SUMMARY OF 2025 SEASON FISH RESCUES CONDUCTED WITHIN THE FREMONT WEIR, YOLO BYPASS, AND SACRAMENTO BYPASS.

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Purpose

The purpose of this document is to summarize fish rescue efforts conducted within the Yolo Bypass Fremont Weir stilling basin, and the Sacramento Weir and stilling basin during the 2024 water year. The U.S. Bureau of Reclamation (USBR) operates the Central Valley Project (CVP) in coordination with the State Water Project (SWP), which is operated by the California Department of Water Resources (DWR). Operation of the CVP and SWP alters the hydrology in the Central Valley and San Francisco Bay-Delta and as a consequence, has a significant influence on fish distribution, migration, survival, and available aquatic habitats. The National Marine Fisheries Service (NMFS) evaluated these stressors in their 2009 Biological Opinion on the Long-term Coordinated Operation of the CVP and SWP Biological Opinion (BIOP) and concluded they are likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*; federal and State endangered), Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*; federal and State threatened), Central Valley steelhead *Oncorhynchus mykiss*; federal threatened), and the southern Distinct Population Segment (DPS) of North American green sturgeon (*Acipenser medirostris*; federal threatened).

Based on their conclusion, NMFS identified reasonable and prudent alternatives (RPAs) intended to avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the adverse modification of critical habitat. The RPAs include *Action I.7." Reduce Migratory Delays and Loss of Salmon, Steelhead, and Sturgeon at Fremont Weir and Other Structures in the Yolo Bypass."* There are a number of actions already implemented or planned for implementation to address this RPA. In the interim to completion of large-scale improvements addressing Action I.7, DWR has contracted the California Department of Fish and Wildlife (CDFW) to conduct fish rescues within the Yolo Bypass.

Introduction and Background

The approximately 59,000-acre Yolo Bypass is essentially designed to convey floodwaters from the Sacramento River and west side streams and drains around the populated regions of the Sacramento Valley **(Figure 1)**. Inundation of the Yolo Bypass primarily occurs when Sacramento River flows overtop the Fremont Weir, located at Sacramento River kilometer (RK) 226 (River Mile 140.4). The Fremont Weir spills on average once every two to three years (USBR and DWR 2012). Inundation of the Yolo

Bypass occurs when Sacramento River flows at the Fremont Weir exceeds a stage height of 32.3 feet above mean sea level North American Vertical Datum of 1988 (NAVD 1988) which occurs at a flow of approximately 1,622 cubic meters per second (57,290 cfs) (DWR 2016). Inundation of the Yolo Bypass is augmented by flows from west side tributaries including Cache Creek, Willow Slough, Willow Slough Bypass, Putah Creek, and South Fork Putah Creek (**Figure 1)**. Up to 80 percent of the Sacramento River's floodwaters are conveyed for a distance of approximately 50 km (31 miles) through the Yolo Bypass and returned to the Sacramento River via the Cache Slough Complex approximately two miles upstream of the town of Rio Vista. The Yolo Bypass capacity is 9,713 cubic meters per second (343,000 cfs) (DWR 2010).

The Yolo Bypass serves as a migration corridor for adult and juvenile anadromous fish during overtopping events as well as rearing habitat for juvenile salmonids and other freshwater fish species. Flows within the Yolo Bypass can be much greater than flows within the Sacramento River during weir overtopping events, attracting anadromous fish migrating up the Sacramento River into the Yolo Bypass at the Cache Slough complex. When Sacramento River stage height drops below 32 feet mean sea level, flows over the Fremont Weir cease, resulting in fish stranding within the Fremont Weir stilling basin and various ponded areas within the Yolo Bypass. Importantly, the perennially inundated areas of the Yolo Bypass such as the Knights Landing Ridge Cut, Tule Canal, and Toe Drain are habitat for a number of resident native and non-native fish species. Federal and State anadromous listed species including Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, southern Distinct Population Segment (sDPS) green sturgeon, and white sturgeon, are also known to utilize these areas during low flow periods.

