POSEIDON WATER

Appendix EE
Comparison of
Fish Return Options

Renewal of NPDES CA0109223
Carlsbad Desalination Project

August 10, 2016

Josie McKinley
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Re: **Technical Memorandum: Comparison of the CDP Fish Return in the Discharge Pond and Agua Hedionda Lagoon**

Dear Josie,

I am pleased to submit HDR's final technical memorandum which is a comparison two fish return discharge locations: in Agua Hedionda Lagoon and in the EPS Discharge Pond. I look forward to discussing our findings with you at your earliest convenience.

Sincerely,
HDR Engineering, Inc.

Timothy M. Hogan

Tim Hogan
Project Manager

Final Technical Memo: Feasibility of the CDP Fish Return in the Discharge Pond

Introduction

Poseidon Water (Poseidon) has developed a conceptual design for the New Screening/Fish-friendly Pumping Structure, that will be implemented when the Carlsbad Desalination Plant (CDP) enters long-term, stand-alone operation when the Encina Power Station (EPS) goes offline. At that point, the CDP will become subject to the provisions of Chapter III.M of the Water Quality Control Plan, Ocean Waters of California (Desalination Amendment). The long-term, stand-alone CDP will install 1-mm modified (referring to the presence of fish protection features) traveling water screens to return collected organisms and debris to the ocean.

Modified traveling water screens require fish return systems to safely transport collected organisms from the screen back to the ocean. The fish return/debris design must minimize, to the extent practical, abrasion, turbulence, shear, and excessive velocity for transported fish. It is critical that the fish return also has sufficient water depth to transport organisms, sufficient velocity to flush organisms towards the discharge point, a means to protect organisms from avian and/or terrestrial predators, and a discharge point that minimizes the risk of recirculating organisms back to the intake.

The initial conceptual design routed the fish return so that organisms would be discharged to Agua Hedionda Lagoon (Lagoon). The state and federal resource agencies have requested that Poseidon evaluate whether the fish return discharge point can be moved from the Lagoon to the EPS discharge pond (Pond) to minimize construction and operational impacts in the Lagoon. Therefore, the objective of this technical memorandum (memo) is to evaluate the feasibility of re-routing the fish return so that collected organisms and debris are returned to the EPS discharge pond.

Description of Fish Return Alternatives

The two fish system discharge locations assessed in this memo were in the Lagoon and in the Pond (Figure 1). A brief description is provided below for each fish return alternative.

Figure 1. Fish discharge locations assessed.

Return to Agua Hedionda Lagoon

The initial conceptual design for the New Screening/Fish-friendly Pumping Structure system for the long-term, stand-alone CDP was designed to return organisms and debris to the Lagoon. Figure 2 depicts this fish return system.

The current design includes a single combined fish and debris return trough. Fish and debris removed by the low- and high-pressure spray washes, respectively, would combine into a single trough that would transition to a pipe that would extend to the Lagoon approximately 205 feet northeast of the existing intake structure (Figure 2). The fish return discharges into a quiescent area in the southeast corner of the Lagoon thereby reducing the potential for recirculation of returned organisms into the intake flow.

Within the New Screening/Fish-friendly Pumping Structure, the combined return trough would be mounted to the intake deck on the downstream side of the screens. A 2.0-foot diameter half-round trough with a slope of 1/16 inch per foot was chosen for this stage of design. Shortly after leaving the screening structure, the return trough would transition into a 2.0-foot diameter pipe that continues for a run of approximately 382 feet. The velocity and depth of flow in the pipe would be optimized for fish transport to the discharge point during the advanced design process. Except for a short section adjacent to the screening structure, the fish return would be buried. Two cleanouts would be located along its length to facilitate cleaning and inspection of the return pipe. At the point of discharge, the fish return would be an open trough, from El. 0.0 feet to below the low water level, to ensure that organisms are returned to the Lagoon during all anticipated water levels. The discharge location would extend out into the Lagoon to ensure sufficient water depth during low water. Depending on the final arrangement, this section could be anchored directly to the seafloor, supported by small piles, or attached to the piers supporting the dock.

