper portion of the water column during the day and being more dispersed throughout the water column during the night. If fish were migrating along the bottom of the river channel, they would encounter the plume at its highest temperature differential gradient at the point of discharge. Exposure to this higher temperature gradient has a higher likelihood of occurrence at night when juvenile fish are expected to occupy more of the water column. Temperatures and exposure times within the plume are not anticipated to reach levels that would result in acute injury or mortality due to exceeding the species' upper incipient lethal temperature or critical thermal maximum thresholds (described in the BA in section 7.2.3.4.2 [RBI 2020]). Furthermore, any juvenile fish encountering the plume, is expected to move away from the elevated water temperatures and seek more favorable water temperature conditions. This searching behavior has the potential to expose fish to greater predation risk by moving the fish away from its original migratory route into one that has more vulnerability to predation, resulting in harm to the fish. For example, juvenile fish that moved vertically towards the surface to find cooler water will be exposed to avian predation from above, or be silhouetted against the sky for predators below them. Fish that moved away from thalweg towards the inner bend of the river would occupy considerably shallower water with higher predation risks due to the lack of cover. Similarly, fish that moved closer to the eastern levee bank to escape the plume just offshore will be in close proximity to habitat favored by ambush predators such as largemouth bass, including the newly constructed concrete outfall structure.

In summary, NMFS expects that nearly all listed salmonids and sDPS green sturgeon migrating past the location of the outfall structure will be exposed to the elevated temperatures in the effluent plume due to the circulation patterns of the river along the outer bend. This exposure will result in an adverse effects, causing some of these fish to alter their behaviors and avoid the plume to find more suitable water temperatures. This movement away from their preferred migratory path will increase their travel time through this reach and increase their risk of predation, resulting in harm, harassment, and mortality to individual fish. Juveniles will be more at risk to predation due to their smaller size during migration and the size of predatory fish in this reach. However, adult salmonids are also at risk from larger striped bass, and all adult fish are at risk from mammalian predators such as river otters (*Lontra Canadensis*) and sea lions (*Zalophus californianus*) which are also known to occur in this reach of river.

2.5.2.1.4. Contaminants of Emerging Concern:

The discharge of urban and industrial sourced wastewater from the City of Lathrop's CTF to the San Joaquin River is expected to contain contaminants of emerging concern (CECs) which will increase the risk of exposure to novel contaminant stressors in the action area. These compounds include a wide range of pharmaceuticals, antibiotics, and personal care products (PPCPs), as well as micro particle plastics and fire retardant compounds. These compounds constitute a wide range of chemical families commonly found in water bodies associated with wastewater treatment plants and human activities. CECs have the potential to pose a risk to humans, aquatic organisms, and the environment. However, these contaminants are not regulated under current environmental laws and rarely tested for in water quality assessments of wastewater effluents compared to more typical classes of contaminants (i.e., metals, ammonia, common pesticides, etc.). As the human population grows, there is greater use of therapeutic drugs, illicit drugs, plastics, antibiotics, hormonal therapies, and other synthetic compounds in our everyday life. The byproduct of increased domestic use of CECs is the increased propensity for these materials to show up in our freshwater and marine environments. These compounds enter the environment, usually through treated sewage and untreated stormwater runoff (Katzenellenbogen 1995; Sumpter and Jobling 1995; Hallig-Sørenson et al. 1998; Daughton and Ternes 1999; Rodgers-Gray et al. 2000; Daughton 2002, 2003a, 2003b; Pawlowski et al. 2003; Ebele et al. 2017; Nilsen et al. 2018).

Municipal wastewater treatment plants (WWTP) are not designed to remove or treat CECs under most cases. Thus, WWTP discharge contains a complex mixture of CECs including pharmaceuticals, illicit drugs, synthetic personal care products, steroid hormones, industrial and commercial compounds, current-use pesticides, and microplastics (Vidal-Dorsch et al. 2012, Krough et al. 2017). CECs enter WWTPs through direct disposal into the wastewater stream (i.e., dumping them down the sink or toilet), indirect disposal, and excretion from human use (i.e., metabolic breakdown products in urine and feces).

Many classes of drugs have been identified as common trace environmental pollutants in surface and ground waters. Although the half-lives of most CECs are far shorter than those of other more well-known pollutants, the continual environmental introduction of drugs by sewage effluent makes them “pseudopersistant” pollutants with physiological consequences for exposed aquatic organisms (Daughton and Ternes 1999). Many of these drugs target specific receptors or biochemical pathways in humans that make them effective at very low doses (Ebele et al. 2017). Thus, even at the low environmentally relevant concentrations seen in surface waters and ground water, the drugs remain biologically active and relevant. This is particularly concerning since the receptors and biochemical pathways targeted in humans are highly conserved in other species of animals, and thus are affected by the drug or compound. Furthermore, little research has been conducted on the sensitivities of non-target organisms to the different drug families and especially the responses to mixtures of drugs and compounds observed in the environment.

Growing research has linked CECs to adverse effects in aquatic life (e.g. Brodin et al. 2014, Jasinska et al. 2015, Chen et al. 2021). Yet, generally little is known about how individual CECs or chronic exposure to these complex and variable mixtures of CECs affect organisms or if these pollutants are transferred through the food web (Richmond et al. 2018). This is in part because there have been 631 unique pharmaceutical products detected in the environment, and likely a number of other undetected compounds (aus de Beek et al. 2016). As such, our understanding and assessment of effluent-related contaminants on aquatic organisms remains limited (Meador et al. 2020), warranting further research into these interactions.

To date, studies indicate that impacts of CECs on salmonids are variable and can produce different responses to exposure. For example, exposures of brown trout to endocrine disruptors in the surface waters of the Liri River in Italy have induced the production of vitellogenin (yolk protein) in male fish (Zezza et al. 2020). Typically, the gene that produces vitellogenin in male fish is silent. However, after exposure to estrogenic compounds in surface water, the male trout exhibited vitellogenin production and increased feminization. Production of vitellogenin in male fish has become a standard biomarker for exposure to estrogenic endocrine disruptors. Other studies in Washington State show that certain CECs bioaccumulate in Chinook salmon (Meador et al. 2016, Meador et al. 2020). In the 2020 study the authors concluded that effluent associated CECs were likely responsible for the observed alterations in the profiles of amino acids, proteins, and lipids produced in metabolic pathways (metabolomes) for migrating juvenile Chinook salmon in watersheds with WWTPs (Meador et al. 2020). Alterations in metabolic pathways can have impacts on future fish health, including lowered energy production, inhibition of maturation, and reduced survival.

Exposure to pharmaceutical compounds in WWTP effluent, including illicit drugs, can affect aquatic organism health. For example, exposure of brown trout (*Salmo trutta*) to the illicit drug methamphetamine indicated that exposed fish became addicted and exhibited withdrawal symptoms upon return to clean freshwater environments, including more lethargy compared to unexposed fish (Horký et al. 2021). Exposure to methamphetamine at environmentally relevant concentrations also caused pathological lesions to heart and liver tissue in exposed brown trout (Sancho Santos et al. 2020) that can lead to long-term health implications. Other aquatic organisms also have the potential to be affected by exposure to pharmaceuticals. A study by Reisinger et al. (2021) exposed crayfish to the antidepressant citalopram, a common selective serotonin reuptake inhibitor, at environmentally relevant concentrations in surface waters. The crayfish exhibited increased boldness and more time foraging outside of protective habitat than unexposed crayfish. This behavior is postulated to heighten their risk to predation from aquatic predators of crayfish.

CEC studies on long-lived, late maturing species such as sturgeon are even more limited than those available for salmonids. A recent study on Lake Sturgeon found that the species in the Great Lakes basin are exposed to multiple personal care products especially antidepressants and antibiotics (Banda et al. 2020) and that these compounds were present in the blood and gametes of exposed fish at detectable levels. It remains unknown how or if these exposures impact sturgeon behavior and life history, indicating that additional research is prudent.

In summary, NMFS expects all listed salmonids and SDPS green sturgeon migrating past the location of the outfall structure will be exposed to the CECs in the effluent plume. Exposure to these compounds will cause alterations in the metabolic pathways in the exposed fish leading to changes in behavior and physiology. These alterations have the potential to cause adverse effects leading to morbidity and mortality both as a direct effect and as a secondary effect (i.e. predation, disease from a lowered immune system response, or poor reproduction capacity due to reduced fertility, etc.).

2.5.2.2. Permanent Structures - Placement of Riprap and Outfall

The placement of an outfall structure on the levee's waterside face creates an additional need to keep the existing levee in place and in its current state, thus perpetuating the existing habitat conditions in the lower San Joaquin River. The construction of levees to protect against flooding has significantly altered the environment of lower San Joaquin River in the action area. Levees armored with riprap replaced the naturally occurring shallow water habitat that existed along the banks of rivers and sloughs in the lower San Joaquin River and the spectrum of complex habitats they provided. Levees preclude the formation of complex shallow water habitat with riparian vegetation, fallen trees and woody materials (i.e., IWM) that once existed on their banks, and the ability of the river to migrate across the floodplain. Native fish species, including listed salmonids and green sturgeon, evolved under these historical environmental conditions. (The Bay Institute 1998).

Rock rip-rapping, which is designed to protect the levee faces from erosion, will have deleterious effects on the functioning of the riverine process (USFWS 2000). The intent of riprap is to stabilize stream channels and limit natural fluvial processes. The reduction of the erosion and consequent deposition cycle, naturally inherent to all alluvial channels, eliminates a channel's ability to maintain bedforms for salmonid habitat and impairs the ability of a stream to be maintained in a dynamic steady state. This alteration of the aquatic ecosystem has diverse detrimental effects on aquatic communities, ranging from carbon cycling to altering salmonid population structures and fish assemblages (Schmetterling et al. 2001). Riprap does not provide the intricate habitat requirements for multiple age classes or species similar to natural banks, or banks that include IWM (Peters et al. 1998).

Riprapping affects the stability of IWM along the river channel margin. Stable wood retention is important for creating and maintaining good fish habitat (Bisson et al. 1987). Loss of IWM negatively impacts salmonids through multiple phases of their life history. Schaffter et al. (1983) showed that juvenile Chinook salmon densities along riprapped banks are one third that of natural banks with the presence of fallen trees and their root balls in the water, concluding that traditional riprap methods of protection will likely cause decreases in the salmon numbers in the Sacramento River basin. USFWS (2000) reported the highest number of juvenile Chinook salmon were associated with the nearshore areas with woody material, sloping banks, and moderate velocities. Riprapped banks had low habitat value and mitigated sites had intermediate habitat value for juvenile Chinook salmon.

In large mainstem streams and rivers such as the San Joaquin River, the primary benefit of IWM is to the channel margins. The woody materials act to deflect and break up stream flow, creating small eddies, pools, undercut banks, variability in channel depth, and back water areas conducive to rearing and growth of salmonids (Bisson et al. 1987, Murphy and Meehan 1991). In addition, sediment is trapped by the woody material and stored along the channel margins, contributing to the hydraulic and biologic complexity of the stream reach, particularly where organically rich materials are present (Bisson et al. 1987, Murphy and Meehan 1991). These areas also provide velocity refugia for juvenile salmonids to hold and are critically important to the lower river reaches where levee construction and riprapping have disconnected the rivers from the historically adjoining floodplain.

Like the studies upriver in the mainstem Sacramento River, salmonids in the Delta and lower river reaches are associated with natural banks and IWM cover where there is sandy or muddy substrates and shallow water shorelines (McLain and Castillo 2009). Areas with riprap and a lack of cover tended to be dominated by non-native predators and these riprapped shorelines had lower densities of salmonids present. Other studies have shown this trend for non-natives, in particular piscivorous fish that prey on salmonids (Nobriga et al. 2005, Brown and May 2006, Brown and Michniuk 2007, and Grimaldo et al. 2012). It is unclear whether the low density of salmonids in riprapped areas is caused by salmon avoiding these areas volitionally or whether they are very vulnerable to predation from non-native predators with a resulting high predation loss (Schmetterling et al. 2001, McLain and Castillo 2009).

In addition to the diminished habitat quality provided by the rock riprap protecting the levee face, the presence of the concrete outfall structure is also expected to reduce the suitability of the shoreline habitat in the lower San Joaquin River. The concrete outfall structure will create an approximately 3 meter by 3 meter (10 foot by 10 foot) recessed area on the eastern levee bank to protect the outfall pipeline from damage and high flows. The back headwall of the outfall structure is approximately 3 meter (10 feet) tall, with the wing walls sloping down at the same approximate angle as the levee slope from 3 meters to 0.6 meter (10 feet to 2 feet) in height. This recessed area will provide both structure as well as velocity refugia from the flows in the channel. It is the only substantial holding area along this reach of the river. The closest significant structures within the channel are the bridge pilings approximately 800 meters (~2,600 feet) upstream at the railroad overcrossing/ I-5 and US 120 overpasses and approximately 2,000 meters (~6,500 feet) downstream at the River Islands Parkway Bridge.

Predatory fish make opportunistic use of structure that provides cover, shade, or velocity refugia from river flows (Kahler et al. 2000, Carrasquero 2001). The structures themselves, as well as the flow shears between different velocities, will create eddies and holding areas for predators to lie in wait for passing prey. These elements associated with the ambient hydraulic conditions will adversely affect the survival of listed salmonids passing through these channels.

Vertical walls also create shaded areas along their face during certain periods of the day. These shaded areas create hiding places for predators and prey, which conceals them from fish in the lighted zone outside of the shaded area. Such behavior by fish creates a temporal and spatial overlap of predators and prey in the shaded zone, as well as enhancing the success of predator ambush attacks on prey outside of the shaded zone (Kahler et al. 2000, Carrasquero 2001).

NMFS expects that catfish (*Ictaluridae*) species as well as black bass (*Micropterus*) species will make use of this structure. Both of these predatory fish families prey upon salmonids and sturgeon species (Michel et al 2018).

NMFS finds that the placement of additional rock riprap on the levee face and construction of the outfall structure will further diminish the habit quality in this reach of the lower San Joaquin River. NMFS expects the majority of listed salmonids and SDPS green sturgeon migrating past the location of the outfall structure will be exposed to this diminished quality of habitat along the eastern levee bank. This reduction in habitat quality will lead to adverse effects to these migrating salmonids due to increased predation risk to migrating juvenile salmonids from all of the tributary populations within the San Joaquin River basin upstream of the outfall location and will prevent the formation of natural riverine shallow water and riparian habitat that benefits salmonids. Thus, exposure will result in a reduction in fitness and survival of juvenile listed salmonids moving past this location causing harm and mortality, although only a small proportion of the population is likely to be adversely affected due to the relatively small footprint of the outfall location compared to the adjacent riverine habitat upstream and downstream of the site and the duration of time spent in this reach of river compared to the overall time spent migrating within the San Joaquin River system. The loss of nearshore shallow water habitat and adjoining riparian areas are likely to also adversely impact green sturgeon through loss of food resources and habitat complexity causing harm to occupying this reach of river, however few individual fish are believed to be present in this area compared to the rest of the occupied habitat in the Central Valley and Delta.

2.5.2.3. Perturbation of Channel Bottom

The Project will permanently alter the characteristics of the channel bottom at the location of the outfall by the installation of the concrete mat and associated riprap protection along the waterside levee face below the OHWM, creating hardened surfaces that are resistant to erosive forces. The area of rip rapped and concrete matting is approximately 4,400 square feet (0.10 acres). A concrete mat is placed immediately outboard of the outfall structure to avoid erosion and down cutting of the channel invert due to effluent flows. The edges of the concrete mat are anchored in the substrate with a cement cap to keep it in place. Rock riprap is then applied along the perimeter of the 20 foot by 20-foot concrete mat to provide additional erosion protection (Figure 4). The continuity of sediment transport along the channel bottom and shorelines will be disrupted due to the hardened surfaces and changes within the boundary layer flows associated with these structures is expected. NMFS anticipates that the leading and trailing edges of the riprapped area as well as the longitudinal edge of the rip rapped/ concrete mat will cause a scouring effect due to the changes in flow across these surfaces during higher flows in winter and spring. Conversely, increased sediment deposition over the rip rapped area is likely to occur during low flow conditions in summer and fall due to the friction of the irregular surface and lower overall flow velocities in the thicker boundary layer.