In 1966, a Denil fish ladder was constructed in the east section of Fremont Weir to facilitate adult fish passage back into the Sacramento River following several observations of stranded Chinook salmon and sturgeon in the weir stilling basin and downstream scour ponds. Central Valley Flood Protection Board permit number 4899 issued to the California Department of Fish and Game on 1 April 1965 authorized CDFW to operate the fish ladder by removing flashboards on the river side of the structure following an overtopping event. The ladder was essentially a 1.2 meter-wide, zero percent gradient notch structure in the Fremont Weir which facilitated volitional fish passage from the splash basin back into the Sacramento River. While installation and operations of the ladder appeared to reduce the magnitude of the stranding at the weir, it did not eliminate it. The Denil fish ladder appeared to be mostly ineffective for

volitional passage of adult sturgeon; as many as 13 sDPS green sturgeon and 17 white sturgeon were rescued from the splash basin following overtopping events in 2011 (CDFW 2016). Additionally, as the Fremont Weir consists of two separate sections, the Denil fish ladder does not address stranding in the west section splash basin or in numerous ponds, scour pools, drainages, and swales in the Fremont Weir Wildlife Area downstream of the weir. Most of the historical observations of stranding and rescue efforts were focused on adult fish, more recent studies and fish rescues have shown juvenile or young-of-year (YOY) anadromous fish also become stranded in the weir splash basin, scour ponds, drainages, and swales within the Yolo Bypass when floodwaters recede and connectivity to the Sacramento River is lost.

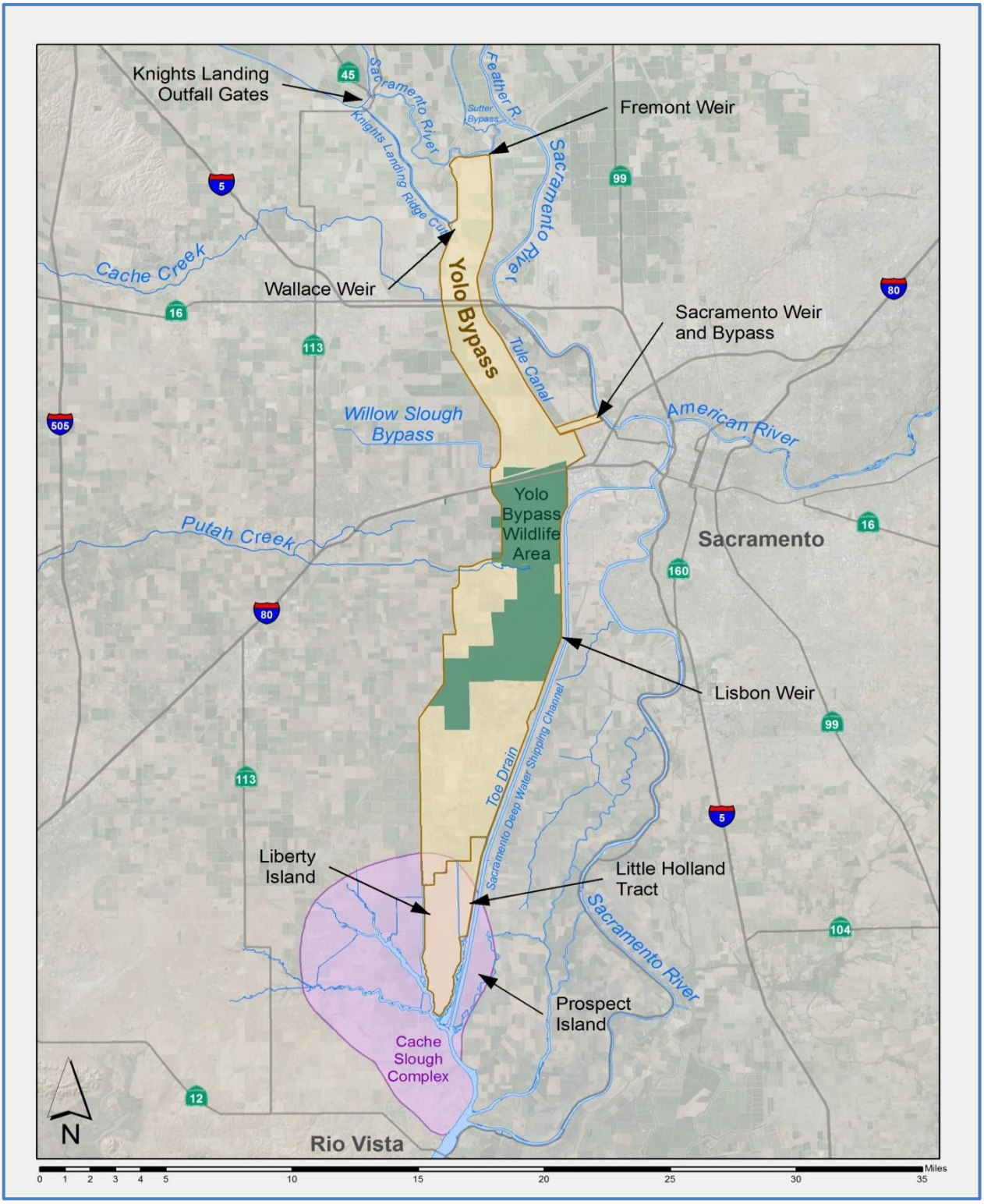

Figure 1. Fremont Weir, Yolo Bypass, Westside Tributaries, Sacramento Weir, and Cache Slough Complex.