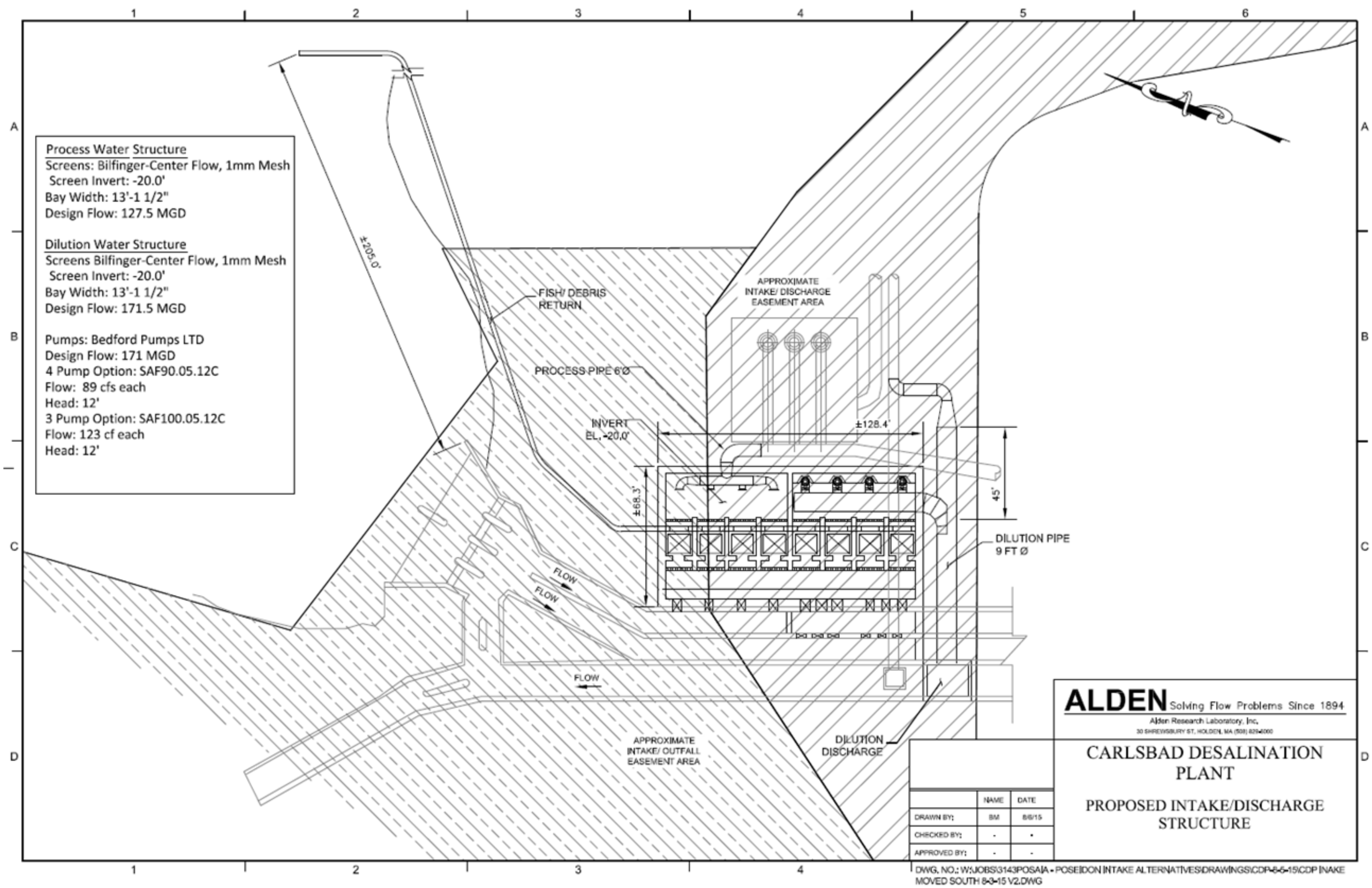

Figure 2. Long-term, stand-alone CDP New Screening/Fish-friendly Pumping Structure with fish return/debris system discharging to the Lagoon.

Return to the EPS Discharge Pond

An alternative arrangement for the fish return system would route collected fish and debris to the EPS discharge pond. Figure 3 depicts this fish return system alternative.

