Appendix 2A

Attachment 4: North Bay Aqueduct Fish Screen Sediment and Aquatic Weed Removal Standard Operating Procedures

NBA Fish Screen Sediment and Aquatic Weed Removal

Standard Operating Procedures

Environmental Compliance

Standard operating procedures (SOP) for fish screen cleaning and the removal of sediment and aquatic weeds that impair fish screen functionality at Barker Slough Pumping Plant are outlined below. This SOP includes procedures that were developed during intra-agency group discussions and are intended to meet fishery protection regulations.

Project Description

Barker Slough Pumping Plant (BSPP) is a SWP screened diversion that pumps water through the North Bay Aqueduct (NBA), an underground pipeline to Cordelia Forebay. Protective fish screens, located in front of each pump bay, accumulates biofouling, fine sediment, and aquatic weed fragments. Cleaning is needed to prevent excessive head loss and minimize increases in localized approach velocities. Aquatic weeds impinge against the fish screens and impede water flows. Sediment accumulates on the bottom of BSPP forebay, on the concrete apron at the base of the fish screens, and in the pump wells.

Fish Screen Cleaning Operating Procedures

- Shut down half of the pumps prior to cleaning the corresponding fish screens.
- Before raising the screens, conduct a visual inspection from the deck for the presence of accumulated/impinged aquatic weeds on the screens.
- If aquatic weeds are present, remove the weeds according to the *Aquatic Weed Rake System Operating Procedures.*
- Each fish screen will be raised with on overhead crane, power washed, and lowered back into place.
- Cleaning will occur monthly, as needed.

Sediment Removal Operating Procedures

- Accumulated sediment will be removed by suction dredge.
- Locations are:
    - trap and concrete apron in front of the BSPP fish screens within the forebay,
    - pump wells behind the fish screen.
- Sediment removal from the trap and apron can occur during the annual NBA shutdown in March or from June 1 through October 15.
    - Sediment removal may take up to 2 weeks to complete.
    - A biologist will observe sediment removal activities and record fish observed in the removed sediment.
    - This activity may occur annually for the first several years, and then once every three to five years thereafter.
- Removal of sediment from within the pump wells (behind the fish screens) can occur as needed, year-round.
- Sediment will be tested and disposed at a suitable location or existing landfill.
- DWR will provide an annual summary report of BSPP sediment removal activities and the results of fish monitoring data to USFWS, NMFS, and CDFW, copying Reclamation.

If for any reason, DWR needs to deviate in the conditions for the timing of sediment removal, DWR will provide a plan to USFWS, NMFS and CDFW copying Reclamation, identifying at a minimum:

- Conditions for the timing of sediment removal
- Potential for exposure of listed species
- Additional protective measures to prevent or minimize adverse effects.

Upon receiving concurrence from USFWS, NMFS, and CDFW, which may include additional requirements, DWR may implement the plan. Upon completion of the plan (and no less frequently than annually for a multi-year plan), DWR will provide a letter to USFWS, NMFS, and CDFW, copying Reclamation, describing compliance with the plan and compliance with additional requirements imposed in the concurrence to the plan.

Aquatic Weed Rake System Operating Procedures

DWR will remove accumulated aquatic weeds from the BSPP fish screens year-round using a weed rake, consisting of an aluminum frame with grappling hooks, lowered by a boom truck.

- Removal of impinged aquatic weeds from the fish screens may occur year-round.
- Each pump is shut down prior to removing weeds from the corresponding fish screen.
- The weed rake is slowly lowered in front of each fish screen using a boom truck or crane positioned on the deck above.
- Once the rake reaches the bottom of the screen, it is slowly pulled forward away from the screen (approximately 6 to 10 feet) to avoid striking the screen should the rake spin upon retrieval.
- The rake is slowly raised, returned to the deck and cleared of weeds by hand, using a pitchfork or similar tool.
- When all screens are cleaned, record the total volume of weeds removed (in cubic yards).
- The accumulated aquatic vegetation will be transported to spoil sites located near the pumping plant.
    - If biological monitoring is triggered (see below), retain the weeds on the deck until biological sampling is completed.
- When high volumes of weeds are removed (over 3 cubic yards removed per day) and pose a potential entanglement hazard for fish, biological monitoring in BSPP forebay will be triggered by:
    - (a) the detection of larval (less than 25mm) Delta smelt (DSM) in the most recent survey at 20mm Survey station 720, or
    - (b) the collection of juvenile chinook salmon or steelhead in Yolo Bypass Fish Monitoring Program (YBFMP) sampling, specifically:
        - (November-December) Collection of juvenile chinook salmon or steelhead in the most recent seining at YBFMP sites BL1-5 (located in the Lower Yolo Bypass toe drain). The YBFMP seining is conducted biweekly year-round.
        - (January-June) Collection of juvenile chinook salmon or steelhead within the past five days in the YBFMP rotary screw trap (located in the Lower Yolo Bypass toe drain). The YBFMP rotary screw trap is operated on weekdays from January 1 through June 30.