Figure 2. Adult Fish Passage Structure with gate open. Flow in the channel is from right to left; the majority of which is from the Sacramento River and to a lesser degree from water draining from the east side stilling basin. Photograph date 12 February 2024.

In the fall of 2018, DWR completed the Adult Fish Passage Modification Project, which consisted of widening the existing notch to a bottom width of 15 feet, decreasing the elevation of the notch to 22 feet, widening and re-grading the channels located immediately upstream and downstream of the new weir notch, and connecting the downstream channel to the Deep Pond **(Figures 2 and 3)**. The Adult Fish Passage Structure (AFPS) is operated by DWR, and the gates are opened and closed using inflatable air bladders. Three gate operational scenarios were approved as part of the Department of Fish and Wildlife (DFW) California Endangered Species Act (CESA) Incidental Take Permit (ITP) No. 2081-2017-015-02-A1 for the project.

Scenario 1: The AFPS remains open until the upstream channel no longer receives water from the river at a stage of 22 feet. Scenario 1 was determined to be infeasible due to the increased duration of inundation of agricultural lands in the southern portion of the Yolo Bypass. **Scenario 2**: The AFPS remains open for three days after Fremont Weir stops overtopping. **Scenario 3**: The AFPS remains open for one day after Fremont Weir stops overtopping and reopens when the river stage falls below 27 feet and closes when the river stage reaches 24 feet, for no longer than five days.