This alternative design also includes a single combined fish and debris return trough. Fish and debris removed by the low- and high-pressure spray washes, respectively, would combine into a single trough that would transition to a pipe that would extend to the Pond to the west of the discharge tunnel outlet (Figure 3). This location would discharge returned organisms close to the exit of the Pond (Figure 4).

Within the New Screening/Fish-friendly Pumping Structure , the combined return trough would be mounted to the intake deck on the downstream side of the screens. A 2.0-foot diameter half-round trough with a slope of approximately 1/8 inch per foot was chosen for this stage of design. Shortly after leaving the screening structure, the return trough would transition into a 2.0-foot diameter pipe, make a gradual drop, and then transition into a run of approximately 280 ft. The velocity and depth of flow in the pipe would be optimized for fish transport to the discharge point during the advanced design process. Except for a short section adjacent to the screening structure, the fish return would be buried. Two cleanouts would be located along its length to facilitate cleaning and inspection of the return pipe. At the point of discharge, the fish return would be an open trough, from El. 0.0 feet to below the low water level, to ensure that organisms are returned to the Pond during all anticipated water levels. The discharge location would extend out into the Pond to ensure sufficient water depth during low water. Depending on the final arrangement, this section could be anchored directly to the Pond bottom or supported by small piles.

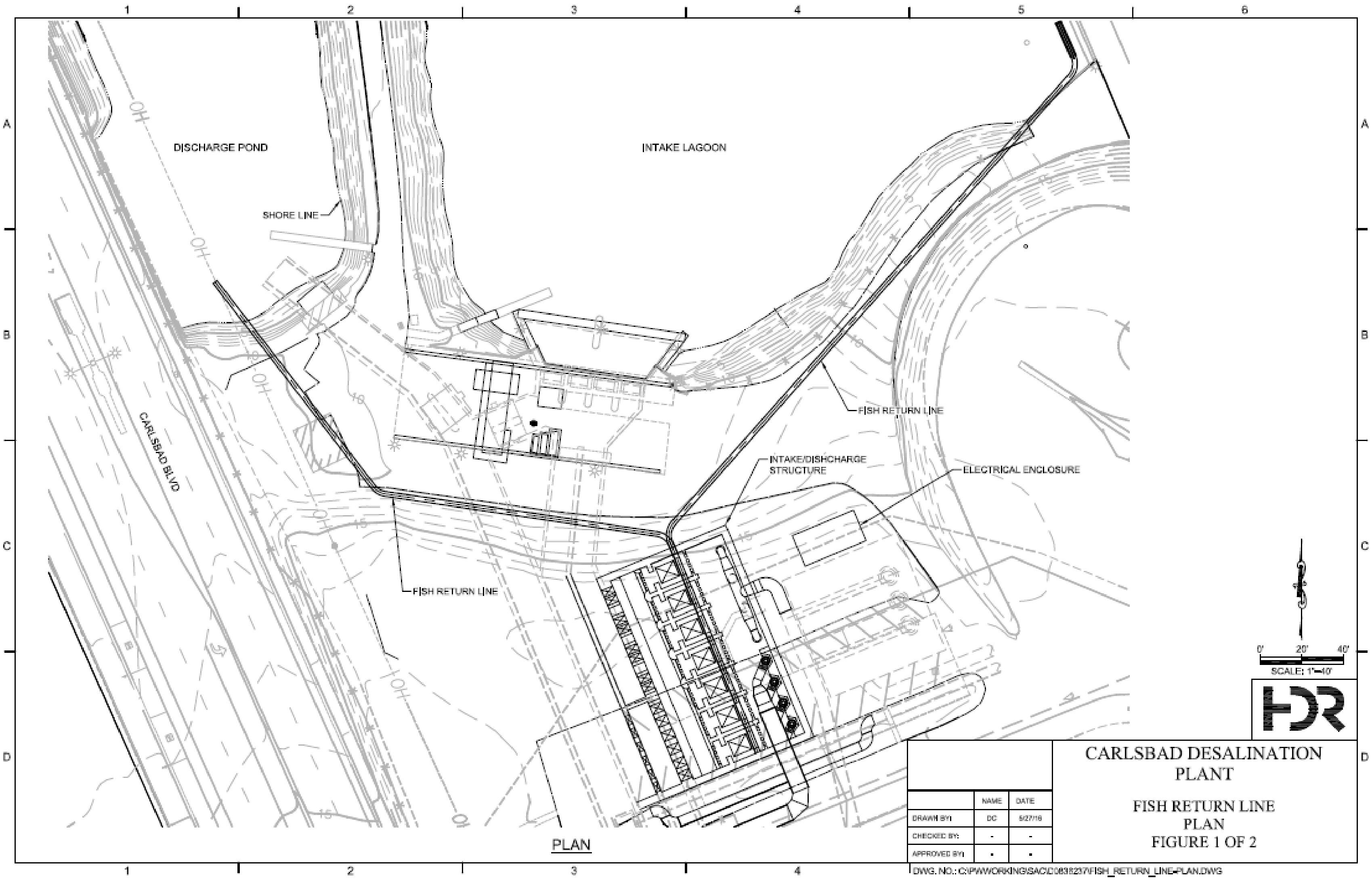

Figure 3. Long-term, stand-alone CDP New Screening/Fish-friendly Pumping Structure showing two alternative fish return/debris system discharge locations.

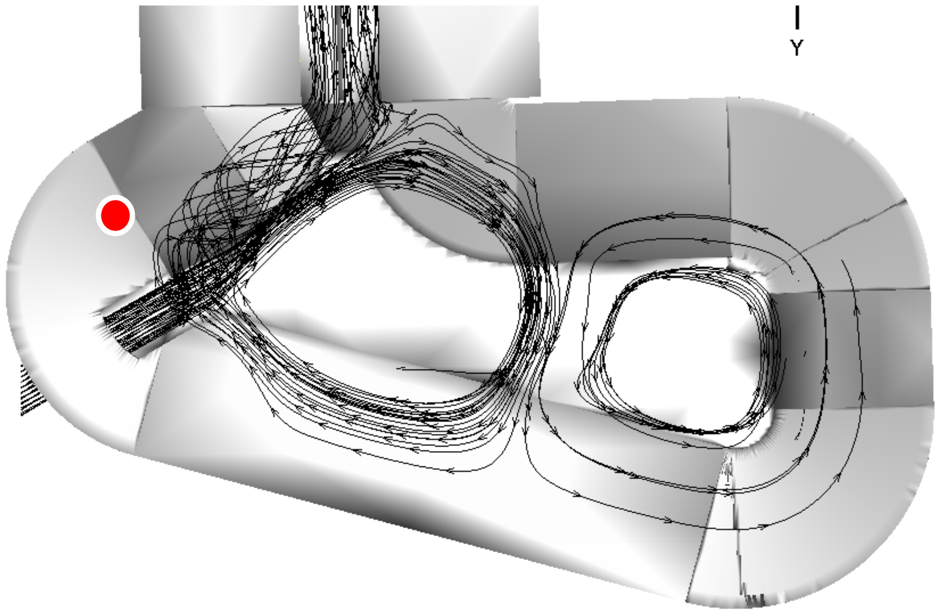