The potential for depressions in the channel substrate due to localized scouring along the perimeter of the rip rapped area and concrete mat elevates the risk of predation by providing velocity refugia along the bottom for predators to utilize. This will be particularly beneficial to predators such as catfish (i.e., white catfish [*Amelurus catus*] and channel catfish [*Ictalurus punctatus*]) that are known to predate on juvenile Chinook salmon and perhaps smaller steelhead and green sturgeon (Michel et al 2018). NMFS anticipates that these predator refuges will increase the risk of predation on migrating juvenile salmonids, leading to higher levels of mortality and harm in the affected river reach. Predation on juvenile green sturgeon is less likely to occur due to the size of juvenile sturgeon rearing in the Delta, but is not impossible. This leads to a lesser level of harm for this species due to increased predation risks compared to juvenile salmonids.

In addition, the change in sediment type in the channel bottom from soft sediments comprised of sand and small grained materials to hard surface substrates (i.e., rock and concrete) will alter the composition of benthic invertebrates that make up the forage base for salmonids and green sturgeon. The change in sediment and bottom composition will have a greater impact on green sturgeon that preferentially feed upon invertebrates associated with soft bottoms. This impact will reduce the availability of food resources for green sturgeon and juvenile salmonids, which will reduce growth potential and fitness of individual fish. However, due to the relatively small foot print of the altered channel bottom compared to adjacent habitat, any adverse effects to juvenile listed salmonids and sDPS green sturgeon is expected to be short lived and minor.

In summary, NMFS expects the majority of listed salmonids and SDPS green sturgeon migrating past the location of the outfall structure will be exposed to the channel bottom alterations. This exposure will result in a reduction in fitness and survival of juvenile listed salmonids moving past this location, although only a small proportion of the population is likely to be affected due to the relatively small footprint of the outfall location compared to the adjacent riverine habitat upstream and downstream of the site and the short duration of time spent in this reach of river compared to the overall time spent migrating within the San Joaquin River system. A small number of listed salmonids are expected to fall prey to predatory fish using this habitat as a holding area to launch ambush attacks on migrating salmonids. The relatively small area of modified habitat compared to adjacent river bottom and levee face will impact only a small fraction of the listed salmonids and sDPS green sturgeon foraging for food resources in the area. Since additional areas of river bottom and levee banks immediately adjacent to the outfall location are not impacted by the Project, migrating fish can readily forage in these areas.

2.5.3. Effects of Other Actions

2.5.3.1. Stormwater Discharge to the San Joaquin River

Once the outfall is operational and the growth of the City of Lathrop according to the General Plan proceeds, additional stormwater discharge is expected. This increase is due to the creation of additional impervious surfaces within the area covered by the General Plan which limit or preclude infiltration of precipitation into the underlying soils. The water quality of the stormwater discharge will be regulated by the NPDES permitting system, which is implemented through the SWRCB issuance of Clean Water Act 401 certifications. These certifications stipulate limits on permissible TMDLs and some aquatic life criteria for constituents in the stormwater effluent (USEPA 2018). While this aquatic life criteria has helped to improve water quality regarding specific toxins, often this system is not sufficiently protective for listed species that may be more sensitive than the sampled/experimental species used to establish the criteria. Also, stormwater runoff delivers a wide variety of pollutants to aquatic ecosystems, many of which are not listed by the USEPA or SWRCB. Therefore, discharge of such pollutants often goes unregulated and uncontrolled. Increased urbanization of streams generally leads to decreases in the health and abundance of aquatic species (Closs et al. 2016, Feist et al. 2017, Scholz 2011), including the abundance and health of salmonids and sDPS green sturgeon. Post-development stormwater runoff often picks up a variety of pollutants from both diffuse (nonpoint) and point sources before depositing them into receiving water bodies. Constituents may include, but are not limited to: fertilizers, herbicides, insecticides, and sediments (landscaping/agriculture); oil, grease, polyaromatic hydrocarbons (PAHs), and other toxic compounds from motor vehicle operations (roads and parking lots); pathogens, bacteria, and nutrients (pet/dairy wastes, faulty septic systems); toxic metals and metalloids such as aluminum, arsenic, copper, chromium, lead, mercury, nickel, and zinc (from building decay, manufacturing or industry byproducts); and the atmospheric deposition onto impervious surfaces from other surrounding land uses (industrial and manufacturing sources, freight and trucking exhaust, agriculture field treatments).

Fish exposure to these ubiquitous pollutants in the freshwater and estuarine habitats is likely to cause multiple adverse effects to CCV steelhead, CV spring-run Chinook salmon, and sDPS green sturgeon, even at pre-project, ambient levels (Hecht et al. 2007; Macneale et al. 2010; Sandahl et al. 2007; Spromberg & Meador 2006), and are among the identified threats to sDPS green sturgeon in the NMFS Recovery Plans for green sturgeon (NMFS 2018). Contaminants also accumulate in both the prey of and tissues of juvenile salmonids. Depending on the level of concentration, those contaminants can cause a variety of lethal and sub-lethal effects on salmon and steelhead, including disrupted behavior, reduced olfactory function, immune suppression, reduced growth, disrupted smoltification, hormone disruption, disrupted reproduction, cellular damage, and physical and developmental abnormalities (Hecht et al. 2007). Even at very low levels, chronic exposures to those contaminants have a wide range of adverse effects on the ESA-listed species considered in this opinion, including:

- Increases in early development issues in gastrulation and organogenesis (exposure of adults, sub-lethal effects passed to resulting offspring) which lowers hatching success.
- Decreases in juvenile survival through reduction in foraging efficiency, reduced growth rates and condition index.
- Increased delay in, or issues occurring during smoltification (only in salmonids) rooted in anion exchange, thyroxin blood hormone, and salinity tolerance.
- Increases in mortality due to increased susceptibility to diseases and pathogens, and depressed immunocompetence.
- Decreased survivorship due to increased predation, reduced predator detection, less shelter use, and less use of schooling behaviors.
- Changes or delays to migration patterns, use of rearing habitats, ability of adults to home to natal streams, and spawning site selection.
- Changes to reproductive behaviors that affect production, including altered courtship behavior, reduced number of eggs produced, and decreased fertilization success (NMFS 2016b).

Stormwater infiltration treatment practices, such as infiltration/retention basins, bioretention, bioslopes, and porous pavements (Multi-Agency 2015) can be highly effective to reduce or eliminate contaminants from runoff to a degree that sufficiently protects anadromous species (McIntyre et al. 2015), as well as providing flow control. Although the City of Lathrop uses some of these practices (infiltration basins), this treatment will not eliminate all pollutants in the City’s post-Project stormwater discharges. Thus, adverse effects of post-Project related stormwater runoff from upland development under the General Plan will persist for the foreseeable future.

Stormwater runoff pollutant load and volume is likely to increase as the amount of impervious cover increases (NRC 2009) with the planned build out of the industrial and residential developments proposed under the City of Lathrop’s General Plan. Pollutants become more concentrated on impervious surfaces until either they degrade in place, or are transported via wind, precipitation, or active site management to another location. Though stormwater discharge from an individual location may be small, especially in comparison to the total volume and pollutant loads in the receiving waterway, these contributions, when taken cumulatively from multiple locations, have incremental impacts on total pollutant levels in downstream water bodies. Due to the additive and compound effects of persistent pollutants contributed by small, unrelated land developments with differing levels of stormwater treatment, such development may be more likely to have a greater impact on aquatic life in receiving waterbodies than the stormwater output of large, individual projects since larger actions are often more carefully planned and monitored.

Non-point source urban stormwater impacts to species can have drastic effect at times. For example, some adult coho salmon (*O. kisutch*) runs in Washington State regularly experience acute mortality (fish kills) in otherwise 'healthy' streams that also receive stormwater drainage from urban areas with impervious surfaces supporting high amounts of automobile activity (Feist et al. 2017; Chow et al 2019; Tian et al 2020). These studies highlight an extreme response of a salmonid to toxic nonpoint source urban stormwater. Although the species under consideration in this opinion have not displayed the same response to similar conditions even when co-occurring in the same watershed (Scholz et al. 2011), the unique sensitivity of a particular salmonid species to an individual contaminant illustrates the ever present risk faced by salmonids to poorly understood contaminants within the watershed. Data that quantify the exact effects of urban stormwater on steelhead, Chinook salmon, and green sturgeon are severely lacking, which makes analyzing the effects of a new source of non-point stormwater discharge on a subset of these populations difficult.

It is reasonable, however, to conclude that stormwater that is not sufficiently treated will cause adverse effects that are realized at a watershed level due to the expected persistent low-level addition of pollutants and the synergistic effects that occur when different chemicals co-occur. Stormwater constituents that are benign or that are not toxic enough alone to elicit a negative response, may through interactions with other chemicals cause significant effects in individual fishes exposed to the mixture. More instances of fish being affected by these mixtures will be observed as these new compounds pervade their habitat and bioaccumulate in their prey and tissues (Presser & Louma 2010, 2013; Closs et al. 2016). ESA-listed species will absorb or ingest some of those contaminants in quantities sufficient to cause injury or death due to modified behavior, disrupted endocrine functions, or immunotoxin disease effects, either by themselves or through additive, interactive, and synergistic interactions with other contaminants in the river. These adverse effects are likely to be greater for sDPS green sturgeon, because of their benthic feeding habits resulting in ingestion of, and dermal contact with, contaminated sediments, and for Pacific salmon with sensitive sub-yearling life history stages in the affected river reaches, that may occupy low velocity habitats where contaminants are likely to be more concentrated in fine, suspended sediments and in their prey organisms.

In summary, NMFS anticipates that exposure to the contaminants in the stormwater discharge will result in mortality, morbidity, and reduced fitness of exposed listed salmonids and sDPS green sturgeon. First flush events occurring after a period of prolonged dry weather are likely to result in greater levels of mortality or morbidity due to the high concentrations of toxic contaminants contained in the stormwater discharge. Subsequent discharges during the wet season will have less concentrated constituents, but are still likely to cause adverse impacts such as altered physiology and metabolic pathways, decreased fitness, and behavioral changes. The harmful effects of stormwater discharges will be greatest during rain events, but will still be present after the rain event is over due to contamination of sediments and the forage base for listed fish occupying habitat downstream of the stormwater discharge. Finally, as more development occurs under the City of Lathrop's General Plan, the catchment area for creating stormwater runoff and the percentage of impervious surface in those areas increases, thus creating greater volumes of stormwater runoff entering the San Joaquin River with the associated toxic compounds.

Because sub-lethal responses in individual fishes are difficult to isolate and attribute back to single constituents or nonpoint sources, it is more useful to consider the effects of urban stormwater runoff on fish through changes to their aquatic habitats, because environmental water quality measurements are more quantifiable. Therefore, the adverse effects resultant from the expected increase of urban stormwater pollutant load to the San Joaquin River will be discussed further in the effects to critical habitat section below.

2.5.3.2. Mitigation Credit Purchase or In-Lieu Fee Program Participation

Anthropogenic alterations to any available riverine or riparian habitat could hinder the recovery of the CCV steelhead DPS, CV spring-run Chinook salmon ESU, and sDPS green sturgeon, depending on the extent and severity of these alterations, and how sparsely suitable habitat is otherwise locally available. With the construction of the outfall and placement of riprap, which is considered an enduring condition, reestablishment of functional submerged aquatic habitat and riparian vegetation will be permanently controlled by erosion control materials and levee maintenance to ensure the operational integrity of the outfall. Thus it is unlikely that future naturalization of the Project location will occur. Riprap is also likely to facilitate the channelization of the San Joaquin River and prevent natural river geological processes from occurring in an already highly modified system. The addition of the riprap and the placement of a new, artificial structure on a leveed bank is expected to result in adverse effects to CCV steelhead, CV spring-run Chinook salmon, and sDPS green sturgeon through increased changes to the San Joaquin River system, taking it further from its historical natural state.

To address the long-term effects of the removal of riparian vegetation and placement of rock revetment and concrete mats on listed CCV steelhead and sDPS green sturgeon and their designated critical habitat, the proposed action includes the commitment to purchase mitigation bank credits or restoration of habitat on-site or within the vicinity of the Project at a 1:1 ratio for impacts that occur above the OHWM (0.16 acres of riparian habitat) and at a ratio of 3:1 for impacts that occur below the OHWM (0.10 acres riverine perennial habitat) (RBI 2021b). Thus, there will a total of 0.3 acres of perennial aquatic habitat mitigation and 0.16 acres of riparian habitat mitigation, for a cumulative total of 0.46 acres of mitigation, acquired or developed for the Project. The final mitigation plan issued prior to construction will detail the final disposition of the sources of mitigation acres.

In part, the conclusions of the biological opinion rely on the beneficial effects of the bank credits or habitat restoration to minimize the effects of the Project on critical habitat for CCV steelhead and sDPS green sturgeon over the long term. The Project will alter and reduce the ecological function of submerged river channel bottom in the aquatic zone and shoreline habitat in the riparian zone by placing hardened surfaces composed of rock riprap and concrete in these areas over naturally occurring soft substrates. These surfaces will alter the natural benthic and riparian communities within the project's footprint in a detrimental fashion by altering benthic invertebrate communities, altering food web processes, and altering the flow of energy through the impacted habitats. The restoration of aquatic and riparian habitat at either the conservation/mitigation banks or within the area adjacent to the Project footprint reverses this aspect and creates habitat that will support natural ecological processes and communities, which will provide shelter, holding and rearing habitat, and forage bases for listed salmonids and sDPS green sturgeon. This will occur at either the locations of the conservation/mitigation banks in the northern Delta and lower Sacramento River, or at the local areas surrounding the Project location on the lower San Joaquin River where restoration activities have occurred. Through the purchase of credits for listed salmonids, some aspects of these unavoidable impacts are expected to be offset.

Currently, there are no designated mitigation credits available for sDPS green sturgeon. However, individuals from the CCV steelhead DPS, sDPS green sturgeon, and CV spring-run populations, should be able to access habitats created and maintained by the banks that serve the service area (i.e., waters of the Delta and range of CCV steelhead), and these individuals may potentially rest, shelter, and forage within these properties, which would increase the probability of their long-term survival. Although the conservation banks that cover the action area within their service area may not technically offer benefits to individual CCV steelhead or CV spring-run Chinook salmon originating from the Southern Sierra Nevada Diversity groups, we expect that populations from the remaining diversity groups for these species should benefit from the purchase of credits since these fish should be able to access the purchased riverine habitat areas created and maintained by the banks/programs by the purchase of such credits.

These benefits to individuals of each listed species are expected to be provided in perpetuity. The banks that serve the action area all have adequate mechanisms in place to track credits and debits to ensure that more debits are not sold than credits that are available. A non-wasting endowment fund to pay for long-term management of the bank sites also ensures credit values are maintained in perpetuity and therefore the properties are expected to be permanent habitat improvements that provide benefits to protected anadromous fishes. To document this, each bank must submit a Mitigation Banking Instrument with USACE when they are developed (USACE 2018). A description of these tracking mechanisms can be found in the respective banking instruments for Bullock Bend (Westervelt Ecological Services 2016), Fremont Landing (Wildlands Inc. 2006), and Liberty Island (Wildlands Inc. 2010). The Mitigation Banking Instrument also specifically identifies that NMFS has jurisdiction over certain living marine resources that may occur within the property for the bank to be considered NMFS approved, such as the ones identified in this opinion.