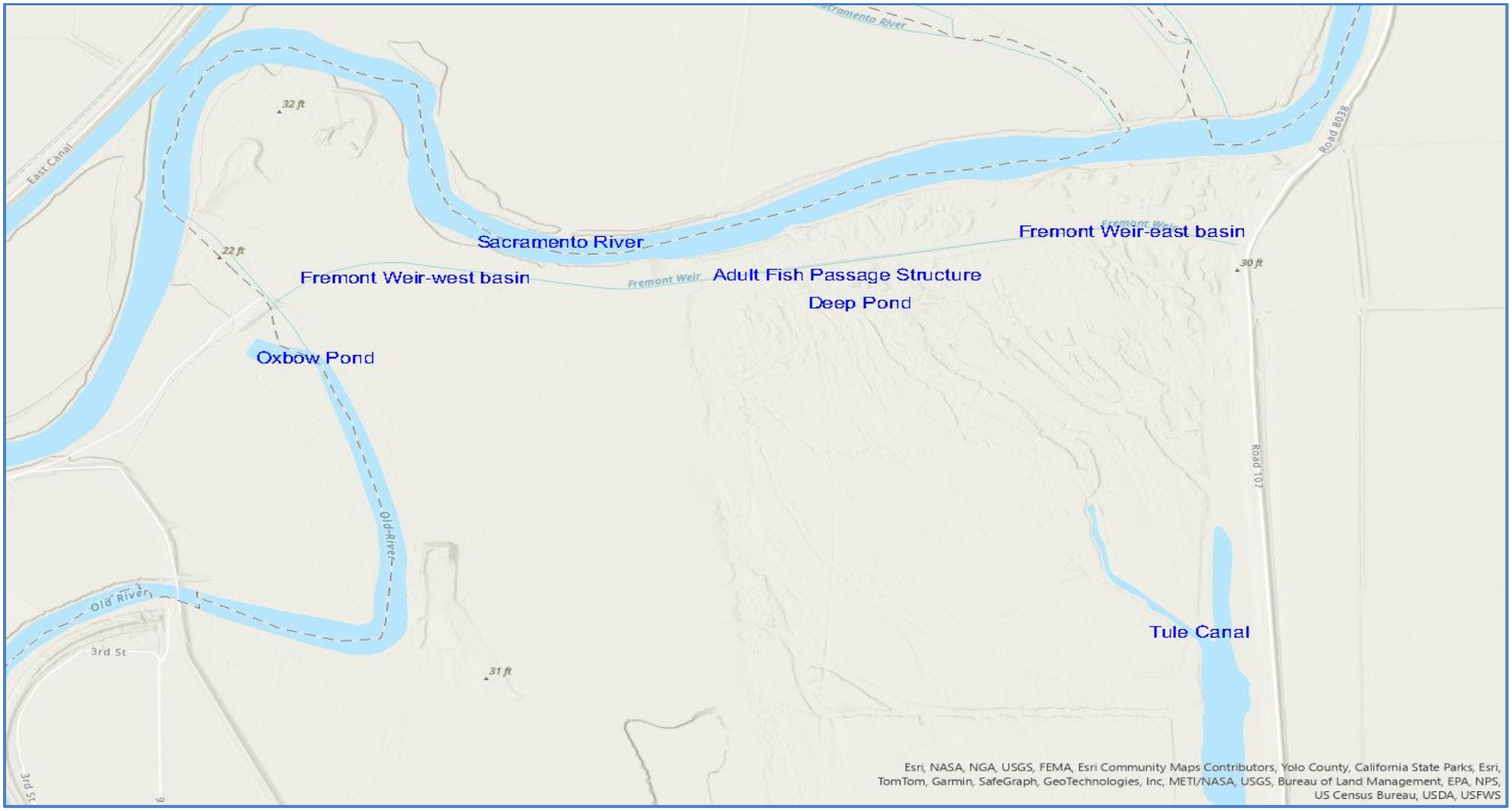

Figure 3. Fremont Weir, Adult Fish Passage Structure, Deep Pond, Oxbow Pond, Tule Pond, and Sacramento River.