Figure 4. Flow streamlines within the EPS discharge pond with the approximate fish return location indicated with a red dot (figure from Alden 2015).

Feasibility Assessment

This section evaluates the feasibility of both fish return discharge locations in accordance with the definition of "feasible" included in the Desalination Amendment:

> *Feasible means capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social, and technological factors*.

Table 1 provides a summary of the technical, economic, schedule, environmental, and social aspects of each fish return discharge location.

From a technical perspective, both alternative discharge locations have similar impacts. Each is feasible, though the Pond alternative is shorter overall and would likely be less impactful on existing structures on the property.

Similarly, from a cost perspective, the principal difference between the two alternatives is that the Pond option would be slightly less expensive since the pipeline length is shorter.

From a schedule perspective, the Lagoon alternative will require additional permitting for the in-water work. In addition, the discharge into the Lagoon would be considered a new outfall. Permitting efforts associated with the construction and operation of the Lagoon-based discharge location will require a longer schedule for completion compared to the Pond discharge location. The environmental impacts of the two fish return discharge locations can be parsed generally into those associated with construction and those associated with operation. Relative to construction-related impacts, the Lagoon alternative presents more potential construction-related impacts than the Pond alternative. Because of the nature of the Pond (i.e., as a component of the EPS discharge system), it is not considered functional habitat for marine life; whereas, the Lagoon is. Therefore, any construction in an area that is considered habitat (e.g., eelgrass beds) will have greater potential for creating an environmental impact.