2.5.4. Effects to Critical Habitat

The effects of the proposed Project on designated critical habitat within the action area can be separated into short-term impacts related to the construction elements of the Project (i.e., pile driving, cofferdam presence, and installation of the pipeline crossing of the levee work) and those associated with the longer term elements of the Project related to the discharge of treated effluent to the river and the presence of the outfall and associated erosion control actions (i.e., chemical constituents in the effluent from the outfall and stormwater discharges from future development, temperature changes, predation, and aquatic community alterations). All impacts related to the construction phase of the Project will last only as long as the construction actions are taking place, and are therefore transitory in nature. As described in the Project description, construction will occur over the planned 8-week duration of the construction phase for the cofferdam, outfall, and levee pipeline crossing between July 1 and October 31. Without the constant input of the stressor causing the alteration to the PBFs of the designated critical habitat, the changes will either stop instantly (pile driving noise or construction noise) or gradually dissipate (turbidity or sediment disturbance), allowing the habitat to resume its normal function. In contrast, impacts related to the long term operations of the outfall and its associated discharge to the river and surrounding erosion protection will last for the foreseeable future and are considered permanent effects of the Project.

2.5.4.1. Short-term impacts

2.5.4.1.1. Pile Driving and Construction Related Sound

The pile driving will occur for a short defined period of time within the channel of the San Joaquin River. Pile driving will only last for 10 hours per day (7 am to 5 pm), Monday through Friday, and for a short period of time (no more than a cumulative period of 15 days [7 days to install and 6 days to remove the sheet piles plus 2 days for installation and removal of the steel pipe pile]) during the proposed in-water work window of July 1 to October 31. When pile driving is done for the day, or for the Project in total, the habitat impacts associated with the acoustic stressor ceases after the last pile strike (within a few seconds). Once pile driving ends, there is no more noise associated with the pile driving action. The environment returns to its pre-pile driving acoustic environment with no lingering acoustic effects of the pile driving action. The pile driving affects designated critical habitat for CCV steelhead and for sDPS green sturgeon. The sounds generated during the period of active pile installation has the potential to block free movements of fish in the area surrounding the cofferdam, but this only lasts while the piles are being driven. After the pile driving has stopped for the day, fish are free to move throughout the area surrounding the cofferdam without being affected by the sound associated with the pile driving. This is also the case after the pile driving actions are finished for the Project.

Construction related sounds from the movements and activities of heavy equipment on the levee and within the dewatered area behind the cofferdam will last for a period of approximately 6 weeks. Like pile driving, construction activities will only occur during the day and between Monday and Friday of the workweek. No construction is anticipated over the weekends. During these periods of inactivity, there will be no sounds generated by construction related activities.

2.5.4.1.1.1. Effects to CCV Steelhead designated Critical Habitat

The sounds generated by pile driving and construction related activities will affect the following PBFs for critical habitat within the action area:

Freshwater migration corridors:
Pile driving and the sounds related to construction activities have the potential to impede migratory movements of adult steelhead by increasing the level of sound within the channel of

the San Joaquin River. The high levels of sound in the aquatic habitat will cause fish to exhibit behavioral modifications, including falling back and waiting until the sound subsides during the night or weekends before passage past the location of the Project is successful. NMFS anticipates that while pile driving is occurring, the higher sound levels present in the aquatic environment will adversely affect the function of the habitat as a migration corridor by forming a blockage to free movement of adult CCV steelhead past the location of the cofferdam. However these blockages will be transient, and last only as long as the pile driving is occurring, with no long lasting or permanent impacts upon the habitat once pile driving ceases to occur.

2.5.4.1.1.2. Effects to sDPS Green Sturgeon designated Critical Habitat

Freshwater migration corridors:
Pile driving and the sounds related to construction activities have the potential to impede migratory movements of adult and juvenile green sturgeon by increasing the level of sound within the channel of the San Joaquin River. The high levels of sound in the aquatic habitat will cause fish to exhibit behavioral modifications, including falling back and waiting until the sound subsides during the night or weekends before passage past the location of the Project is successful. NMFS anticipates that while pile driving is occurring, the higher sound levels present in the aquatic environment will adversely affect the function of the habitat as a migration corridor by forming a blockage to free movement of individual green sturgeon past the location of the cofferdam. However these blockages will be transient, and last only as long as the pile driving is occurring, with no long lasting or permanent impacts upon the habitat once pile driving ceases to occur.

2.5.4.1.2. Increased Turbidity

Increased turbidity related to the construction phase of the Project will be a transient stressor on the aquatic habitat adjacent to the cofferdam and outfall location. Turbidity will result from the installation and removal of the piles, as well as placement of the rip rap erosion control material along the levee face. This will occur during the in-water construction work window of July 1 through October 31. Construction actions that occur above the waterline will be minimized by the BMPs employed in the conservation measures for the Project (CM – 2).

2.5.4.1.2.1. Effects to CCV Steelhead designated Critical Habitat

Freshwater migration corridors:
High levels of turbidity could impede migration of adults past the location of the outfall and cofferdam. However, levels of turbidity are not expected to reach levels that would cause widespread dispersion of the turbidity plume nor have input of sufficient duration to create anything more than a minor plume that hugs the eastern levee shoreline.

Freshwater rearing:
Suspension of sediment and soils from the construction actions causing a turbidity plume to drift downstream could temporarily adversely affect foraging behavior of steelhead. However, the plumes would tend to be transient in nature, and persist for only short periods of time along the outside bend of the river channel. Since only adult steelhead life stages are expected to be present at this time, and migrating upstream to spawn, the rate of foraging is believed to be

relatively low. Turbidity could also impact the forage base by smothering benthic communities under silt and sediment deposition. However given the transient nature of the sediment sources related to construction actions and the short presence of the plume in the river channel, only benthic areas immediately adjacent to the Project site will be affected. These areas a would then be subject to "cleansing" flows of river water over time that would move the sediment away from the areas of deposition. These areas of affected substrate will be recolonized by species present in the surrounding habitats as soon as the disturbance ends.

2.5.4.1.2.2. Effects to sDPS Green Sturgeon designated Critical Habitat

Freshwater migration corridors:
Elevated turbidity levels would likely have little impact on the riverine habitat that would negatively affect green sturgeon migration. Since juvenile, sub-adult, and adult life stages of green sturgeon inhabit and utilize relatively turbid waters within the San Francisco Bay estuary and Delta during rearing and migration phases of their life history, the low level of turbidity expected from this Project is unlikely to create changes in the habitat that would influence their movements.

Water Quality:
The transient nature and small amounts of sediment suspended into the water column are unlikely to have a demonstrable impact on the water quality of the San Joaquin River adjacent to the Project location. Water quality would only show degradation if the soils resuspended into the river originated from a contaminated site or from an area where a spill had occurred. The BMPs associated with CM2 are designed to minimize or avoid this type of event from happening.

Freshwater Food Resource:
Turbidity could also impact the forage base by smothering benthic communities under silt and sediment deposition. However given the transient nature of the sediment sources related to construction actions and the short presence of the plume in the river channel, only benthic areas immediately adjacent to the Project site will be affected. The duration of this impact would likely be very short in time.

2.5.4.2. Long-Term Impacts

2.5.4.2.1. Chemical Constituents, Water Temperature, and CECs in the Effluent

The new effluent discharge to the San Joaquim River will introduce additional chemical constituents, including CECs, to the water body which add to the cumulative load already present in the baseline. The addition of these constituents would not occur but for the Project. However, many of these constituents are below the ambient concentrations already observed in the baseline conditions present in the river, and thus would lead to a dilution effect upon the addition of the effluent. Others would lead to a slight increase in the river concentrations. Based on aquatic life water quality criteria parameters, the effluent will not cause an exceedance of the acute or chronic criteria thresholds for those constituents that have limits. However as stated previously, while these aquatic life criteria have helped to improve water quality regarding specific toxins and chemical constituents, often this system is not sufficiently protective for listed species that may be more sensitive than the sampled/experimental species used to establish the criteria. These criteria also do not assess the effects of mixtures of chemical constituents, which may have additional synergistic qualities between compounds acting on common biochemical or metabolic pathways. This is particularly relevant for green sturgeon, for which few studies have been conducted to date that establish protective levels for this species. In addition, treated wastewater effluent delivers a wide variety of chemical constituents to aquatic ecosystems, many of which are not listed by the USEPA or SWRCB, and thus have no aquatic criteria associated with them. This is particularly true for CECs, many of which have little or no studies on the impacts to listed species following exposure and their eventual outcomes. The effluent will also create localized temperature gradients due to the higher thermal load in the effluent stream compared to the receiving waters of the San Joaquim River under almost all conditions.

2.5.4.2.1.1. Effects to CCV Steelhead designated Critical Habitat

Freshwater migration corridors:
Migration can be impaired due to pollutant-diminished sensory abilities, which is a form of obstruction. Trace amounts of copper in effluent water have been shown to diminish the ability of salmonids to navigate, detect predators and conspecifics, and forage for prey. The extent to which effluent constituents may chemically alter the homing ability of returning adults is dependent on the water hardness and level of DOC in the river water upon discharge, which can vary greatly over the course of a year. Constituents in the effluent will add to, and compound with, other pollutants already present in migratory habitats in ways that reduce water quality. The water column is an important connection between many of the biogeochemical processes that move pollutants through the action area in suspension, solution, or in the bodies of aquatic organisms, and is a medium that brings those pollutants into contact with freshwater migratory sites where they contact salmon that are undergoing growth, development, and smoltification. This exposure will cause harm to exposed individuals through reduction of fitness and health by altering sensory and physiological processes. Furthermore, thermal loading from the effluent is expected to create impediments to migration for both adult and juvenile steelhead that encounter the effluent plume as it discharges from the outfall pipe. Thermal gradients that are present in the water column surrounding the outfall and adjacent portions of the river channel will create habitat conditions that steelhead will try to avoid, forcing them to alter their movement patterns and move away from the effluent plume, resulting in harm, primarily associated with increased risks of predation to individual fish as they avoid the thermally altered habitat in the migratory corridor. This will decrease the value of this river reach as a migratory corridor.

Freshwater rearing:
Juvenile (young-of-year, parr, and smolts) and adults (including kelts) CCV steelhead will be subject to the effects of the effluent discharge. Constituents, including CECs, in the effluent discharge from the CTF outfall will add to, and compound with, other pollutants already present in the San Joaquin River in ways that adversely affect the amount of food available for juvenile steelhead by injuring or killing their prey, thus reducing the amount of energy available to meet the physiological demands of rearing and migration. Similarly, the differential impact of the discharge of effluent on prey species is likely to change their relative abundance and their community composition, thus further altering the foraging efficiency of juvenile fishes. Consumption of constituent related contaminants ingested inside the bodies of prey, or with plankton, detritus or sediment that is also ingested while feeding, provides a major pathway into the body of steelhead where they are likely to negatively affect juvenile growth and

development, suppress their immune systems, and impair sensory functions, thereby reducing their survival.

2.5.4.2.1.2. Effects to sDPS Green Sturgeon designated Critical Habitat

Freshwater migration corridors:
Migration of adult and juvenile sDPS green sturgeon within the San Joaquin River is expected to be affected in similar ways as previously explained for CCV steelhead. Sturgeon are highly sensitive to chemical contaminants, such as copper, and are expected to respond with olfaction impairment as well as avoidance of noxious stimuli in the water due to chemical constituents and thermal gradients.

Water Quality:
Constituents, including CECs, in the discharge of the effluent from the outfall will add to, and compound with, other pollutants already present the San Joaquin River in ways that will adversely affect water quality in freshwater riverine systems used by sDPS green sturgeon. Many of the constituents and CECs do not have water quality criteria for aquatic life, and most water quality criteria are not fully protective of listed species such as green sturgeon due to the limited amount of studies conducted on this species. Furthermore, the extremely long life of green sturgeon allows them to be exposed to these chemical compounds over a period of decades whenever they return to these freshwater habitats.

Freshwater Food Resource:
Chemical constituents in the outfall effluent, including CECs, will add to, and compound with, other pollutants already present in the San Joaquim River in ways that will adversely affect the amount of food available to sDPS green sturgeon by injuring or killing their prey. This will reduce the amount of energy available for young or adult green sturgeon foraging in the vicinity of the outfall and areas downstream of the outfall influenced by the effluent discharge. Juveniles are particularly susceptible since they have less body reserves to sustain periods of low food intake compared to adult fish. Furthermore, the prey upon which the green sturgeon forage is likely to become contaminated with the constituents contained in the effluent, including CECs. Consumption of contaminated prey items, or sediment and detritus in which the prey are found will add to the tissue burden of the green sturgeon which consumes these materials and prey. Many of these contaminants, including the CECs, can have detrimental effects on the metabolism, physiology, immune system, and reproductive capacity of the green sturgeon which has ingested them. This will lead to reduced fitness, and potentially morbidity and mortality following prolonged exposure.

2.5.4.2.2. Permanent Structures - Placement of Riprap and Outfall

The long-term presence of the newly applied 4,400 square feet of erosion control materials including rock riprap to the levee faces will impair the functioning of the riparian and aquatic habitats as already discussed in this Opinion. NMFS expects that food resources will be negatively affected due to a lack of riparian and shallow water habitat that will benefit food webs in the action area. Likewise, the benefit of diverse channel morphology and variable flows and water depths that a naturally meandering river channel would provide are prohibited from occurring due to the levee armoring. This affects the quality of the migratory corridor, food resources, and variable water depths identified as PBFs for freshwater riverine habitats for both CCV steelhead and sDPS green sturgeon.

The Project will also create permanent structures below the MLLW. These permanent structures include the outfall structure on the submerged portion of the eastern levee bank, as well as the portion of concrete mat and rip rap protecting the channel bottom from scour immediately below the outfall structure. The outfall structure creates velocity refugia and shaded area along the levee bank in an otherwise featureless reach of river. The concrete mat and riprap erosion protection along the channel bottom has the potential to create localized scour depressions that can provide refuge to predators. This degrades the quality of the migratory corridor and food resources in the action area, identified as PBFs for freshwater riverine habitats for both CCV steelhead and sDPS green sturgeon.

2.5.4.2.2.1. Effects to CCV Steelhead designated Critical Habitat

Freshwater migration corridors:
Application of new rock riprap on the existing levee will prevent the formation of undercut banks, side channels, or the incorporation and retention of IWM that provide velocity refugia and complex habitat to steelhead. Such habitat supports adult and juvenile mobility and survival as fish transit this reach of the San Joaquin River. Prevention of complex habitat formation increases the risk of predation upon emigrating juvenile steelhead. In addition, the construction of the outfall creates additional predator holding habitat that enhances the risk of predation upon migrating juvenile salmonids moving past the Project's location. Reduction of complex habitat and creating predator habitat will increase the likelihood that migrating juvenile CCV steelhead will be predated upon, leading to the mortality of those fish. This will decrease the value of this reach of river as a migration corridor.

Freshwater rearing:
Application of new rock riprap to the levee face and concrete mat to the channel bottom prevents the establishment and natural function of shallow water and riparian zones along the riverbank. These riparian zones provide shade, habitat structure, refugia for holding and rearing, as well as a source of invertebrates for food. In addition, the incorporation of organic materials, such as leaves, branches, roots, and tree trunks, that fall or otherwise enter the river, provides a source of organic carbon and energy to facilitate the functioning of a complex food web. This will reduce the value of this habitat for rearing juvenile CCV steelhead by decreasing the availability of food resources that will sustain the growth and fitness of migrating fish.

2.5.4.2.2.2. Effects to sDPS Green Sturgeon designated Critical Habitat

Food Resources:
Application of new rock riprap to the levee bank prevents the development of a riparian zone and nearshore shallow water habitat that can help foster a complex food web in the adjacent river channel through the input of organic materials. Within a riverine system, green sturgeon will feed on macrobenthic invertebrates that would benefit from the input of allochthonous material from the riparian zone of a natural river bank. This would include larval and nymph stages of insects, oligochaete and polychaete worms, crustaceans, and bivalves. The reduction of these food resources will decrease the value of this river reach for green sturgeon to rear and grow.