        - (July-October) No biological monitoring required for salmonids.
    - Biological monitoring will consist of either:
        - the collection of a whole water sample from the BSPP forebay (e.g., at the Barker Slough water quality station or in front of the BSPP fish screens) within one day of weed rake operations for later eDNA analysis (for listed species: Delta smelt, longfin smelt, winter-run Chinook salmon, spring-run Chinook salmon, and CV steelhead), or
        - the inspection of the removed weeds for listed fish by a biological monitor within one-day of removal.

- After one year of implementation under the ROD, the continuation of biological monitoring during operation of the weed rake will be evaluated. The evaluation will include an analysis of eDNA samples, fish counts, and approximate daily weed loads during BSPP weed rake operations beginning in 2020.
- DWR will provide an annual summary report of daily weed volume (in cubic yards), the results of any required fish monitoring data and findings to USFWS, NMFS and CDFW copying Reclamation.
- Reclamation and DWR will meet and confer with USFWS, NMFS and CDFW on the continuation of biological monitoring during BSPP weed rake operations.

Aquatic Weed Harvesting Operating Procedures

A boat-mounted aquatic weed harvester will be operated on an as-needed basis to remove aquatic weeds in the BSPP Forebay.

- A boat-mounted aquatic weed harvester can be used in BSPP Forebay, within the bounds of the boat/debris barrier (north of barrier).
- Harvesting may occur intermittently on a year-round basis, with peak use during periods of hyacinth entrainment.
- The accumulated aquatic vegetation will be transported to spoil sites located near the pumping plant.
    - If biological monitoring is triggered (see below), retain the weeds until biological sampling is completed.
- When high volumes of weeds are removed (over 3 cubic yards removed per day) and pose a potential entanglement hazard for fish, biological monitoring in BSPP forebay will be triggered by:
    - Biological monitoring for salmonids will be implemented following a joint trigger of:
        - expected harvest of at least 3 cubic yards of weeds, and

    - collection of juvenile chinook salmon or steelhead in recent fish monitoring November through June.

- DWR will provide an annual summary report of BSPP aquatic weed harvesting activities and the results of any required fish monitoring data to USFWS, NMFS, and CDFW, copying Reclamation.

Background information on BSPP fishery studies, aquatic weed removal methods and monitoring results, and proposed salmonid monitoring location

Barker Slough Pumping Plant (BSPP) has nine pumps. Each of the pumps are individually screened with a positive barrier fish screen consisting of a series of flat, stainless steel, wedge-wire panels with a slot width of 3/32 inches. The screen is designed to prevent entrainment of fish larger than 25 millimeters (mm). Fish entrainment is defined as fish being drawn into or transported out of their normal habitat by the flow of water. Fish can be entrained in water diversions when they are unable to swim against the flow of the water caused by the pumps. However, when the screens are pulled up for cleaning, which allows the potential for fish to move freely into and out of the intake bays, the pumps are not operating. The first two bays have smaller pump units (nominally 14 cubic feet per second (cfs)), and seven bays have larger pump units (nominally 28 cfs). The last bay does not have a pump. The two smaller pump units are designed for a screen approach velocity of about 0.2 feet per second (fps) at the screen face, whereas the larger pump units are designed for a screen approach velocity of about 0.4 fps.

The theoretical maximum pipeline capacity is 175 cfs, but currently the normal pumping rate is between 0 cfs and 130 cfs because the maximum pipeline capacity cannot be reached due to biofilm accumulation in the pipe. Operations are demand driven and pumping rate varies seasonally. Based on historical pumping, higher pumping generally occurs in the summer and fall. During the winter period, exports from BSPP range from a monthly average of 10.9 cfs in March to 29.5 cfs in January based on historical patterns for the past ten years (2008 to 2018). From May to November, the average diversion flow ranges from a monthly average of 66.4 cfs in November to 91.4 cfs in August for the same ten-year period.

