

Rubber Dam #3 (RD3) and Fish Ladder: Normal Operations during Adult Migration Period, September 1 – March 31

RD3 is normally inflated and in service during adult migration except during high-flow events. When inflated, the adjacent RD3 ladder is in operation and provides passage for adult salmonids whenever flows exceed 25 cubic feet per second (cfs). RD3 is only deflated when instantaneous flows exceed ~1,200 cfs, which typically occurs on days when average daily flows exceed 700 cfs. When deflated, the dam lays flat and smooth on its foundation across the ~280ft channel bottom. Under these high flow conditions, the deflated rubber dam typically has overtopping flow depths of approximately 1ft or more, providing sufficient depth for adult passage (Reiser and Bjornn, 1979).

Figure 1 RD3 4/9/2019. Under normal operations, RD3 inflated with ~ 70 cfs overtopping flow. Ladder operational in the background



January 2023 Atmospheric River Events

A series of atmospheric river events in January 2023, generated sufficiently high streamflow to mobilize and deposit enough sediment to substantially bury approximately 1/3 of the deflated RD3 dam under several feet of mixed sand and gravel, causing the rubber dam bladder to rupture on January 21, 2023¹. The dam cannot be re-inflated until the rupture is repaired. For RD3 to be repaired, the sediment load currently on top of the dam requires removal.

Because the RD3 ladder is designed to only operate when RD3 is inflated, if RD3 cannot be repaired and returned to service by the fall, the ladder will be unavailable for any in-migrating adult salmonids in Water Year (WY) 2023/24.

Passage Assessment of Deflated RD3 and Foundation

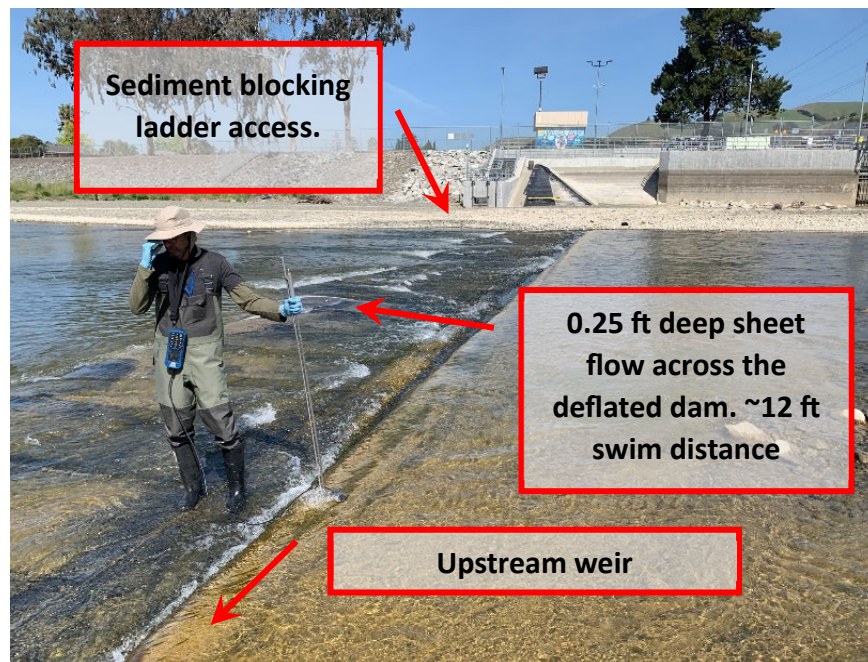
Staff, aided by fisheries biologist Dr. Joe Merz of Cramer Fish Sciences, conducted a field assessment of conditions on April 25, 2023. Background flow conditions were 100 cfs. Observations found that the upstream foundation anchoring of RD3 acts as a weir, providing controlled and predictable overtopping sheet flow across the deflated fabric dam. At flows observed, the weir generates supercritical flow (*shallow and fast*) across the length of the deflated dam, yielding a consistent depth of ~0.25 ft and

¹ First documented occurrence of this since RD3 began operations in 1992. Personal communication with USACE engineer, Patrick Singh, reports that the January rainfall events are considered to be the 100-year recurrence interval.

velocity of ~6 feet per second (ft/s), with a small hydraulic jump forming on the downstream edge of the deflated dam, about 12 ft downstream of the weir.

Under this condition, the deflated RD3 forms an adult salmonid passage barrier, falling significantly short of the 0.6 ft and 0.8 ft depth requirements for Steelhead (*O. mykiss*) and Chinook salmon (*O. tshawytscha*), respectively (Reiser and Bjornn, 1979). In transition, as flow increases above 100 cfs, velocities across the dam may increase until the weir becomes sufficiently inundated to eliminate the weir effect, resulting in deeper, lower velocity, and improved passability. Staff estimates the flow thresholds to create the minimum depths to be 400 cfs for Steelhead and 680 cfs for Chinook, using the Francis equation for weir flow.

Figure 2 Deflated RD3 under ~100 cfs flow. The RD3 ladder in the background can be clearly seen separated from the channel by ~80 ft of sediment and unavailable to provide passage.



Conclusions Regarding the Impact of RD3 Deflation on Adult Migration

If RD3 cannot be repaired during the summer of 2023, the ladder will be inoperable during the WY 2023/24 adult migration season. A 20-year review of the historic average daily flow² suggests that this would result in a significant reduction in days meeting the passage criteria through the lower Alameda Creek / USACE flood control channel.

Passage criterion for Steelhead (*O. mykiss*) met from Dec 1 – Mar 31:

- With RD3 and ladder (25 cfs) = 78% of days
- Without RD3 (400 cfs) = 15% of days

Passage criterion for Fall Run Chinook (*O. tshawytscha*) met from Sep 1 – Dec 31

- With RD3 and ladder (25 cfs) = 48% of days
- Without RD3 (680 cfs) = 2% of days

² USGS gauge: Alameda C NR Niles CA – 11179000, Water Years 2003-2023