Freshwater migratory corridor:
Application of new rock riprap protection to the levee face, and construction of the outfall and mat structures will create predator refugia. This will reduce the value of the river as a migratory corridor for juvenile sDPS green sturgeon moving past the action area. Higher predation rates on migrating juvenile green sturgeon are expected from predators using this habitat compared to adjacent reaches.

2.5.4.2.3. Stormwater Discharge

Once the outfall is operational and the growth of the City of Lathrop according to the General Plan proceeds, additional stormwater discharge is expected. This increase is due to the creation of additional impervious surfaces within the area covered by the General Plan which limit or preclude infiltration of precipitation into the underlying soils. Discharge of raw stormwater into the San Joaquin River will add additional contaminates to an already burdened watershed. The impacts to the critical habitat for CCV steelhead and sDPS green sturgeon will be similar to that already described for the discharge of effluent from the CTF outfall above. However, the effects are expected to be greater in magnitude due to the nature of the stormwater effluent which receives little if any treatment before discharge and the expected volumes of discharge required during precipitation events.

2.6. Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02 and 402.17(a)). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

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

2.6.1. Agricultural Practices

Agricultural practices immediately surrounding the action area may negatively affect riparian and wetland habitats through upland modifications of the watershed that lead to increased siltation or reductions in water flow in stream channels flowing into the action area. The Delta lands surrounding the action area are primarily agricultural lands with orchards, row crops, and grazing lands for dairy cattle. Unscreened agricultural diversions entrain fish including juvenile salmonids and juvenile green sturgeon and are present in the action area within the mainstem San Joaquin River. Grazing activities from dairy and cattle operations can degrade or reduce suitable critical habitat for listed salmonids by increasing erosion and sedimentation as well as introducing nitrites, nitrates, ammonia, and other nutrients into the watershed, which then flow into the receiving waters of the action area. Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may negatively affect salmonid reproductive success and survival rates (Dubrovsky et al. 1998, 2000; Daughton 2003).

2.6.2. Increased Urbanization

The action area is surrounded by the growing urban centers of Tracy, Manteca, and Lathrop in San Joaquin County. Expansion of urban development is occurring in the cities of Manteca, Lathrop, and Tracy along the I-5 and I-205/580 corridors replacing agricultural uses. Increases in urbanization and housing developments can impact habitat by altering watershed characteristics, and changing both water use and stormwater runoff patterns. Increased growth will place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure such as wastewater sanitation plants, roads and highways, and public utilities. Some of these actions, particularly those which are situated away from waterbodies, will not require federal permits, and thus will not undergo review through the ESA section 7 consultation processes with NMFS.

Increased urbanization also is expected to result in increased recreational activities in the region. Among the activities expected to increase in volume and frequency is recreational boating. There are currently several boat launches, and a marina, within the vicinity of the action area. These sites provide recreational boaters access to the Delta. Any increase in recreational boating due to population growth would likely result in increased boat traffic in the action area. Boating activities typically result in increased wave action and propeller wash in waterways. This potentially will degrade riparian and wetland habitat by eroding channel banks and mid-channel islands, thereby causing an increase in siltation and turbidity. Wakes and propeller wash also churn up benthic sediments thereby potentially resuspending contaminated sediments and degrading areas of submerged vegetation. This in turn would reduce habitat quality for the invertebrate forage base required for the survival of juvenile salmonids and green sturgeon moving through the system. Increased recreational boat operation in the Delta is anticipated to result in more contamination from the operation of gasoline and diesel powered engines on watercraft entering the water bodies of the Delta. Furthermore, increased recreational boating, particularly those that can be trailered from one water body to another, greatly increases the risk of spreading non-native invasive species into the Delta.

2.6.3. Rock Revetment and Levee Repair Projects

Cumulative effects include non-Federal riprap projects. Depending on the scope of the action, some non-Federal riprap projects carried out by state or local agencies do not require Federal permits. These types of actions as well as illegal placement of riprap occur within the lower San Joaquin River surrounding the Project’s location. For example, most of the levees have roads on top of the levees which are either maintained by the county, the local reclamation district, the landowner, or by the state. Landowners may utilize roads at the top of the levees to access parts of their agricultural lands and repair the levees to protect property with unauthorized materials (i.e., concrete rubble, asphalt, etc.). The effects of such actions result in continued fragmentation of existing high-quality habitat, and conversion of complex nearshore aquatic to simplified habitats that affect salmonids in ways similar to the adverse effects associated with the Project.

2.7. Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section,

we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

2.7.1. Status of CV Spring-run Chinook Salmon

In the 2016 status review (NMFS 2016a), NMFS found, with a few exceptions, that CV spring-run Chinook salmon populations have generally increased through the 2013 returns (23,696 fish total including hatchery fish) but then sharply declined in 2014 (9,901 total fish including hatchery fish; the last escapement numbers available to the TRT since the last status review in 2010/2011(NMFS 2011a). Based on these escapement numbers, the 2016 status review changed the status of the Mill and Deer creek populations from the high extinction risk category, to moderate, while keeping the Butte Creek in the low risk of extinction category. Additionally, the Battle Creek and Clear Creek populations continued to show stable or increasing numbers in that period, putting them at moderate risk of extinction based on abundance. Overall, the Southwest Fisheries Science Center concluded in their viability report that the status of CV spring-run Chinook salmon (through 2014) had probably improved since the 2010/2011 status review and that the ESU's extinction risk may have decreased.

However, adult escapement numbers in 2015 were extremely low. The adult escapement to Central Valley waterways was 1,195 fish and the return to the Feather River Fish Hatchery was 4,440 fish. Returns in 2016 increased slightly but then declined again through 2018 from the high of nearly 24,000 adults seen in 2013 (CDFW 2021). However this trend was somewhat reversed in 2019, when over 20,000 adult CV spring-run Chinook salmon returned to the Central Valley river systems, compared to a 5-year average of approximately 5,800 fish from 2014 to 2018 (CDFW 2021). Escapement in 2020 declined sharply to a total of 3,242 adults, with 1,554 adults returning to the FRFH and 1,688 returning in-river (CDFW 2021). The impacts of the recent drought series, and warm ocean conditions on the juvenile life stage appears to have manifested in the low returning adult run sizes in 2015–2018 for most CV spring-run Chinook salmon populations. The Central Valley is again experiencing drought conditions over the past two years (2020–2021) and these conditions are expected to negatively influence juvenile survival and the overall CV spring-run Chinook salmon population.

2.7.2. Status of CCV Steelhead

The 2016 status review (NMFS 2016b) concluded that overall, the status of CCV steelhead appears to have changed little since the 2011 status review (NMFS 2011b) when the TRT concluded that the DPS was in danger of extinction. Furthermore, there is still a general lack of data on the status of wild populations. The Central Valley population of steelhead still faces the loss of the majority of the historical spawning and rearing habitat due to dams and other passage impediments, as well as the other factors previously described for their decline. There are some encouraging signs however, as several hatcheries in the Central Valley have experienced increased returns of steelhead over the last few years. There has also been a slight increase in the percentage of wild steelhead in salvage at the south Delta fish facilities, and the percentage of wild fish in those data remains much higher than at Chipps Island. The new video counts at Ward Dam show that Mill Creek likely supports one of the best wild steelhead populations in the Central Valley, though at much reduced levels from the 1950's and 60's. Restoration efforts in Clear Creek continue to benefit CCV steelhead. However, the catch of unmarked (wild) steelhead at Chipps Island is still less than 5 percent of the total smolt catch, which indicates that natural production of steelhead throughout the Central Valley remains at very low levels. Despite the positive trend on Clear Creek and encouraging signs from Mill Creek, all other concerns raised in the previous status review remain.

2.7.3. Status of sDPS North American Green Sturgeon

The viability of sDPS green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into just a few locations. The risk of extinction is believed to be moderate because, although threats due to habitat alteration are thought to be high and indirect evidence suggests a decline in abundance, there is much uncertainty regarding the scope of threats and the viability of population abundance indices (NMFS 2015). In 2018, NMFS issued their Recovery Plan for the sDPS green sturgeon (NMFS 2018).

Although the population structure of sDPS green sturgeon is still being refined, it is currently believed that only one population of sDPS green sturgeon exists. Lindley et al. (2007), in discussing winter-run Chinook salmon, states that an ESU represented by a single population at moderate risk of extinction is at high risk of extinction over the long run. This concern applies to any DPS or ESU represented by a single population, and if this were to be applied to sDPS green sturgeon directly, it could be said that sDPS green sturgeon face a high extinction risk. However, the position of NMFS, upon weighing all available information (and lack of information) has stated the extinction risk to be moderate (NMFS 2015).

Recent observations of green sturgeon spawning in the Feather River (Seeholtz et al 2015) and Yuba Rivers (CDFW 2018) at least indicate that green sturgeon will make opportunistic use of other watersheds for spawning if conditions are appropriate. Furthermore, verified observations by professional fisheries biologist of adult green sturgeon in the San Joaquin River system upstream of the Delta have occurred recently (Stanislaus River [October 2017] and within the mainstem of the San Joaquin River above the confluence with the Merced River [April 2020]).

There is a strong need for additional information about sDPS green sturgeon, especially with regards to a robust abundance estimate, a greater understanding of their biology, and further information about their micro- and macro-habitat ecology.

2.7.4. Status of Environmental Baseline and Cumulative Effects in the Action Area

CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon use the action area as an upstream and downstream migration corridor and for rearing. Within the action area, the essential features of freshwater rearing and migration habitats for salmon, steelhead, and green sturgeon have been transformed from meandering waterways lined with dense riparian vegetation, to a highly leveed system. Levees have been constructed near the edge of the river and sloughs and most floodplains have been completely separated and isolated from the river. Severe long-term riparian vegetation losses have occurred throughout the action area, and there are large gaps along leveed shorelines devoid of riparian vegetation due to the high amount of riprap. The change in the ecosystem as a result of halting the lateral migration of the river channels, the loss of floodplains, and the removal of riparian vegetation and IWM have likely affected the functional ecological processes that are essential for growth and survival of salmon, steelhead, and green sturgeon in the action area.

The Cumulative Effects section of this opinion describes how continuing or future effects such as agriculture, increased runoff and non-point source contaminants, armoring of levees and shoreline modifications from non-federal projects, and increased urbanization affect the species in the action area. These actions typically result in habitat fragmentation, and conversion of complex nearshore aquatic habitat to simplified habitats that incrementally reduces the carrying capacity of the rearing and migratory corridors.

2.7.5. Summary of Project Effects on individual Listed Salmonids and Green Sturgeon and at the ESU/DPS level

2.7.5.1. CV Spring-run Chinook salmon

2.7.5.1.1. Active Construction Related Activities

2.7.5.1.1.1. Temporal and Spatial Overlap

Adults and Juveniles: There are no spatial or temporal overlaps between construction activities and the presence of adult or juvenile CV spring-run Chinook salmon since neither adult nor juvenile life stages will be present in this area during the proposed in-water construction period of July 1 through October 31. There is no spawning habitat in this area, so there are no effects to eggs, fry, or parr. There are no effects related to the active construction actions at the outfall location to either adults or juveniles, therefore there are no effects to the ESU.

2.7.5.1.1.2. Effects to Individual Fish

Adults - Since it is not expected that any adult CV spring-run Chinook salmon will be present at the construction site during the construction work window of July 1 to October 31, there are no effects to individual fish.

Juveniles - Since it is not expected that any juvenile CV spring-run Chinook salmon will be present at the construction site during the construction work window of July 1 to October 31, there are no effects to individual fish.

2.7.5.1.2. Long Term Effects Related to the Project

2.7.5.1.2.1. Temporal and Spatial Overlap

Adults –Adult CV spring-run Chinook salmon returning from the ocean will migrate upstream through the San Francisco Bay estuary and into the Delta each year from January to June with a peak presence from February to April. Most of these fish will continue upriver to the spawning grounds within the Sacramento River and its tributaries. An additional group of adult CV spring-run Chinook salmon from the experimental reintroduction effort (SJRRP) will return to the spawning grounds below Friant Dam on the San Joaquin River. These fish will pass the location of the outfall.

Juveniles – Downstream emigration of juvenile CV spring-run Chinook salmon from the San Joaquin River basin will occur through the winter and spring of each year within the lower mainstem of the San Joaquin River as fish leave the upper watershed. Most of the young-of-the-year spring-run juveniles in the San Joaquin River are expected to move downstream in the March through May time frame, with a peak in April, when flows from the tributaries are typically elevated. However, some fish may emigrate earlier than March, or later than May, if river flows are elevated during those periods of time. All juveniles from the San Joaquin River upstream of the South Delta will pass the location of the outfall during their downstream migration except under very high flow conditions. During these high flow conditions, some fish will pass over the weir at Paradise Cut when it overtops and water flows from the San Joaquin River into Paradise Cut. These particular fish will enter the South Delta where Paradise Cut flows into Old River. The remaining fish will either stay in the mainstem San Joaquin River or enter into Old River where it splits from the mainstem of the San Joaquin River (i.e., Head of Old River).

2.7.5.1.2.2. Effects to Individual Fish

Adults - NMFS expects that all adult CV spring-run Chinook salmon returning to the San Joaquin River basin upstream of the South Delta will be exposed to the long-term effects of the Project. Fish must swim past the outfall location and thus be exposed to the outfall effluent within the river channel and the permanent structures constructed for the Project. NMFS expects that exposure to the effluent will diminish the physical health of susceptible fish that have an existing compromised physical status through exposure to chemical constituents in the effluent. This will result in the reduction of fitness and physiological status leading to harm and potentially mortality for the smaller fraction of individuals in the total population that are susceptible or already have compromised health status. Behavioral alterations are also expected to occur as well due to temperature gradients created by the warmer water in the effluent stream. Exposure to thermal gradients is expected to impede or disrupt upstream migratory behavior in some individual fish that are more sensitive to thermal conditions, potentially reducing their fitness and increasing the risk of predation, leading to mortality of a smaller fraction of the exposed population of individual fish that are actually consumed by predators. In addition, adult fish moving upstream during their spawning migration are expected to be exposed to stormwater effluent if their passage coincides with precipitation events causing harm to a subset of these fish. Exposure to the contaminants in the stormwater effluent is likely to diminish fish health and may cause morbidity or mortality following prolonged exposure or if contaminant loads are high in the discharge. Adult fish migrating upstream will also encounter the altered aquatic habitat due to the presence of the newly applied rock riprap to the levee, concrete mat armor on the channel bottom, and the newly constructed outfall into the foreseeable future. This alteration of aquatic habitat and its effects are described in section 2.5.2.2 *Permanent Structures - Placement of Riprap and Outfall*.

Juveniles – All juvenile CV spring-run Chinook salmon migrating downstream in the San Joaquin River in spring towards the South Delta are expected to be exposed to the outfall effluent and the permanent structures constructed for the Project, except for those that migrate through Paradise Cut under infrequent high river discharges. Any juvenile fish exposed to the outfall effluent are expected to have an increased potential of diminished physical health through exposure to constituents in the effluent stream, particularly if they have pre-existing deficiencies in their physiological status that make them more susceptible to contaminant exposures and toxicities (i.e., disease, poor nutritional status, prior exposure to contaminants, etc.). This will result in the transient reduction of fitness and physiological status for the majority of the exposed population. This portion of the population is expected to recover from their exposure. However, for a smaller fraction of the population with a compromised health status, the exposure has the potential to result in morbidity or mortality. NMFS also expects changes in migration behavior due to temperature gradients created by the warmer water in the effluent stream. Exposures of migrating juvenile CV spring-run Chinook salmon to thermal gradients are expected to impede or disrupt downstream migratory behavior resulting in harm and potentially mortality due to increased predation risks from delays in migration or selecting less favorable habitat to move through. In addition, juvenile fish moving downstream during their out-migration are likely to be exposed to stormwater effluent if their passage coincides with precipitation events. Exposure to the contaminants in the stormwater effluent is also likely to diminish fish health and may cause morbidity or mortality following prolonged exposure or if contaminant loads are high in the discharge. Fish with a compromised health status are at a higher risk than healthy fish, and are more likely to die or fall prey to predators after exposure.