Monitoring by CDFW for the North Bay Aqueduct larval fish survey indicates that some Chinook salmon have been observed at the most western monitoring location (site 721) in Barker Slough, but in general, observations of Chinook salmon are rare, and occur farther to the east near the confluence of Miners Slough with the Cache Slough complex. The low diversion rate during the period from December to April is unlikely to entrain fish from the lower reaches of the Cache Slough complex to locations adjacent to the Barker Slough Pumping Plant Barker Slough. In May, the average monthly diversion rate is only about 71 cfs, with a range of 33 to 108 cfs. Even at the current maximum diversion rate of 140 cfs, the size of the channels in the Cache Slough complex would mute any flow towards BSPP from the lower reaches of the Cache Slough complex.

The fish screens, which were designed to protect juvenile Delta smelt and meet the NMFS criteria for salmonids, should prevent entrainment and greatly minimize any impingement of fish against the screen itself. In 2013-2015, during the months of January—June, DWR conducted a series of studies to evaluate fish screen performance at BSPP. One of the studies investigated entrainment of larval fish, as

well as monitoring for impingement of fish onto the fish screens. In all, over 8000 larval fish were collected behind the fish screens during normal operations, with the majority of the fish being non-listed species or species of concern. The majority of the fish found in the BSPP vicinity were threadfin shad and prickly sculpin. DWR staff identified one larval Delta Smelt, no salmonids and no green sturgeon. The results of the study showed that the fish screens performed as designed and kept out any fish larger than 25mm in length. No fish species of any length were observed impinged on the screens. In addition, the location of the pumping plant on Barker Slough is substantially removed from the expected migration corridors utilized by emigrating Chinook salmon and steelhead juveniles in the North Delta system.

Aquatic Weed Rake System and Monitoring Results, 2020-2022

DWR operates an aquatic weed removal system consisting of grappling hooks attached by chains to an aluminum frame. A boom truck, staged on the platform above the fish screens, slowly lowers the weed rake into the water immediately in front of the fish screen to retrieve the accumulated aquatic vegetation for transport to spoil sites located near the pumping plant.

DWR removes weeds from the fish screens year-round. Removal of aquatic weeds is typically highest during summer and fall months when aquatic weed production is highest. Typically, weeds are removed from the fish screen once to twice a month but may occur weekly during high weed load periods. Under exceptionally high weed loads, weed removal may need to occur daily for several weeks. Floating aquatic vegetation, i.e., water hyacinth, may need to be removed during winter and spring months if water hyacinth becomes entrained into BSPP forebay and accumulates in front of the fish screens.

Currently, DWR staff remove aquatic weed fragments that flow towards BSPP, accumulate on the fish screens, and block flows into the pump wells. Based on the volume of aquatic weeds removed from the fish screens between April 2020 to June 2022, the fish screens were impacted by aquatic weeds April through early June and late October through December (Figure 1). Little to no weeds (≤0.5 cubic yards) accumulated against the screens during the other months. The heaviest weed loads (≥4 cubic yards) occurred April to May and October to November.

The removed aquatic weeds were inspected for entangled fish from September 2020 to present. Two centrarchids were collected during two separate events in November 2020. The estimated volume of aquatic weeds when the fish were found was 4 cu-yd or greater. To assess the potential entanglement risk to larval DSM, the residual water that drained from the removed weeds was collected and analyzed for the presence of DSM eDNA. During Spring 2021, no delta smelt DNA was detected in any of the samples. During Spring 2022, the daily volume of aquatic weeds removed from the fish screens was too small to collect the required sample volume of residual water for eDNA analysis.