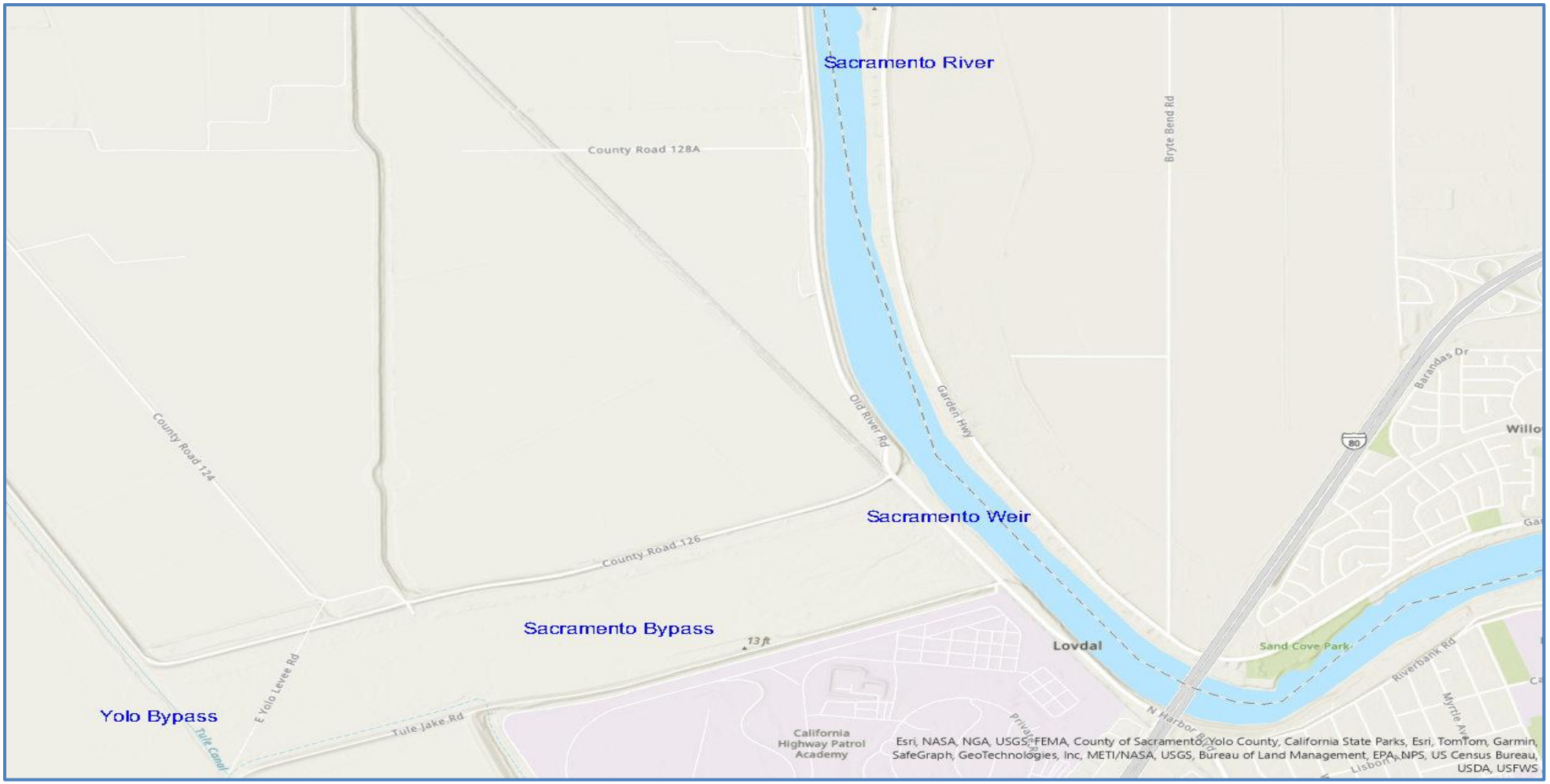

Figure 4. Sacramento Weir, Sacramento River, Sacramento Bypass, and Yolo Bypass.

Initial operations were to follow Scenario 2 and would be evaluated for performance. If fish remain stranded in the stilling basin following overtopping events, Scenario 3 would be operated for future overtopping events and would undergo evaluation for stranded fish. The scenario that performed the best would continue to be used.

Methods

The Sacramento River overtopped Fremont Weir once during the 2025 water year which resulted in fish stranding and necessitated CDFW to conduct fish rescue operations after the overtopping event **(Figure 5)**.

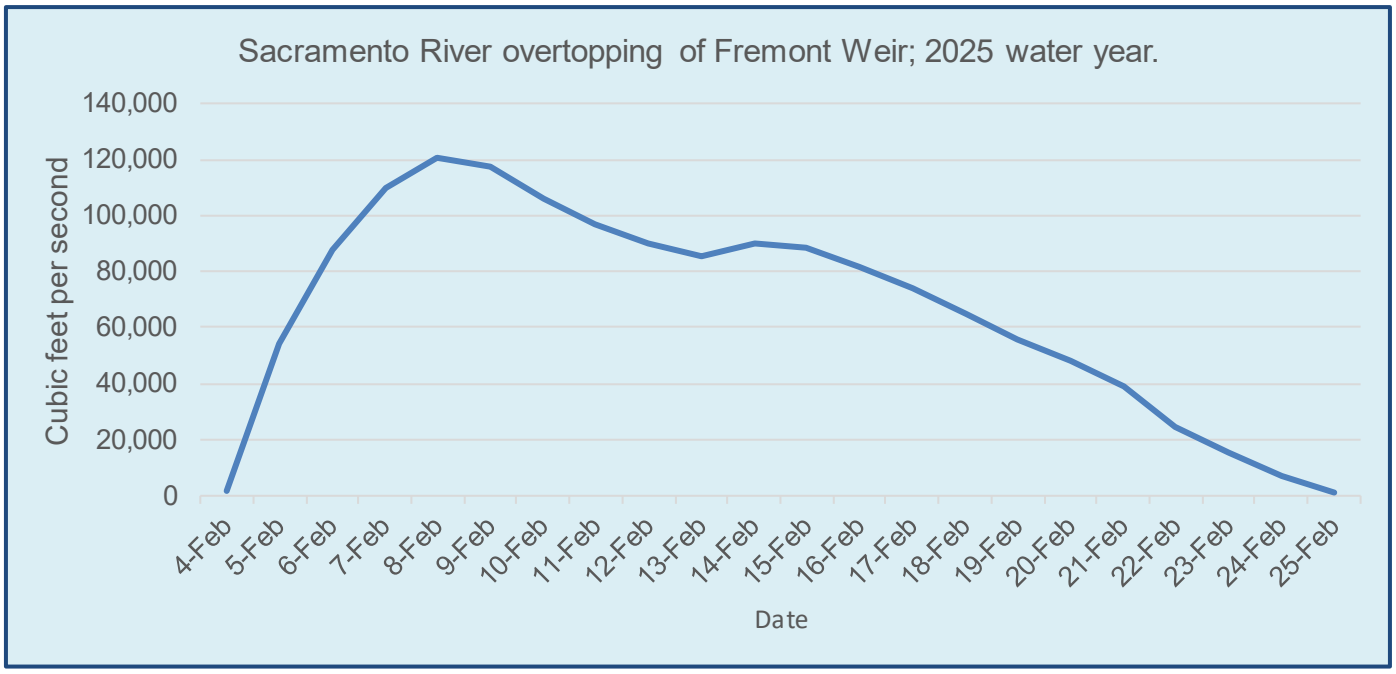

Figure 5. Hydrograph of Fremont Weir 2025 overtopping event, 4 through 25 February 2025. Maximum flow during the period was 120,596 cfs on 8 February 2025.