Juvenile fish migrating downstream will also encounter altered aquatic habitat due to the presence of the newly applied rock riprap to the levee face, concrete mat armor on the channel bottom, and the new outfall structure into the foreseeable future. This alteration of aquatic habitat and its effects are described in section 2.5.2.2 *Permanent Structures - Placement of Riprap and Outfall*. Juvenile fish migrating downstream will also experience elevated predation risks due to the creation of the outfall structure on the eastern levee bank and adjoining channel bottom and new riprap on the levee face that provides predator holding habitat. This will lower the rate of survival through this reach of river for migrating juvenile CV spring-run Chinook salmon. NMFS expects that some fish from the overall population will fall prey to predators utilizing the permanent structures and erosion control materials and will be killed.

Exposure of benthic communities to the outfall effluent and stormwater effluent will diminish the forage base of invertebrates in areas adjacent to the outfall. This will negatively impact the foraging success of juvenile CV spring-run Chinook salmon as they migrate downstream to the

Delta, reducing their fitness and increasing the risk of morbidity and mortality through consumption of contaminated prey. Although the entire downstream migrating population will pass through the outfall location on the river, NMFS expects that this will only affect a small proportion of the entire population as fish will move relatively quickly through the affected reach to other habitat outside the action area. Healthy fish should have the resiliency to be able to move through this reach and survive to continue rearing in waters farther downstream. Fish that already have underlying pre-existing deficiencies in their physiological status are likely to have greater loss of fitness and lower survival rates.

2.7.5.1.3. Effects to the CV Spring-run Chinook salmon ESU

Adults -The majority of the currently existing populations of the CV spring-run Chinook salmon ESU originate in the Sacramento River basin (Northwestern California, Northern Sierra Nevada, and the Basalt and Porous Lava diversity groups) and are not expected to be present within the action area. Therefore the Project will have a minimal effect upon the ESU as a whole and will have minor impacts on the overall viability of the ESU. All natural-origin adult CV spring-run Chinook salmon returning to the San Joaquin River and its tributaries upstream of the South Delta belong to the Southern Sierra Nevada Diversity group. No other diversity groups are expected to be present in this region in any significant numbers, although some straying of individuals from other diversity groups may occur. Therefore only populations originating from this diversity group will be negatively impacted by the Project. Since no adult CV spring-run Chinook salmon are anticipated to be present during the construction activities due to migration timing, there will be no effect upon the ESU by those activities. However, over the long term operations and associated effects of the Project, adult CV spring-run Chinook salmon will be affected through exposure to the outfall and stormwater effluents as well as the other factors described previously. Exposure to the outfall effluent and stormwater discharges and other factors are expected to negatively influence the viability of the Southern Sierra Nevada Diversity Group by decreasing the level of survival and fitness of individuals from all of the populations within the diversity group upstream of the outfall location since the location of the Project is in a reach of the river through which all individuals from the diversity group must pass to migrate upstream of the Delta. Even though only small numbers of individual fish will be lost to the diversity group population through exposure to the effects of the Project, this will slow the initial process of building self-sustaining populations in this river basin when adult escapement populations are small. The NMFS Recovery Plan for CV spring-run Chinook salmon (NMFS 2014) has a recovery criteria requiring two self-sustaining populations in the Southern Sierra Nevada Diversity Group at a low risk of extinction. The impacts associated with the Project are likely to slow the attainment of this recovery goal since all populations within this diversity group upstream of the outfall location will be affected by the Project during their migration movements within the lower San Joaquin River, and individual fish will continue to be lost due to their exposure to the Project's effects. The impacts will be greater, at least initially, when adult escapement populations in the basin are small, and each individual fish has greater importance to the viability of this diversity group's overall population. As populations within the diversity group grow, the loss of small numbers of adults will have less of an effect on the growth and sustainability of the populations, as suitable numbers of adults remain to breed and sustain the population. The realization of the recovery goals for the entire CV spring-run Chinook salmon ESU requires the recovery goals for the Southern Sierra Nevada Diversity Group to be met.

Juveniles – As described for the adult CV spring-run Chinook salmon above, the majority of the juvenile spring-run Chinook salmon populations comprising the CV spring-run Chinook salmon ESU originate in the Sacramento River basin and will not be present in the action area. Thus, the Project will have minimal impact on the entire ESU as a whole. No juvenile CV spring-run Chinook salmon are expected to be present during construction activities, thus there will be no effects upon this ESU related to those activities. However, over the long term operations and associated effects of the Project, juvenile CV spring-run Chinook salmon will continue to be affected by the Project and those juveniles that are killed or injured by exposure to contaminants, reduced or contaminated forage base, or elevated predation risks due to the Project will be lost to the ESU. Even though small numbers of individual fish will be lost to the diversity group population through exposure to the effects of the Project, this will slow the initial process of building self-sustaining populations in this river basin when juvenile populations surviving to the Delta are small. Low numbers of juveniles surviving to the Delta can have a rolling effect on the potential number of adults returning to spawn from that particular brood year. The changes to the aquatic environment caused by the Project will continue to be a negative influence on the viability of the Southern Sierra Nevada Diversity Group by decreasing the level of survival and fitness of all juvenile spring-run Chinook salmon populations within this diversity group upstream of the outfall location that survive their migrations downstream to the action area of this Project. As described for the adult life stage, two populations of self-sustaining CV spring-run Chinook salmon at a low risk of extinction are required in the Southern Sierra Diversity Group to meet recovery criteria under the NMFS Recovery Plan (NMFS 2014). The realization of the recovery goals for the entire CV spring-run Chinook salmon ESU requires the recovery goals for the Southern Sierra Nevada Diversity Group to be met.

2.7.5.2. California Central Valley Steelhead

2.7.5.2.1. Active Construction-Related Effects

2.7.5.2.1.1. Temporal and Spatial Overlap

Adults - Adult CCV steelhead will be present in the waterways of the action area during the construction work window of July 1 through October 31. Adult steelhead entering the San Joaquin River basin start to appear in September in low numbers and typically increase in numbers from October through January based on the Stanislaus River weir data. Migration trends after late December are compromised due to the removal of the weir by the end of December in many of the years in which it was operated. Fish from the San Joaquin River basin (Southern Sierra Nevada diversity group) are expected to be present within the waters of the San Joaquin River adjacent to the outfall location during the in-water work window.

Juveniles – Juvenile steelhead have a very low probability of being present in the action area during the construction work window of July 1 through October 31. Most emigration by juvenile steelhead from the San Joaquin River basin (Southern Sierra Nevada diversity group) through the action area occurs from March through May based on data from the Mossdale trawl. Juvenile steelhead from the Sacramento River basin are not expected to be present at any time in the waterways adjacent to the outfall location.

2.7.5.2.1.2. Effects to Individual Fish

Adults – Medium numbers of adult steelhead present near the outfall construction site will be directly exposed or affected by construction related noise and activities related to pile driving or the pipeline outfall construction activities upon the levee. Those fish that are exposed to the effects of construction activities will encounter short-term (i.e., minutes to hours) construction-related noise depending on how long they remain in the channel of the San Joaquin River immediately adjacent to the construction site. The Project proposes to use only vibratory pile drivers to install the sheet piles forming the cofferdam. Sound levels are not anticipated to reach levels that would cause injury or mortality during the installation of the sheet piles for the cofferdam. Behavioral affects are estimated to range out to 70 m (230 feet) at which point the level of sound intensity drops below the threshold (150 dB) believed to cause behavioral responses. This distance spans the entire width of the river at the outfall location. Although direct injury or harm is unlikely, behavioral avoidance may cause fish to delay their upstream migration or drop back downstream past the location where the installation of the cofferdam is occurring on San Joaquin River. Installation of the sheet piles will take approximately 6 to 7 days and 5-6 days for removal.

In addition to the installation of the sheet piles for the cofferdam, the Project will install steel pilings inside of the cofferdam using an impact hammer to provide support for the cofferdam walls. Sound generated by the impact hammer will be attenuated with a bubble curtain. However, even with attenuation, the estimated distances to acute injury and cumulative injury extends across the river channel, and therefore those fish present during the impact pile driving are expected to be injured or killed. Exposure to this level of sound is expected to last 1 day during the in-water construction window.

Fish often respond to construction activities by quickly swimming away from the construction sites, resulting in the majority escaping direct physical injury. However, this effect is considered a form of harassment that results in an adverse response by the exposed fish. The probability of an individual fish being present during construction actions in the affected areas of the San Joaquin River increases after mid-September. Prior to mid-September, few adult steelhead have been observed passing the Stanislaus River fish weir. This information can be used as a surrogate for when fish might be present in the San Joaquin River system within the action area. In-water construction at the outfall location is scheduled to occur from July 1 to October 31, giving approximately 46 days of overlap between the presence of adult steelhead in the San Joaquin River system and in-water construction actions. There is approximately 2.5 months (approximately 62 to 77 days, July 1 to September 15) when adult steelhead are less likely to be present in the action area. Therefore construction that takes place earlier in the in-water construction window has a lower probability of having any overlap with the presence of adult steelhead in the action area and thus a reduction in any demonstrable impacts from the Project. The exposure of adult steelhead to pile driving sound is anticipated to last no more 15 days during the July 1 to October 31 in-water work window as described previously. Effects related to contaminants and turbidity released during construction actions will be minor and are not expected to impact adults migrating through the action area due to the implementation of construction BMPs designed to limit these factors and the short duration of exposure anticipated for adults as they move through the action area.

Juveniles - There is a negligible probability of exposure of juvenile CV steelhead to the effects of the active construction during the in-water work window. This is due to temporal and spatial separation of the Project's actions with the migratory timing and presence of juvenile steelhead in the San Joaquin River and south Delta. Presence of juvenile CV steelhead during the in-water work window would only occur due to substantially increased tributary flows from significant storm events or substantial reservoir releases on the tributaries. These events are unlikely to happen prior to the end of the work window in the San Joaquin River basin during the dry fall season. Therefore, NMFS does not anticipate that there will be any juvenile CV steelhead exposed to the construction related activities.

2.7.5.2.2. Long Term Effects Related to the Project

2.7.5.2.2.1. Temporal and Spatial Overlap

Adults - Returning steelhead adults from the Southern Sierra Nevada diversity group will migrate upstream in the San Joaquin River each year enroute to the San Joaquin River basin and its tributaries from approximately mid-September through early winter (January/ February) based on fish passage records from the Stanislaus River fish weir. It should be noted, however, that adult steelhead passage records are truncated artificially in most years by the fish counting weir being removed at the end of December. Adults may potentially migrate into any one of the tributaries of the San Joaquin River such as the Calaveras, Stanislaus, Tuolumne, and Merced rivers to reach their spawning grounds. Some adult steelhead will survive after spawning and return downstream as "kelts" through the action area. Adult steelhead from the Sacramento River basin are not expected to be present in the San Joaquin River basin upstream of the South Delta in any appreciable numbers, although some straying is likely.

Juveniles - Downstream emigration of juvenile steelhead will typically occur through the winter and spring each year within the mainstem of the San Joaquin River. As described for CV spring-run juveniles, all steelhead juveniles are expected to pass the outfall location during the downstream migration to the Delta and then to the ocean. Only a small fraction will enter Paradise Cut during high flow events when the weir overtops. Most of the juvenile steelhead from the San Joaquin River basin are expected to move downstream from March through May, peaking in April and May, when flows from the San Joaquin River basin tributaries are typically elevated. However, some fish may emigrate earlier than March, or later than May, if river flows are elevated during those periods of time.

2.7.5.2.2.2. Effects to Individual Fish

Adults – Adult steelhead are expected to have similar responses to the long term effects of the Project as was previously described for adult CV spring-run Chinook salmon. During their upstream migration, adult steelhead will be exposed to the effluent from the outfall and to any stormwater discharges that may occur during precipitation events. Responses to the effluents, are expected to be similar. Adult steelhead will also encounter the altered aquatic habitat due to the presence of the newly applied rock riprap to the levee face and concrete mat armored channel bottom as well as the new outfall structure and will have responses that have already been described in section 2.5.2.2 *Permanent Structures - Placement of Riprap and Outfall.*

Juveniles – Juvenile steelhead from the San Joaquin River basin will typically migrate through the action area from January through June with the majority of the population emigrating from March through May. The peak of emigration, based on observations at the Mossdale trawl location near the Head of Old River, is during April and May. The period of emigration overlaps with that of juvenile CV spring-run Chinook salmon. NMFS anticipates that responses of juvenile steelhead will be similar to that of juvenile CV spring-run Chinook salmon based on exposure timing and location. The general patterns of sensitivities to constituents in the effluents from the outfall and from stormwater discharges are expected to be similar in nature, although species differences in absolute responses are likely to exist. Juvenile steelhead will also be exposed to the ongoing impacts of the newly applied rock riprap to the levees, concrete mat armoring the channel bottom, and the new outfall structure on the aquatic and riparian habitats into the foreseeable future. These response and impacts were described in section 2.5.2.2 *Permanent Structures - Placement of Riprap and Outfall.*

2.7.5.2.3. Effects to the CCV Steelhead DPS

Adults – The majority of the currently existing populations of the CCV steelhead DPS originate in the Sacramento River basin (Northwestern California, Northern Sierra Nevada, and the Basalt and Porous Lava diversity groups) and are not expected to be present in the action area for this Project. Therefore, impacts to the Southern Sierra Nevada Diversity Group will not substantially affect the overall abundance or productivity of the DPS.

All natural-origin adult CCV steelhead returning to the San Joaquin River and its tributaries upstream of the south Delta belong to the Southern Sierra Nevada Diversity group. No other diversity groups are expected to be present in this region in any significant numbers, although some straying of individuals from other diversity groups may occur. Adult CCV steelhead from the Southern Sierra Nevada diversity group are expected to be present in the construction area of the Project during the in-water work window, and thus will be affected by the Project's actions. All of the adult CCV steelhead migrating upstream into the San Joaquin River basin above the south Delta are expected to use the mainstem of the San Joaquin River as their migratory route and will pass through the area adjacent to the outfall construction site. In approximately a third of the 11 years of passage data, 50 percent of the CCV steelhead passing the Stanislaus River fish weir did so after the beginning of September but prior to the end of the in-water work window as proposed (October 31) and thus have the potential to be exposed to the construction actions and their effects. Since lethal take of adult CCV steelhead has a low probability of occurring due to only 1 day of impact pile driving and any non-lethal take is expected to be primarily due to harassment of fish by noise and activity, the abundance of the CCV steelhead DPS will not be negatively impacted by the exposure of the San Joaquin River basin steelhead population to the construction related effects of the action.

Over the long term, adult CCV steelhead from the Southern Sierra Nevada Diversity Group will be negatively impacted by the Project through exposure to the outfall and stormwater effluents as well as the other factors described previously. Although some individuals from this diversity group are expected to be lost due to their exposure to the outfall and stormwater effluent, slowing the process of building self-sustaining populations in this river basin, the overall viability of the CCV steelhead DPS is not expected to have more than a minimal response to the Project as most of the existing populations within in the DPS are unaffected. The NMFS

Recovery Plan for CCV steelhead (NMFS 2014) has a recovery criteria requiring two self-sustaining populations in the Southern Sierra Nevada Diversity Group at a low risk of extinction. The impacts associated with the Project are likely to slow the attainment of this recovery goal since all populations within this diversity group upstream of the outfall location will be affected by the Project during their migration movements within the lower San Joaquin River, and individual fish will continue to be lost due to their exposure to the Project's effects. The impacts will be greater, at least initially, when adult CCV steelhead escapement populations in the basin are small, and each individual fish has greater importance to the viability of this diversity group's overall population. As populations within the diversity group grow, the loss of small numbers of adults will have less of an effect on the growth and sustainability of the populations, as suitable numbers of adults remain to breed and sustain the population. The realization of the recovery goals for the entire CCV steelhead DPS requires the recovery goals for the Southern Sierra Nevada Diversity Group to be met.