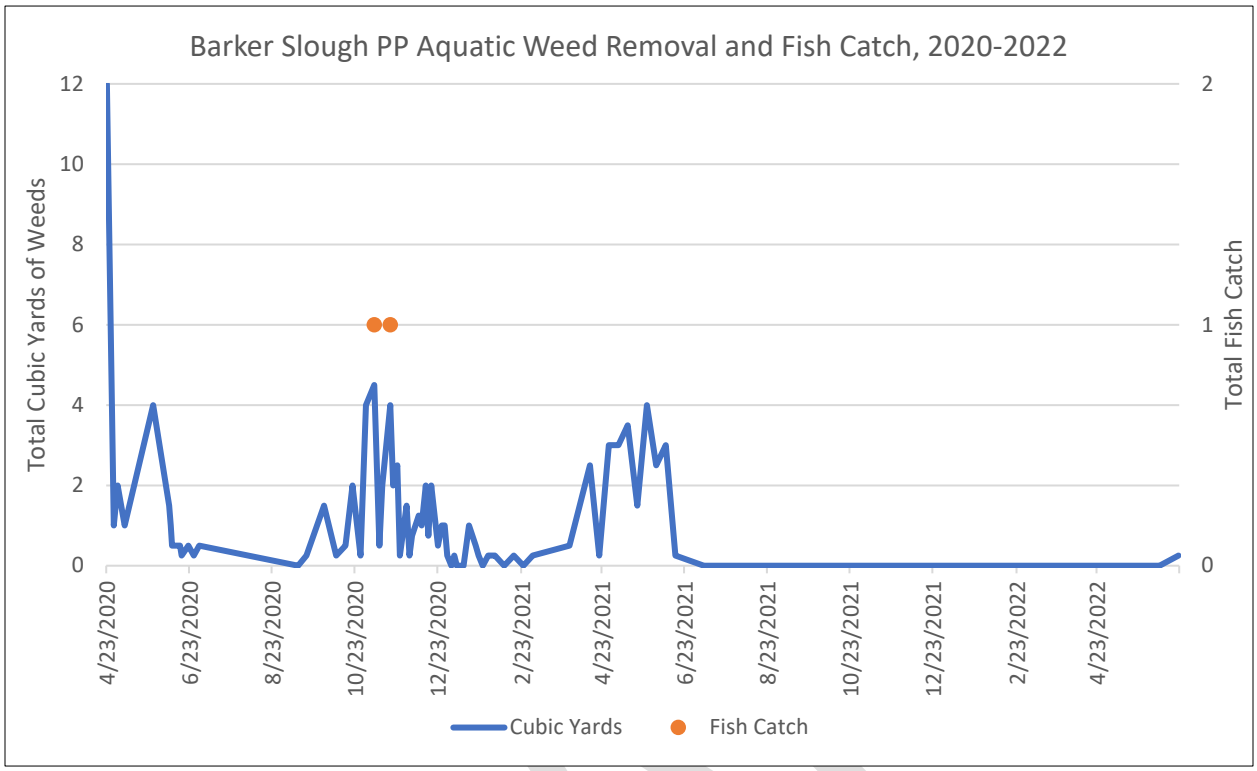

Figure 1. Volume of aquatic weeds and number of fish removed from the BSPP fish screens between April 2020 to June 2022

Proposed Salmonid Monitoring Location

The Yolo Bypass Fish Monitoring Program (YBFMP) operates a rotary screw trap in the Yolo Bypass from January 1 through June 30 each year and conducts seining at sites BL1-5 year-round. The rotary screw trap (RSTR) and seine sites BL1-5 are located in the lower portion of the bypass in close proximity to the Cache Slough Complex, which includes Barker Slough (Figure 2). The rotary screw trap is sampled daily, Monday through Friday, except during high flow events when the trap is non-operational due to high debris loads and personnel safety concerns. Seine sites BL1-5 are sampled biweekly, with occasional deviations due to local site conditions.

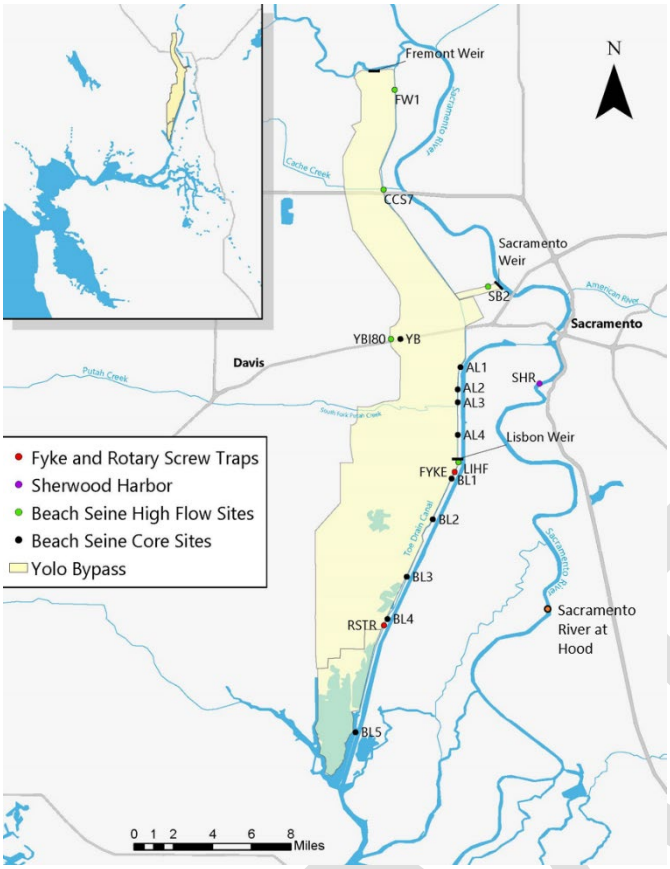

Figure 2. Yolo Bypass Fish Monitoring Program sampling locations