CDFW staff monitored the California Data Exchange Center (CDEC) National Weather Service River Forecast Center website during overtopping events to determine when Sacramento River stage height at Fremont Weir was forecast to drop to approximately 32.0 feet above mean sea level (msl) on the receding hydrograph curve. At 32.0 feet msl, flow over the weir essentially ceased, at which point CDFW staff conducted reconnaissance surveys of the east and west sections of the Fremont Weir stilling basin

to determine rescue timing, logistics, and potential safety issues regarding fish rescue operations. The Sacramento Weir, unlike the Fremont Weir, is not a passive flood control structure and is opened by Department of Water Resources staff removing flashboards when the Sacramento River stage height reaches 39.5 feet. The Sacramento Weir is located approximately 33 river km downstream of Fremont Weir (**Figures 6 and 7**). Although the Sacramento Weir was not opened during the 2025 water year, river flows reached the weir infrastructure resulting in water flowing through gaps between broken or damaged flashboards and entering the stilling basin bays. During the summer of 2024, DWR or USACE contractors notched the stilling basin bays to facilitate fish passage into a channel which flows into the Sacramento Bypass and hence the Yolo Bypass. The effort was highly effective at reducing stranding in the stilling basin bays, however; CDFW staff were concerned that emigrating juvenile Chinook salmon could still be susceptible to stranding in the downstream scour pools within the Sacramento Bypass.

CDFW staff conducted four days of fish rescue operations within the Fremont Weir stilling basin during the 2025 water year: 25 and 26 February; and 1 and 3 March 2025; and one day of fish rescue operations within the Sacramento Bypass scour pools on 10 March 2025 basin. Equipment used to conduct fish rescue operations included a 50-foot long 1/8-inch mesh size beach seine and 1/8 and 1/4-inch mesh size dip nets. Fish capture was conducted by seining isolated sections of the weir stilling basins and upon reaching the end of a haul, pursuing the seine and using dip nets to aid in capturing fish. Fish were then transferred to 5-gallon buckets or an aerated cooler for subsequent identification, enumeration, and measurement. Sturgeon were placed in a specially designed cradle ventral side up to induce a catatonic state and internally tagged with 69 kHz acoustic transmitters and passive integrated transponder (PIT) tags. Fin clips were collected from adult Chinook salmon for Evolutionary Significant Unit (ESU) designation via genetic determination. Juvenile Chinook salmon were assigned an ESU designation using length-at-date criteria (Green 1992). Chinook salmon from the winter-run and spring-run ESUs were considered to be of wild origin if they possessed an intact adipose fin and of hatchery origin if they their adipose fin was clipped, as 100 percent of hatchery produced winter-run and spring-run Chinook salmon are marked by clipping the adipose fin. All Chinook salmon determined to be fall-run by length-at-date were assumed to be of wild origin, as no hatchery releases were made prior to the rescue efforts. All fish rescued from the Fremont Weir stilling basin were released in the Sacramento River near the point of capture; fish rescued from the Sacramento Weir

were transported via aerated cooler to the Elkhorn Boat Launch Facility for release into the Sacramento River.

Figure 6. Sacramento Bypass scour pool facing south. Photograph taken 10 March 2025.

Results

Fremont Weir stilling basin

Opening of the AFPS gates likely allowed for the volitional passage of numerous anadromous fish that were holding downstream of the Fremont Weir in the Yolo Bypass Deep Pond, Tule Pond, and Tule Canal. However, fish stranding still occurred after the overtopping event as water does not drain toward the AFPS from the westernmost reach of the eastside stilling basin, and in the entire westside stilling basin where there is currently no opportunity for volitional passage after cessation of weir overtopping events. CDFW staff rescued a total of 143 fish consisting of seven native and nine non-native species within the Fremont Weir stilling basin during the 2025 water year. Listed fish species rescued included Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. Other native fish species rescued included white sturgeon (*Acipenser transmontanus*), Sacramento sucker (*Catostomus occidentalis*), Sacramento pikeminnow (*Ptychocheilus grandis*), Sacramento splittail (*Pogonichthys macrolepidotus*), and hardhead (*Mylopharodon conocephalus*). Non-native species rescued included largemouth bass (*Micropterus salmoides*) spotted bass (*Micropterus punctulatus*), black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), bigscale logperch (*Percina macrolepida*), brown bullhead (*Ameiurus nebulosus*),golden shiner (*Notemigonus crysoleucas*), and threadfin shad (*Dorosoma petenense*).**Tables 1 and 2** present rescue data by weir stilling basin section and rescue date.

Table 1. Summary of fish rescued from east stilling basin of Fremont Weir; 25 and 26 February and 1 March 2025.