Juveniles – Like steelhead adults, the majority of juvenile CCV steelhead originate in the Sacramento River basin and belong to one of the three diversity groups found there. These diversity groups are not expected to be present in the action area for this Project. Therefore, the extent of impacts to the Southern Sierra Nevada Diversity Group will not substantially affect the overall abundance or productivity of the DPS.

Due to the anticipated absence of juvenile CCV steelhead during construction, there are no effects to the DPS related to the construction actions. However adverse impacts are expected over the long term operations of the Project and the presence of permanent structures and erosion protection materials within the river reach of the action area. Those juveniles that are killed or injured by exposure to contaminants, reduced or contaminated forage base, or elevated predation risks will be lost to the DPS. As described for the adult life stage, two populations of self-sustaining CCV steelhead at a low risk of extinction are required in the Southern Sierra Diversity Group to meet recovery criteria under the NMFS Recovery Plan (NMFS 2014). Since all populations of CCV steelhead arising within the San Joaquin River basin upstream of the outfall location must pass through the river reach occupied by the outfall, all juvenile fish will be exposed to the effects of the Project over the long term. Most fish are anticipated to survive this exposure and pass into the Delta on their way to the ocean, but a small percentage of the population is expected to be lost due to their exposure to the effects of the Project. Even though small numbers of individual fish will be lost to the diversity group population through exposure to the effects of the Project, this will slow the initial process of building self-sustaining populations in this river basin when juvenile populations surviving to the Delta are small. Low numbers of juveniles surviving to the Delta can have a rolling effect on the potential number of adults returning to spawn from that particular brood year. The changes to the aquatic environment caused by the Project will continue to be a negative influence on the viability of the Southern Sierra Nevada Diversity Group by decreasing the level of survival and fitness of all juvenile CCV steelhead populations within this diversity group upstream of the outfall location that survive their migrations downstream to the action area of this Project.

2.7.5.3. sDPS of North American Green Sturgeon

2.7.5.3.1. Active Construction Related Effects

2.7.5.3.1.1. Temporal and Spatial Overlap

Adults - Adult green sturgeon are expected to be present year-round in the Delta. Peak presence is during the upstream spawning migration into the Sacramento River from approximately February through June. Post-spawn adults move back downstream following spawning, but spend varying lengths of time resting upriver before returning downstream. Less is known regarding their potential use of the San Joaquin River basin upstream of the Delta, but CDFW sturgeon report card information and the observation of a live adult green sturgeon in the Stanislaus River in October 2017, and another adult green sturgeon on the San Joaquin River mainstem at the confluence with the Merced River in May 2020, indicate that there is opportunistic use of this watershed. The information provided in the CDFW sturgeon report cards indicates that green sturgeon have been caught during all seasons of the year in the San Joaquin River basin, but primarily from fall through spring. Few fish are caught during the summer period.

Juveniles - Juvenile green sturgeon may rear for up to three years in the Delta before finally emigrating to the marine environments along the continental shelf. It is believed that juveniles make use of all accessible waterways in the Delta to rear during this period, including all of the waters in the action area.

2.7.5.3.1.2. Effects to Individual Fish

Adults - For those adults that are in close proximity to the City of Lathrop's CTF outfall construction site during active pile driving, NMFS believes that it is highly likely that only behavioral modifications will occur. NMFS described the exposure to pile driving actions in section 2.7.5.2.1.2 for the exposure of adult steelhead and believes the responses will apply to adult green sturgeon too. Exposed fish are expected to move away from the disturbance and noise to waters that are quieter and have less activity, resuming foraging or holding behavior. Any delays to movements are temporary. Furthermore, fish can continue their movements during the night when pile driving activities cease until the next morning.

NMFS does not expect any demonstrable effects to adult green sturgeon due to turbidity or spilled contaminants related to Project activities. The Project will adhere to construction BMPs that will minimize the effects or potential release of turbidity plumes or exposure to spilled contaminants. Any turbidity associated with the Project's actions is not anticipated to reach a magnitude that would adversely affect green sturgeon, a species that is typically found in the turbid waters of the Delta and San Francisco Bay estuary. The release of contaminants from spills is also unlikely due to the spill prevention and clean up components of the Project's BMPs. These components of the BMPs are designed to prevent spills or leaks before they can occur, and if they do occur, quickly containing them and cleaning them up before they can enter adjacent waterways.

Juveniles - Effects to juveniles are expected to be the same as those described for adult green sturgeon. NMFS anticipates that it is highly unlikely that any lethal effects from construction activities will occur. Like the effects to adults, juveniles are most likely to have behavioral modifications as a result of their exposure to the pile driving. Fish are expected to move away from noise and disturbances to quieter areas of the adjacent waterways, and resume their normal behaviors. These effects are considered non-lethal and temporary in duration. Juveniles will also have the same exposure and responses to any increased turbidity or presence of contaminants as described for the adult life history phase.

2.7.5.3.2. Long Term Effects Related to the Project

2.7.5.3.2.1. Temporal and Spatial Overlap

Adults - Adult green sturgeon are present year-round in the waters of the Delta and the San Francisco Bay estuary and therefore are expected to be present year round in the waters of the San Joaquin River adjacent to the Project site. Therefore, their presence will overlap with the year-round operations of the outfall and the presence of Project related impacts previously identified in this Opinion.

Juveniles –.Juvenile green sturgeon are present in the waters of the Delta and the San Francisco estuary year-round and are present throughout the action area. Therefore, their presence will overlap with the year-round operations of the outfall and the presence of Project related impacts previously identified in this Opinion.

2.7.5.3.2.2. Effects to Individual Fish

Adults – Adult green sturgeon are expected to have similar responses to the long term effects of the Project as was previously described for adult CV spring-run Chinook salmon and CCV steelhead. During their movements into and out of the San Joaquin River basin, adult green sturgeon will be exposed to the effluent from the outfall and to any stormwater discharges that may occur during precipitation events. Responses to the effluents are expected to be similar to those previously described for salmonids. The general patterns of sensitivities to constituents in the effluents from the outfall and from stormwater discharges are expected to be similar in nature to salmonids, although species differences in absolute responses are likely to exist. Adult green sturgeon will also be exposed to the ongoing impacts of the riprapped levees on the aquatic and riparian habitats as well as the permanent outfall and concrete mat structures. These response and impacts were described in section 2.5.2.2 *Permanent Structures - Placement of Riprap and Outfall.*

Juveniles – Juveniles are also expected to have similar responses to the long term effects of the Project as was previously described for CV spring-run Chinook salmon and CCV steelhead. During their movements into the San Joaquin River basin, juvenile green sturgeon will be exposed to the effluent from the outfall and to any stormwater discharges that may occur during precipitation events. Responses to the effluents are expected to be similar to those previously described for salmonids. The general patterns of sensitivities to constituents in the effluents from the outfall and from stormwater discharges are expected to be similar in nature to salmonids, although species differences in absolute responses are likely to exist. Juvenile green sturgeon will also be exposed to the ongoing impacts of the riprapped levees on the aquatic and riparian habitats as well as the permanent outfall and concrete mat structures. These response and impacts were described in section 2.5.2.2 *Permanent Structures - Placement of Riprap and Outfall.*

2.7.5.3.3. Effects to the sDPS of North American Green Sturgeon

Adults – No effects to the viability of the sDPS of green sturgeon are expected from the exposure to Project's construction activities. Since exposure to the effects will result in only non-lethal responses, which are temporary in nature, there are no long lasting effects to the individual fish and hence the DPS as a whole. The long term exposure to contaminants, including CECs, is expected to adversely affect adult green sturgeon present in the lower San Joaquin River. Due to the long lifespan of green sturgeon, adults have the potential to be exposed multiple times during their life if they opportunistically enter into the lower San Joaquin River and move past the Project location. Repeated exposures to contaminants and CECs is anticipated to reduce the fitness of exposed individuals, increasing the likelihood that their reproductive capabilities as well as overall health will be diminished. Adult green sturgeon have a high reproductive value per individual, particularly if the individual fish is a female. The high fecundity of female sturgeon, coupled with the ability to spawn multiple times over their long lifetime means that the loss of even one mature breeding age individual can have discernable impacts to future population abundance. This is particularly true if the population of spawning age fish is small. The loss of an individual fish or reduction in reproductive status of any adult green sturgeon due to contaminant exposure will lead to a negative effect on the sDPS viability, since all green sturgeon found within the Central Valley watersheds are expected to be from the same sDPS population. However, NMFS expects that the opportunistic use of the San Joaquin River is infrequent, and that the numbers of fish occupying waters in the basin are very low, thus the potential for an individual from the DPS to be exposed to the Project's effects is low. Therefore, the exposure and potential loss of adult sDPS green sturgeon from the Project is considered to have a low potential and will have minimal impact to the overall viability of the DPS.

Juveniles – There are no effects to the viability of the sDPS of green sturgeon due to the exposure of juveniles to the Project's construction activities. Since only non-lethal behavioral effects are expected, and individuals are anticipated to fully recover from these effects, there are no expected losses of any individual fish to the overall population. Thus there is no diminishment in abundance or any of the other elements that affect the viability of the DPS. Losses of juvenile green sturgeon due to contaminant exposure and alterations to aquatic habitat related to permanent levee presence will have a negative effect on the future viability of the sDPS, although less so than losses of sexually mature adults. As fish grow older and become sexually mature, they become more valuable to the viability of the DPS. However, juvenile fish must survive their early years in order to reach their sexual maturity. Increases in juvenile mortality rates due to the additional stressors represented by contaminants and aquatic habitat alterations related to the riprapped levees places additional pressure on the population to remain viable. However, the effects of the Project are expected to be of limited magnitude related to the entire sDPS population of green sturgeon. This is due to the majority of the juvenile sDPS green sturgeon population occurring outside of the action area. Only a small proportion of the juvenile sDPS green sturgeon population is anticipated to use the lower reaches of the San Joaquin River for rearing, and thus the fraction of the population exposed to the Project's long term effects is considered to be relatively small compared to the overall population of juvenile fish in the DPS. Therefore the effects of the long term operations of the Project and the presence of permanent structures and erosion control materials will have only a minimal impact on the overall sDPS population.

2.7.6. Summary of Project Effects on Designated Critical Habitat

Within the Project's action area, there is designated critical habitat for CCV steelhead, and sDPS green sturgeon within the mainstem San Joaquin River. The relevant PBFs of the designated critical habitat for steelhead are migratory corridors and rearing habitat, and for green sturgeon the six PBFs include food resources, substrate type/size, flow, water quality, migration corridor free of passage impediments, depth (holding pools), and sediment quality.

Pile driving actions will cause temporary delays or blockage to the migration or movements of CCV steelhead and sDPS green sturgeon for both adult and juvenile life stages if they are present in the area surrounding the City of Lathrop's CTF outfall location. This impacts the ability of the designated critical habit to fulfill its utility as an unobstructed freshwater migration corridor for both CCV steelhead and sDPS green sturgeon. Pile driving noise may also displace individual fish from the aquatic habitat affected by the sound, thus reducing the physical area available for freshwater rearing and foraging.

The noise generated by pile driving does not physically alter the surrounding designated critical habitat. Once the pile driving stops and the sound subsides within a few seconds, the habitat resumes its normal function. There are no permanent effects to the habitat and fish can immediately start occupying it and using it for migration, rearing, or foraging once the pile driving stops.

Under the proposed action, pile driving can only occur between the hours of 7 am and 5 pm on weekdays from July 1 through October 31. It is anticipated that all pile driving will be accomplished within a total of 15 days, spaced out over two separate periods to install and remove sheet piles and pipe piles. After this, there is no additional impact to the designated critical habitat for CCV steelhead and sDPS green sturgeon related to the pile driving actions associated with the Project.

Alterations to the aquatic and riparian habitat as a result of the application of new rock riprap to the levee face and construction of the outfall and concrete mats will impact both freshwater migratory corridors and rearing habitat for both steelhead and green sturgeon critical habitat. The footprint of the outfall structure and associated erosion protection on the channel bottom and levee banks effectively removes functional acreage from their critical habitats in perpetuity, though the total amount removed is small. Because the project must occupy some amount of critical habitat to proceed as proposed, a purchase of compensatory mitigation credits is included as part of the action to offset, to some degree, this unavoidable impact. The purchase of compensatory mitigation credits will restore and preserve, in perpetuity, habitat that will offset the loss of 0.10 acres of perennial riverine habitat and 0.16 acres of riparian habitat caused by the Project. The purchase of compensatory mitigation credits of shaded riverine aquatic habitat (SRA) or similar types of habitat will be beneficial to CV spring-run Chinook salmon, and CCV steelhead (and potentially sDPS green sturgeon although there are no current mitigation credits authorized for this species). In particular, the shallow, river margin habitat used by juvenile salmonids will be impacted by the project. To offset such loss, most of the mitigation banks that serve the action area offer floodplain or other habitats that can support rearing salmonids in the same way the river margin habitat would have functioned, had the project not occurred.

Even though the conservation credits are purchased in banks that are removed from the action area, the banks can benefit adults and juveniles from the listed ESU or DPS, despite the fact that individuals from the action area may never benefit from these credits. The conservation/ mitigation banks considered in this opinion are located in the northern Delta (Liberty Island) or along the lower Sacramento River upstream of the Delta (Bullocks Bend and Fremont Landing). These conservation/mitigation banks provide enhanced habitat for individuals originating from the three different diversity groups that occupy the Sacramento River Basin (Northwestern California, Basalt and Porous Lava, and Northern Sierra Nevada) that would normally migrate through waters adjacent to these banks. The listed salmonid species which would benefit from these banks include the CV spring-run Chinook salmon ESU and CCV steelhead DPS (which occur in the Project's action area), and although not a species considered in this opinion, the Sacramento River winter-run Chinook salmon ESU. Individuals from the Southern Sierra Nevada Diversity Group, which occur in the action area, are unlikely to be found in the northern Delta or Lower Sacramento River and thus would not benefit from using these enhanced habitats. Furthermore, while the banks that cover the action area in their service area may not technically offer sDPS green sturgeon credits, NMFS expects that some sDPS green sturgeon individuals should benefit from the purchase of SRA credits since individuals should be able to access the purchased riverine habitat areas created and maintained by the banks/programs. In addition, sDPS green sturgeon that opportunistically use the lower San Joaquin River in the action area, are also likely to move throughout the Delta waterways and the Sacramento River mainstem during their life, and thus have the potential to utilize the banks and their enhanced habitat.

The long-term operations of the outfall to discharge treated effluent from the CTF as well as discharge of untreated stormwater into the San Joaquin River will affect the water quality of the freshwater migratory corridor and rearing habitat for CCV steelhead and food resources, water quality, and freshwater migration corridors for sDPS green sturgeon. Changes to water quality due to the effluent's chemical constituents, including CECs, may also impact the forage base supporting juvenile steelhead and green sturgeon development and health.

The amount of critical habitat for CCV steelhead and sDPS green sturgeon impacted by the Project is very small compared to the entire area of critical habitat available in the Central Valley and Delta regions for these two species. Thus, the function of critical habitat for these two species on an ESU or DPS level, particularly pertaining to freshwater rearing, food resources, and migration corridors, will only be minimally affected throughout the range of the two species. The additional areas of designated critical habitat within the range of these two species are expected to remain unaffected by the Project and retain their current function.

2.8. Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of CV spring-run Chinook salmon, CCV steelhead, and the sDPS of North American green sturgeon. The project will not adversely modify designated critical habitat for CCV steelhead, or the sDPS of North American green sturgeon.

2.9. Incidental Take Statement

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

Although our jeopardy and adverse modification analysis indicates that adverse impacts to habitat are likely to occur in the future from the associated actions of treated wastewater discharge from the CTF and increased stormwater discharge from future development, NMFS is not including incidental take for these activities in this incidental take statement for the following reasons:

1) As the federal agency for this consultation, USACE has determined that they do not have discretion over post-construction activities, such as effluent from the CTF and future stormwater discharge; and

2) NMFS cannot predict the level of impact resulting in incidental take to listed species and their habitats with the current information on frequency and content of the future stormwater discharge related to future development under the City of Lathrop’s General Plan.

The applicant, the City of Lathrop, can pursue take coverage for the discharge of treated effluent from the CTF and stormwater discharge if it becomes warranted in the future through Section 10 of the ESA.

2.9.1. Amount or Extent of Take

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

2.9.1.1. Construction Related Incidental Take and Permanent Structures

NMFS anticipates incidental take of CCV steelhead and the sDPS of North American green sturgeon in the action area through the implementation of the proposed Project’s construction actions. Construction actions will take place at the outfall location on the east bank of the San

Joaquin River at approximately RM 55.8. Because of the proposed timing of the in-water work for the construction phase of the Project, actual numbers of fish adversely affected by the construction actions are expected to be low. Only medium numbers of adult CCV steelhead and small numbers of juvenile and adult sDPS green sturgeon will be present in the action area in during the construction period. However, they may not always be present at the outfall construction site during actual construction due to the variability in their spatial and temporal distribution within the action area.

However, while individual fish will be present in the area adjacent to the outfall location, NMFS cannot, using the best available information, precisely quantify and track the amount or number of individuals that are expected to be incidentally taken (injure, harm, kill, etc.) per species as a result of the proposed action. This is due to the variability and uncertainty associated with the response of listed species to the effects of the proposed action, the varying population size of each species, annual variations in the timing of spawning and migration, individual habitat use within the action area, and difficulty in observing injured or dead fish. However, it is possible to estimate the extent of incidental take by designating as ecological surrogates, those elements of the project that are expected to result in incidental take, that are more predictable and/or measurable, with the ability to monitor those surrogates to determine the extent of take that is occurring.

The most appropriate threshold for incidental take related to construction is an ecological surrogate of habitat disturbance, which includes the factors responsible for the incidental take of listed fish. In this consultation the ecological surrogates are:

- The physically measureable attributes of sound associated with vibratory and impact pile driving that result in mortality, injury, or behavioral alterations of exposed fish.
- The physically measureable increase in turbidity associated with installation and removal of the sheet piles and construction actions occurring upon the levee resulting in avoidance, feeding disruption, elevated stress responses, and behavioral alterations of exposed fish.
- The physically measurable footprint of the altered streambed and levee face associated with the construction of the outfall structure and placement of erosion resistant materials that reduce the availability of food and increase the risk of predation resulting in mortality, reduced fitness, and harm to exposed fish.

NMFS anticipates construction related incidental take from pile driving and levee work during the 4 months of construction activities. Incidental take related to the exposure to the permanent erosion protection materials (riprap and concrete mat) will continue into the foreseeable future.

Pile Driving: Incidental take of adult CCV steelhead, and juvenile and adult sDPS green sturgeon is expected to occur during the 4-month construction period occurring between July 1 and October 31 as a result of exposure to the noise generated by vibratory and impact pile driving activities. Quantification of the number of fish exposed to the pile driving associated noise and turbidity is not currently possible with available monitoring data. All individual fish that are present during cofferdam installation and removal construction activities in the waters adjacent to the cofferdam location are expected to be exposed to pile driving noise disturbance. Quantifying the number of fish present at any given time is not possible due to variances in migration movements and timing on short temporal scales. Vibratory pile driving will result in take occurring as harassment and behavioral alterations. Impact pile driving will result in take occurring as death, injury, and harassment. The magnitude of energy in the noise associated with impact pile driving has the potential to cause barotrauma resulting in mortality or injury, or behavioral avoidance in exposed fish. Impacts associated with injury or behavioral effects may secondarily result in increased susceptibility to predation, infection, and reduced capacity for feeding, growth, or fitness (see section 2.5.1.1) resulting in take in the form of death or harm. The magnitude of energy in the noise generated by vibratory pile driving is less and will cause behavioral avoidance and disruption of movements. Only the level of acoustic noise generated during the pile driving phases of the Project can be accurately and consistently measured, thus providing a quantifiable metric for determining incidental take of listed fish. Therefore, the measurement of acoustic noise generated during the vibratory and impact pile driving of the piles described in the proposed Project, will serve as a physically measurable ecological surrogate for the incidental take of listed fish species. The numbers and types of piles to be installed, as well as the anticipated number of strikes per pile, were described previously in section 2.5.1.1 and 2.5.1.1.1.

Adjusted source sound metrics for 24–inch AZ sheet piles driven by a vibratory hammer (unattenuated):

- o Distance to 150 dB-RMS = 70 meters/ 230 feet
- o Distance to 163 dB-RMS = 10 meters/ 31 feet

Adjusted source sound metrics for 30–inch steel pipe piles driven by an impact hammer (-5 dB attenuation):

- The $SEL_{accumulated}$ is 208.53 dB at 10 meters (33 feet) and the calculated distance to each of the applicable thresholds is as follows (-5 dB attenuation):
  - o Distance to 206 dB-peak = 9 meter/ 29.5 feet
  - o Distance to 150 dB-RMS = 2,154 meters/ 7,067 feet
  - o Distance to 187 dB-$SEL_{accumulated}$ = 273 meters/ 896 feet (for fish > 2 g)
  - o Distance to 183 dB-$SEL_{accumulated}$ = 293 meters/ 961 feet (for fish < 2 g)

If any of sound thresholds at the specified distances (derived from the NMFS spreadsheet values) are exceeded even after mitigation measures are implemented, the proposed Project will be considered to have exceeded anticipated take levels, triggering the need to reinitiate consultation on the Project.

Turbidity: The most appropriate threshold for incidental take consisting of fish disturbance and sub-lethal effects associated with elevated in-river turbidity plumes is an ecological surrogate of the amount of increase in downstream in-river turbidity generated by cofferdam pile driving activities, placement of riprap, and construction activities on the levee waterside face. In-river pile driving, cofferdam dewatering, and in-river pile removal are expected to mobilize sediment and increase water turbidity beyond natural levels. Immersion of fresh stone riprap and excavations on the waterside face of the levee are also potential sources of turbidity. Increased turbidity is expected to cause harm to adult and juvenile CCV steelhead through elevated stress levels and disruption of normal habitat use. These temporary responses are linked to decreased growth, survivorship, and overall reduced fitness as described previously in section 2.5.1.3. The most appropriate threshold for incidental take consisting of fish disturbance and sub-lethal effects associated with elevated in-river turbidity plumes is an ecological surrogate of the amount of increase in downstream in-river turbidity generated by cofferdam pile driving activities, placement of rip rap, or runoff from freshly excavated levee soils. In-river pile driving and in-river pile removal, as well as placement of riprap and levee excavations are expected to mobilize sediment and increase water turbidity beyond natural levels. Increased turbidity is expected to cause harm to adult and juvenile CCV steelhead through elevated stress levels and disruption of normal habitat use. These temporary responses are linked to decreased growth, survivorship, and overall reduced fitness as described for underwater noise avoidance.

The surrogate for turbidity increase will be based on CCV steelhead sensitivity to raised turbidity levels. According to the data for the in-water work window provided in section 2.5.1.3, typical maximum turbidity in the San Joaquin River during the in-water work season is usually less than 50 NTU. Rarely does ambient turbidity in the San Joaquin River at Mossdale reach 50 NTU, and is frequently below 10 to 20 NTU during the period between July 1 and October 31. 50 NTUs is already above the range at which steelhead experience reduced growth rates (25 NTU) but below the range steelhead would be expected to actively avoid the area. Therefore, the turbidity (in NTU) immediately downstream of the boundary already established for the construction noise/pile driving disturbance surrogate (approximately 70 meters downstream in the San Joaquin River waterway from the northernmost boundary of the construction footprint and cofferdam placement) would measure up to 25 NTU above the turbidity level in the San Joaquin River water measured immediately upstream of project activities at Mossdale, which will serve as the ambient baseline turbidity level in the river without the effects of the action. This downstream turbidity level would be comparable to the expected higher range of normal turbidity in the San Joaquin River as measured at Mossdale during the July 1 through October 31 period. Within the already established 70 meter disturbance area, where impacts from the cofferdam installation/ removal actions are expected to be greatest, San Joaquin River water turbidity would measure up to 50 NTU above the turbidity level in upstream measurements. This allows for localized turbidity spikes related to construction actions and would be comparable to the highest transient levels seen at Mossdale during the July 1 through October 31 in-water construction period. Since in-river values change daily, the upstream comparison value must therefore be taken daily, in association with the location of the cofferdam and downstream readings. Exceeding these tiered turbidity thresholds will be considered as exceeding the expected incidental take levels.

Permanent Structures and Erosion Protection Material: The most appropriate measurement of harm to CCV steelhead, CV spring-run Chinook salmon, and sDPS green sturgeon associated with placement of permanent artificial structure and habitat occupation is a surrogate of the amount of degradation of habitat function in the immediate area associated with artificial structure placement and material occupation. The placement of new rock riprap, the concrete mat, and installation of the permanent outfall structure is expected to cause harm to adult and juvenile CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. The artificial hard structure and materials would occupy benthic substrates that support benthic prey of juvenile CCV steelhead, CV spring-run Chinook salmon and sDPS green sturgeon, reducing feeding opportunities and negatively affecting their potential growth rates. The hard structures and the new water velocities and flow patterns created around them also reduce the possibility of natural processes from otherwise occurring in the area, like the establishment of aquatic or riparian vegetation on the levee face or large woody material capture along the shoreline. Preventing the formation of this refugia habit prevents juveniles from resting or sheltering in the immediate project area. In addition, the new structures and flow patterns will create additional predator holding areas and increase the risk of predation on juvenile fish resulting in harm and potentially death. Adult green sturgeon are also expected to experience reduced feeding opportunity and reduced fitness following Project completion. While habitat functionality will not be lost completely, the outfall will be used and maintained in perpetuity; therefore, the adverse effects associated with these new structures will also remain into the foreseeable future.

On the bank, the applicant estimates that the structure and riprap will occupy 0.16 acres of riparian habitat above the OHWM on the leveed bank. Riparian trees are being retained to the extent feasible without changing the project placement. Below the OHWM, in aquatic habitat, the concrete mat and the riprap are estimated to occupy a 0.10 acre footprint. Therefore, permanent degradation of habitat will be limited to 0.16 acres above the OHWM and 0.10 acres below the OHWM, for a degradation surrogate of 0.26 acres of total affected habitat. Exceeding this total acreage surrogate amount for structure placement will be considered as exceeding the expected incidental take level.

Fish Relocation:
The action of conducting a fish relocation from within the area behind the cofferdam allows for quantification of fish entrapped by the cofferdam structure. NMFS expects incidental take to occur in the form of harassment, trapping, pursuit, capture, collection, harm and death. NMFS anticipates the following numbers of listed species to be taken as a result of entrapment behind the cofferdam and capture and handling during the fish relocation actions:

CCV Steelhead

- Up to four adult steelhead entrapped behind the cofferdam
- Two adult steelhead mortalities as a result of entrapment or handling during the fish relocation.

sDPS Green Sturgeon

- Up to three green sturgeon, regardless of life stage, entrapped behind the cofferdam.
- Two green sturgeon mortalities, regardless of life stage, as a result of entrapment or handling during the fish relocation.

Exceeding the limits described above for entrapment or mortality during the fish relocation action will be considered as exceeding the expected incidental take level.

2.9.2. Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the CV spring-run Chinook salmon ESU, the CCV steelhead DPS, or the sDPS of North American green sturgeon or destruction or adverse modification of designated critical habitat for CCV steelhead or sDPS of North American green sturgeon.

2.9.3. Reasonable and Prudent Measures

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

1. Measures shall be taken by the USACE or their permittees to minimize or avoid deleterious impacts of pile driving and other construction related activities upon listed CCV steelhead or sDPS green sturgeon.

2. The USACE or its permittee shall prepare and provide NMFS with plans and reports describing how impacts of the incidental take on listed species in the action area will be monitored and documented.

2.9.4. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. The USACE or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

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

    a. Underwater sound shall be monitored during vibratory pile driving to ensure that the limit of incidental take does not exceed effective quiet, or 150 dB RMS, beyond 70 meters from the point of construction activity (section 2.5, Effects of the Action), in order to limit the extent of harm or harassment.

    b. Underwater sound shall be monitored during impact pile driving of the steel pipe piles to ensure that the limit of incidental take does not exceed the values for 5 dB of sound attenuation from the point of construction activity (section 2.5, Effects of the Action), in order to limit the extent of harm or harassment.

    c. Acoustic monitoring shall be in accordance with the Federal Highway Working Group's (FHWG) Underwater Noise Monitoring Plan template. Link to webpage

    d. Initial acoustic sound measurements shall be taken at the standard reference distance and depth to verify the initial pile characteristics are valid.

    e. The USACE and their permittee shall immediately notify NMFS if thresholds measured at the specified distances are exceeded. Pile driving activities shall be suspended until NMFS, USACE, and their permittee have determined an appropriate corrective action.

    f. During any in-water construction activities, the permittee shall monitor the waters surrounding the outfall location for the observation of any dead, moribund, or erratically behaving salmonid or sturgeon species within 273 meters (896 feet) of the Project work area. Any observation of such fish will be immediately reported to NMFS within 24 hours at the email address provided in Term and Condition 2.a below. Any dead fish shall be collected in accordance with Term and Condition 2.e below and held for personnel from the NMFS CCV Office, or NOAA Office of Law Enforcement to retrieve or sent to the address provided.

g. The USACE and their permittee shall incorporate a process for fish recovery and resuscitation during the fish relocation process to ensure that relocated fish have regained normal behavior prior to release. Normal behavior shall be considered as normal respiration and ventilation movements, possession of normal equilibrium posture, and reflexive movements to external stimuli. Fish not showing these traits shall be held in an aerated cooler or similar holding device with recirculated river water and aeration until normal behavior is regained prior to their release.

h. Prior to the final closure of the cofferdam with sheet piles, the enclosed space behind the sheet piles shall be swept with a seine net or similar equipment that extends from the surface to the deepest portion of the channel along the base of the cofferdam sheet piles and to the water's edge on the shore. Sweeping the enclosed area will move fish out of the enclosed area prior to installing the final sheet piles. Sweeping the enclosed area prior to closure will also reduce the potential exposure of listed fish to the proposed impact pile driving of the steel pipe piles within the cofferdam enclosed space.

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

a. Any information that is required to be submitted to NMFS per the Project Description or Terms and Conditions of this biological opinion shall be sent electronically to the NMFS CCVO at the following email addresses: ccvo.consultations@noaa.gov

b. The pre-construction report required per Conservation Measure #8 shall be delivered to NMFS no later than 5 business days prior to the start of construction.

c. The post-construction report required by Conservation Measure #9 shall be delivered to NMFS no later than 6 months after construction is completed.

d. The Mitigation Plan required by Conservation Measure #10 shall be delivered no later than 5 business days prior to initiation of construction.

e. Any observations of mortalities or abnormal behavior shall immediately be reported to NMFS within 24 hours. This information shall include species observed, life history stage, location (including GPS coordinates if available), number of fish observed, time of day, as well as any other relevant details that are available. If possible, mortalities shall be collected, frozen, individually labeled with appropriate information. Any dead specimen(s) should be placed in a cooler with ice and either held for pick up by NMFS personnel or an individual designated by NMFS to do so, or sent to:

NMFS Southwest Fisheries Science Center
Fisheries Ecology Division
110 Shaffer Road
Santa Cruz, California 95060

2.10. Conservation Recommendations

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

1. The USACE and their permittee should use species recovery plans to help ensure that any mitigation measures proposed by them in the future will address the underlying processes that limit fish recovery by identifying high priority actions in the Central Valley and San Francisco estuary areas.