Date	Species, origin	Life Stage	Number
25 February	Fall-run Chinook salmon (wild)	Juvenile	1
26 February	White sturgeon	Adult	11
	Winter-run Chinook salmon (hatchery)	Juvenile	1
	Fall-run Chinook salmon (wild)	Juvenile	1
	Central Valley steelhead (hatchery)	Juvenile	3
	Black crappie	Juvenile	2
	Bown bullhead	Juvenile	1
	Threadfin shad	Adult	2

	Golden shiner	Adult	1

Table 2. Summary of fish rescued from the west stilling basin of Fremont Weir; 3 March 2025.

Date	Species, ESU or DPS, origin	Life Stage	Number
3 March	Winter-run Chinook salmon (wild)	Juvenile	5
	Winter-run Chinook salmon (hatchery)	Juvenile	25
	Spring-run Chinook salmon (wild)	Juvenile	1
	Fall-run Chinook salmon (wild)	Juvenile	44
	Central Valley steelhead (wild)	Adult	1
	Central Valley steelhead (hatchery)	Juvenile	7
	Sacramento sucker	Adult	24
	Sacramento sucker	Juvenile	2
	Sacramento splittail	Adult	1
	Hardhead	Adult	13
	Striped bass	Adult	1
	Largemouth bass	Adult	1
	Spotted bass	Adult	2
	Bluegill	Adult	1
	Golden shiner	Adult	2

Sacramento Weir

CDFW staff rescued a total of 1,288 fish from two scour pools within the Sacramento Bypass on 10 March 2025 (**Table 3**). The majority of fish rescued were likely fall run Chinook salmon of wild origin (1,283) based on estimation of fork lengths. Due to deteriorating water quality, handling time was minimized and only a few juvenile Chinook salmon were measured to determine ESU via length-at-date. 229 juvenile Chinook salmon mortalities occurred during the rescue likely due to stress associated with high water temperature and low dissolved oxygen concentration.

Table 3. Summary of fish rescued from Sacramento Bypass scour pools; 10 March 2025.

Species, ESU, origin	Life Stage	Number Rescued
Spring-run Chinook salmon (wild)	Juvenile	1
Fall-run Chinook salmon (wild)	Juvenile	1,283
Bluegill	Juvenile	1
Western mosquitofish	Adult	3

Post-rescue Movement Patterns of Adult Sturgeon Rescued from Fremont Weir stilling basin. In the Sacramento River, white sturgeon spawn between February and June. Spawning takes place from near the confluence with the Feather River (rkm 129) upstream to at least Colusa (rkm 252). Adult white sturgeon typically migrate back to the San Francisco Bay-Delta Estuary soon after spawning (CDFW 2023, CDFW 2022, CDFW 2021, Kohlhorst 1976; Schaffter 1997; Moyle 2002). As of 11 June 2025, five White Sturgeon rescued from the Fremont Weir splash basin that were tagged with 69 kHz acoustic transmitters were subsequently detected in the Sacramento River at the Rio Vista Bridge 69 kHz receiver array located approximately 135 km downstream from Fremont Weir (**Table 4**). The period of time between rescue and tagging and detection at Rio Vista Bridge can be used to infer the fate of the sturgeon's spawning migrations after rescue. The caveat associated with this inference is that there are currently no 69 kHz receiver arrays upstream of Fremont Weir, therefore; some uncertainty exists as to whether the rescued White Sturgeon did indeed continue upstream migration to their spawning grounds. The time between post-rescue release and detection at the Rio Vista Bridge 69 kHz receiver array ranged from four to 71 days; which suggests that four of five White Sturgeon continued their spawning migrations prior to detection at the Rio Vista Bridge receiver array on their downstream return to the lower estuary. White Sturgeon detected at the Rio Vista receiver array 10 days or less after rescue were considered to have aborted their spawning migration. The White Sturgeon that were not detected at the Rio Vista receiver array as of the last receiver download on 11 June 2025 may still be on the spawning grounds or have not yet initiated their downstream migration. White Sturgeon were observed breaching in the vicinity of Tisdale in mid-June (personal communication with Stan Acres, CDFW Scientific Aid). This section of the report will be updated with detection data for the five White Sturgeon that were not detected at the Rio Vista Bridge receiver array when the next download is conducted in September 2025.

Table 4. Post rescue detection and spawning migration status of white sturgeon rescued and tagged with 69 kHz acoustic transmitters from the Fremont Weir stilling basin, 26 February 2025.