   The following Delta and San Joaquin River Recovery Actions represent actions from the NMFS Recovery Plan for winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead (NMFS 2014) which identified the USACE as a potential partner and collaborator:

   - **Del 1.4.** Landscape level restoration of ecological functions in the Delta.
   - **Del 1.6.** Provide access to new floodplain habitat in the South Delta for salmonids from the San Joaquin River system.
   - **Del 1.7.** Restore, improve, and maintain salmonid rearing and migratory habitats in the Delta.
   - **Del 1.13 -1.17.** Restoration of tidal marsh habitat within the Delta at multiple locations.
   - **Del 2.1.** Flood control improvements on the McCormick-Williamson Tract.
   - **Del 2.2 – 2.11**. Riparian and tidal marsh habitat restoration actions throughout the Delta – sites with secondary priority action status.
   - **Del 2.15**. Use alternatives to riprap for providing bank stabilization along Delta waterways.
   - **Del 2.16.** Increase monitoring for and enforcement of illegal riprap applications in the Delta.
   - **SJR 2.6.** Encourage protection of floodplain habitat along the San Joaquin River.
   - **SJR 2.7**. Increase monitoring and enforcement of illegal stream bank alterations and monitor permitted alterations in the San Joaquin River.
   - **SJR 2.12**. Develop and implement design criteria and projects to minimize predation at weirs, diversion dams, and related structures in the San Joaquin River.
   - **SJR 2.16**. Develop an incentive based entrainment monitoring program in the San Joaquin River to help develop projects or actions that minimize pumping impacts

   The final recovery plan for federally listed Central Valley salmonids is available at: NMFS Recovery Plan for Winter-run Chinook salmon, CV Spring-run Chinook salmon, and CCV Steelhead

The following are Recovery Actions and Research Priorities from the NMFS Recovery Plan for sDPS green sturgeon (NMFS 2018) which are San Francisco Bay Delta Estuary (SFBDE) centric.

- **Research Priority 2a (Priority 2).** Evaluate the effects of habitat modification and/or restoration (e.g., levee alteration, channel reconnection, floodplain connectivity measures) on green sturgeon recruitment and growth.
- **Recovery Action 5a (Priority 2).** Improve compliance and implementation of Best Management Practices (BMPs) to reduce input of point and non-point source contaminants within the Sacramento River Basin and San Francisco Bay Delta Estuary.
- **Monitoring Priority 3 (Priority 2***)*. Monitor trends in the annual production and habitat use of juvenile sDPS green sturgeon in the Sacramento River Basin and SFBDE.
- **Monitoring Priority 6 (Priority 3).** Use telemetry to monitor sDPS use of estuaries and coastal environments.

The final recovery plan for sDPS green sturgeon is available at:
NMFS Recovery Plan for sDPS Green Sturgeon

2. The USACE should continue to work cooperatively with other state and federal agencies, private landowners, governments, and local watershed groups to identify opportunities for cooperative analysis and funding to support salmonid and sturgeon habitat restoration projects within the San Francisco estuary, Sacramento River Basin, Delta, and San Joaquin River Basin.

3. The USACE should make all monitoring data collected by implementation of the proposed Project publicly available in order to facilitate integration with concurrent ecological monitoring efforts related to anadromous fish in the California Central Valley.

4. The USACE should support and promote aquatic and riparian habitat restoration within the Delta and other watersheds, especially those with listed aquatic species. Practices that avoid or minimize adverse effects to listed species should be encouraged.

5. The USACE should make set-back levees integral components of their authorized bank protection or ecosystem restoration efforts.

6. The USACE should conduct or fund studies to identify set-back levee opportunities, at locations where the existing levees are in need of repair or where set-back levees could be built in the future. Removal of the existing riprap from the abandoned levee should be investigated in restored sites and anywhere removal does not compromise flood safety.

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

2.11. Reinitiation of Consultation

This concludes formal consultation for the City of Lathrop Outfall Installation Project.

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

3. Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)]

This analysis is based, in part, on the EFH assessment provided by the USACE and descriptions of EFH for Pacific Coast salmon (PFMC 2014); contained in the fishery management plan (FMP) developed by the PFMC and approved by the Secretary of Commerce.

The proposed Project area is within the region identified as EFH for Pacific salmon in Amendment 18 of the Pacific Coast Salmon FMP (PFMC 2014). The USACE is receiving this consultation under the MSA for potential impacts to the EFH of Pacific salmon, as a result of implementing the City of Lathrop Outfall Installation Project (Project) in the San Joaquin River.

The PFMC has identified and described EFH, Adverse Impacts and Recommended Conservation Measures for salmon in Amendment 18 to the Pacific Coast Salmon FMP (PFMC 2014). Freshwater and estuarine EFH for Pacific salmon in the California Central Valley includes waters currently or historically accessible to salmon within the Central Valley ecosystem as described in Myers et al. (1998). CV spring-run Chinook salmon (*O. tshawytscha*), and CV fall-/late fall-run Chinook salmon (*O. tshawytscha*) are species managed under the Salmon Plan that occur in the USGS hydrologic unit codes described in Amendment 18 and which include the action area.

3.1. Essential Fish Habitat Affected by the Project

The MSA defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." NMFS interpreted this definition in its regulations as follows: "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means "the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem"; and "spawning, breeding, feeding, or growth to maturity" covers the full life cycle of a species. In addition to the general description for EFH, the implementing regulations for the EFH provisions of the MSA (50 CFR part 600) recommend that the FMPs include specific types or areas of habitat within EFH as "habitat areas of particular concern" (HAPC) based on one or more of the following considerations: (1) the importance of the ecological function provided by the habitat; (2) the extent to which the habitat is sensitive to human-induced environmental degradation; (3) whether, and to what extent, development activities are, or will be, stressing the habitat type; and (4) the rarity of the habitat type.

The geographic extent of freshwater EFH for Pacific salmon is identified as all water bodies currently or historically occupied by Council-managed salmon as described in Amendment 18 of the Pacific Coast Salmon Plan. In the estuarine and marine areas, salmon EFH extends from the extreme high tide line in nearshore and tidal submerged environments within state territorial waters out to the full extent of the Exclusive Economic Zone (EEZ) (200 nautical miles or 370.4 km) offshore of Washington, Oregon, and California north of Point Conception. The proposed Project occurs in the areas identified as "freshwater EFH", as it is above the tidal influence where the salinity is above 0.5 parts per thousand.

Based on the considerations for defining HAPCs, the Council designated five habitats for Pacific salmon as HAPCs: (1) complex channels and floodplain habitats; (2) thermal refugia; (3) spawning habitat; (4) estuaries; and (5) marine and estuarine submerged aquatic vegetation (SAV). No HAPCs occur in the action area or will be affected by the Project except for estuaries.

3.2. Adverse Effects on Essential Fish Habitat

The proposed Project is considered to have multiple non-fishing activities that affect EFH for Pacific salmon as described in Amendment 18 to the Pacific Coast Salmon FMP. The following actions taken from Amendment 18, which are applicable to the proposed action, are considered to have potential adverse effects on the freshwater EFH in the action area of the Project:

1) High Intensity underwater sounds – A number of human activities can introduce high levels of sound into the aquatic environment. Some of these sounds are incidental to the purpose of the activity, such as the intense impulsive sounds produced when a pile is driven by an impact

hammer or the lower level continuous sounds produced by a cargo ship. The proposed Project has components that will create high intensity underwater sound in the action area which includes freshwater EFH. The adverse effects of pile driving and pile removal has been described in section 2.5.1.1 of the biological opinion, and the adverse impacts of noise associated with shipping has been described in section 2.5.2.1 of the biological opinion.

2) Construction/Urbanization – Activities associated with urbanization (e.g., building construction, utility installation, road and bridge building, storm water discharge) can significantly alter the land surface, soil, vegetation, and hydrology and adversely impact salmon EFH through habitat loss or modification. Construction in and adjacent to waterways can involve dredging and/or filling activities, bank stabilization, removal of shoreline vegetation, waterway crossings for pipelines and conduits, removal of riparian vegetation, channel re-alignment, and the construction of docks and piers. These alterations can destroy salmon habitat directly or indirectly by interrupting sediment supply that creates spawning and rearing habitat for prey species, by increasing turbidity levels and diminishing light penetration to submerged vegetation, by altering hydrology and flow characteristics, by raising water temperature, and by re-suspending pollutants. The proposed Project will enhance urban and residential development based on the objectives of the City of Lathrop's General Plan.

3) Bank Stabilization - The alteration of riverine and estuarine habitat from bank and shoreline stabilization, and protection from flooding events can result in varying degrees of change in the physical, chemical, and biological characteristics of existing shoreline and riparian habitat. Human activities removing riparian vegetation, armoring, relocating, straightening and confining stream channels and along tidal and estuarine shorelines influences the extent and magnitude of stream bank erosion and down cutting in the channel (Gerstein and Harris 2005). In addition, these actions have reduced hydrological connectivity and availability of off-channel habitat and floodplain interaction. The Project has elements that will require bank stabilization. The proposed project includes actions to armor the levee face and channel bottom to prevent erosion.

4) Flood Control Maintenance – The protection of riverine and estuarine communities from flooding events can result in varying degrees of change in the physical, chemical, and biological characteristics of existing shoreline and riparian habitat. Land surrounding rivers is in high demand for agricultural and developmental purposes, prompting creation of artificial structures that improve flood control (Snake River Salmon Recovery Board 2011). These structures include levees, weirs, channels, and dikes. Artificial flood control structures have similar effects on aquatic habitat, as do bank stabilization efforts and woody debris removal. Riverbanks are artificially steepened, eliminating much of the inshore, shallow-water habitat used by larval and juvenile salmonids. Channel complexity is also lost, reducing naturally formed pool-riffle sequences. The Project has elements that pertain to flood control through maintenance of the levee adjacent to the outfall and providing bank stabilization elements.

5) Wastewater/ Pollutant Discharge - Water quality essential to salmon and their habitat can be altered when pollutants are introduced through surface runoff, through direct discharges of pollutants into the water, when deposited pollutants are resuspended (e.g., dredging), and when flow is altered. Wastewater or pollutants can be directly or indirectly discharged into ocean, estuarine, or fresh water environments. Examples of direct input of pollutants include the wastewater discharges of municipal sewage or stormwater treatment plants, among others. These

sources can result in the introduction of heavy metals, nutrients, hydrocarbons, synthetic compounds, organic materials, salt, warm water, disease organisms, or other pollutants into the environment. The introduction of pollutants into EFH can create both lethal and sublethal habitat conditions to salmon and their prey. For example, fish kills may result from a pesticide run-off event, high water temperatures, or when algae blooms caused by excess nutrients deplete the water of oxygen. Pollutant and water quality impacts to EFH can also have more chronic effects detrimental to fish survival. Contaminants can be assimilated into fish tissues by absorption across the gills or through bio-accumulation as a result of consuming contaminated prey. The Project has elements related to the discharge of treated effluent from the CTF and from stormwater discharges into the San Joaquin River.

3.3. Essential Fish Habitat Conservation Recommendations

NMFS determined that the following conservation recommendations are necessary to avoid, minimize, mitigate, or otherwise offset the impact of the proposed action on EFH. In order to avoid or minimize the effects to EFH, NMFS recommends the following conservation measures described in Amendment 18 to the Pacific Coast Salmon FMP (PFMC 2014).

1) High Intensity underwater sounds
Noise

- When possible, avoid driving piles when MSA-managed species are most abundant, especially the younger life stages and spawning adults.
- Avoid driving piles with an impact hammer when possible. Alternatives include vibratory hammers or press-in pile drivers. Limit impact driving to the minimum necessary for proofing the piles.
- In cases where an impact hammer must be used, drive the piles as far as possible with a vibratory or other method that produces lower levels of sound before using an impact hammer.
- When driving piles in intertidal or shallow subtidal areas, do so during periods of low tide. Sound does not propagate as well in shallow water as it does in deep water.
- Develop and carry out a plan to monitor the sound levels during pile driving to verify that the assumptions in the analysis were correct and to ensure that any attenuation device is properly functioning. A report on the hydroacoustic monitoring should be provided to NMFS according to the individual project requirements, but no later than 60 days after completion of the pile driving.

Sedimentation, Siltation, turbidity

- Minimize the suspension of sediments and disturbance of the substrate when removing piles. Measures to help accomplish this include, but are not limited to, the following:
    - Remove piles with a vibratory hammer, rather than the direct pull or clamshell method.
    - Remove the pile slowly to allow sediment to slough off at, or near, the mudline.

- Shake or vibrate the pile to break the bond between the sediment and pile. Doing so causes much of the sediment to slough off the pile at the mudline, thereby minimizing the amount of suspended sediment.
- Place a ring of clean sand around the base of the pile. This ring will contain some of the sediment that would normally be suspended.

2) Construction/ Urbanization

- Protect existing, and wherever practicable, establish new riparian buffer zones of appropriate width on all permanent and ephemeral streams that include or influence EFH. Establish buffers wide enough to support shading, LWD input, leaf litter inputs, sediment and nutrient control, and bank stabilization functions.

- Plan development sites to minimize clearing and grading and cut-and-fill activities.

- During construction, temporarily fence setback areas to avoid disturbance of natural riparian vegetation and maintain riparian functions for EFH.

- Use BMPs in building as well as road construction and maintenance operations such as avoiding ground disturbing activities during the wet season, minimizing the time disturbed lands are left exposed, using erosion prevention and sediment control methods, minimizing vegetation disturbance, maintaining buffers of vegetation around wetlands, streams and drainage ways, and avoiding building activities in areas of steep slopes with highly erodible soils. Use methods such as sediment ponds, sediment traps, or other facilities designed to slow water run-off and trap sediment and nutrients.

- Where feasible, remove impervious surfaces such as abandoned parking lots and buildings from riparian areas, and re-establish wetlands.

- Implement Low Impact Development construction practices to the maximum extent possible.

3) Bank Stabilization

- Minimize the loss of riparian habitats as much as possible.

- Determine the cumulative effects of existing and proposed bio-engineered or bank hardening projects on salmon EFH, including prey species before planning new bank stabilization projects.

- Bank erosion control should use vegetation methods or "soft" approaches (such as beach nourishment, vegetative plantings, and placement of LWD) to shoreline modifications whenever feasible. Hard bank protection should be a last resort and the following options should be explored (tree revetments, stream flow deflectors, and vegetative riprap.

4) Flood Control Maintenance

- Minimize the loss of riparian habitats as much as possible.

- Replace in-stream fish habitat by providing rootwads, deflector logs, boulders, and rock weirs and by planting shaded riverine aquatic cover vegetation.

- Retain trees and other shaded vegetation along earthen levees.

- Ensure adequate inundation time for floodplain habitat that activates and enhances near-shore habitat for juvenile salmon.

5) Wastewater/ Pollutant Discharge

- Monitor water quality discharges following National Pollutant Discharge Elimination System requirements from all discharge points (including municipal stormwater systems, and desalinization plants), and irrigation ditches).

- Apply the management measures developed for controlling pollution from run-off in coastal areas to all watersheds affecting salmon EFH.

- For those water bodies that are defined as water quality limited in salmon EFH (303(d) list), establish total maximum daily loads (TMDLs) and develop appropriate management plans to attain management goals.

- Allocate more resources to complete existing and future TMDLs established on waterbodies designated as water quality limited in salmon EFH habitat.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, for Pacific Coast salmon.

3.4. Statutory Response Requirement

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

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

3.5. Supplemental Consultation

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

4. Data Quality Act Documentation and Pre-Dissemination Review

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

4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the USACE. Other interested users could include USFWS, CDFW, DWR, and Lehigh Hanson. Individual copies of this opinion were provided to the USACE and USFWS. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

4.2. Integrity

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

4.3. Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

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

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

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

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