Date Rescued	Tag ID	Tagging to Detection at Rio Vista Bridge (days)	Post-rescue spawning migration fate
2/26	A69-9001-61143	4	Likely aborted spawning migration
2/26	A69-9001-5049	36	Likely continued spawning migration

2/26	A69-9001-52800	25	Likely continued spawning migration
2/26	A69-9001-52802	59	Likely continued spawning migration
2/26	A69-9001-61137	53	Likely continued spawning migration

The time between post-rescue release and detection at the Rio Vista Bridge 69 kHz receiver array ranged from 49 to 71 days; which suggests all four white sturgeon rescued 12 and 14 February continued their spawning migrations prior to detection at the Rio Vista Bridge receiver array on their downstream return to the lower estuary.

Discussion

Fish rescue operations conducted following the Sacramento River overtopping of Fremont Weir and the inundation of the Sacramento Weir during the 2023 water year resulted in 1,431 fish being returned to the Sacramento River. Without rescue, these fish would have perished from factors such as desiccation, poor water quality conditions, increased predation, and poaching. Federal or State listed fish species rescued included Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. Juvenile fall-run Chinook salmon were assumed to be all natural origin, as no hatchery releases were conducted prior to the overtopping events. Tagging of rescued sturgeon with acoustic transmitters provided data regarding post-rescue survival and movement patterns. The acoustic transmitters have a ten-year battery life which will continue to provide data regarding seasonal movement patterns and subsequent spawning migrations, as white sturgeon are an iteroparous species with spawning periodicity ranging from two to five years (Moyle 2002).

Fish rescue operations involving the capture of numerous juvenile Chinook salmon are time consuming, and typically only a sub-set of 20 or so fish are measured for length-at-date ESU determination to avoid excessive handling. However, future rescue efforts involving juvenile Chinook salmon that are classified as winter-run or spring-run by length at date criteria should include sampling fin clips or swabbing of slime coat for genetic ESU determination. Comparison of length-at-date and genetic ESU determination could then be used to provide a more accurate representation of Chinook salmon ESUs rescued from flood control weirs and other stranding areas.

While fish rescues do provide benefits in terms of saving listed fish species and preventing indirect mortality associated with CVP, SWP and flood control operations,

there are potential drawbacks associated with fish rescues, and it is generally considered better to address the issue causing the stranding than relying on fish rescues. Although fish rescue operations conducted for listed fish species are of high priority, they are costly and also result in CDFW staff being redirected from regular duties. Stranded fish are often subjected to stressful or lethal conditions prior to rescue including elevated water temperature, low dissolved oxygen levels, increased predation, poaching, and abrasion injuries from contact with concrete structures. Rescue operations also cause considerable stress to fish and the potential to result in injury and delayed mortality from capture and handling (Donaldson *et. al.* 2011; Gale *et. al.* 2011; Raby *et. al*. 2011; Teffer *et. al*. 2017). For salmonids, the loss of slime coat and scales observed during capture and handling could increase the risk of infection from various pathogens. Several sturgeon rescued from the Fremont Weir stilling basin had abrasions to their snouts, barbels, pelvic fins, and ventral surfaces caused by repeated contact with concrete surfaces. These injuries could result in increased susceptibility to pathogens; and decreased function of sensory organs such as barbels and ampullae of Lorenzini, which could in turn impact foraging efficiency and predator avoidance.

The completion of the Yolo Bypass Fish Passage Project resulted in likely resulted in the volitional fish passage through the Fremont Weir although unlike in previous years was not documented by video footage from the Adaptive Resolution Imaging Sonar (ARIS) due to electrical issues with the ARIS camera and heavy siltation within the enclosed bay housing the unit (personal communication with Dennis Finger, DWR Ecology and Restoration Unit). However, fish stranding in the Fremont Weir stilling basin and Yolo Bypass ponds continues to be an issue for several reasons. There are several low spots in the east section of the stilling basin that become hydraulically disconnected from the middle of the east section where the fish passage is located. Fish holding in these low spots have a limited window of opportunity to move toward the passage structure as water levels recede in the stilling basin. The west section of the Fremont Weir will not have a fish passage structure until the completion of the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project (Big Notch Project) and therefore continues to be an area of concern for fish stranding. Ultimately, the completion of the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project should result in a significant reduction in the stranding and loss of listed fish species. However, stranding could still occur if equipment failure, equipment damage during overtopping events, or vandalism prevents adherence to the operational scenarios of the fish passage structure. Therefore, monitoring for fish stranding after weir overtopping events should continue to help determine the overall effectiveness of the

improvements designed to increase volitional fish passage to the Sacramento River and in identifying areas within the Yolo Bypass that remain problematic for fish stranding.

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