Relative to operational-related impacts, the two areas to consider regarding the Pond discharge location are the ultimate discharge of organisms from the Lagoon to the Pacific Ocean and the potential exposure of organisms discharged to the Pond to elevated salinity. In the event that fouling accumulates in the fish return system, cleaning would be required via pigging regardless of the discharge location. The majority of the debris cleared from the return would be collected at the pig retrieval station in a basket; however, some debris may accumulate at the discharge point which would infrequently require removal.

Previous modeling (Jenkins 2016), demonstrated that non-motile larvae in the Lagoon are naturally transported to the Pacific Ocean on the outgoing tide. Specifically, 50% would be transported out of the lagoon within approximately six hours and 98% within approximately 2.5 days; therefore, the ultimate fate for non-motile organisms returned to the Pond versus the Lagoon is similar and any incremental difference should be considered less than significant.

Previous submittals have focused on the exposure of collected organisms to elevated salinity. This work was comprised of laboratory tests in which sensitive larval-stage marine organisms were exposed to the salinities expected in the discharge for the duration estimated through numeric modeling (Appendices C and L of the 2015 Submittal to RWQCB). Though the objective of the research was to assess the exposure of organisms to elevated salinity in the flow augmentation system, the results are applicable to organisms exposed to elevated salinity as a result of being discharged from the fish return system into the Pond. Nautilus Environmental (Appendix I of the Submittal to RWQCB) concluded that exposure of sensitive marine organisms to elevated salinity while being transported to the Pacific Ocean via the discharge would not substantially affect the organisms' development and would not result in increased mortality. Similarly, we would not expect organisms discharged to the Pond to be adversely affected by elevated salinity either.

Recommended Alternative

Based on the feasibility assessment provided above and in Table 1, the Pond is the best location for the fish return discharge. Both alternative discharge locations present similar technical and economic issues; however, the Pond location presents fewer potential permitting requirements that could extend the schedule. Previously conducted research (modeling and laboratory testing) indicates that potential environmental impacts associated with operation of a fish return in either location are comparable, though the Lagoon location has greater potential for creating construction-related impacts to the lagoon floor and nearby eelgrass beds.

Table 1. Comparison of the feasibility criteria for the two fish return discharge locations.

Feasibility Component	Lagoon Discharge Alternative	Pond Discharge Alternative
Technical	• Requires disturbance of road to bury pipe • May require periodic cleaning/dredging of discharge point if there is an accumulation of shells and other similar marine-derived debris	• May require periodic cleaning/dredging of discharge point if there is an accumulation of shells and other similar marine-derived debris in low velocity areas of Pond
Economic	• Requires approximately 380 feet of pipe outside of screen house; otherwise similar to Pond alternative	• Requires approximately 280 feet of pipe outside of screen house; otherwise similar to Lagoon alternative
Schedule	• Similar construction duration • Additional permits may be required for new discharge point and in-water construction	• Similar construction duration • No additional permits required
Environmental	• Concerns over construction impacts to nearby eelgrass due to sediment resuspension • New discharge location	• Organisms will be exposed to the diluted brine in the discharge system. • Lagoon-collected species are returned to the ocean via the Pond rather than back to Lagoon (original habitat); however, ○ 98% of non-motile larvae will be naturally flushed from West Lagoon to the ocean by the outgoing tide in approximately 2.5 days (Jenkins 2016) • No construction impact concerns since Pond is man-made • Residence time in Pond will be short (median of 5.5 minutes) before being flushed to ocean • No potential for recirculation due to hydraulic separation between Lagoon intake and discharge Pond
Social	• No social impacts since construction would happen on private property where there is no public access	• No social impacts since construction would happen on private property where there is no public access

References

Alden Research Laboratory (Alden). 2015. Computational Fluid Dynamics Modeling of the Carlsbad Desalination Plant Discharge during Co-Located Operation with the Encina Power Station. Prepared for Poseidon Water. July 29, 2015.

Jenkins, S. 2016. Biological Considerations of Velocities and Residence Times in Agua Hedionda Lagoon Under Stand-Alone Operations of the Carlsbad Desalination Project. May 31, Provided as Appendix GG to the to the Submittal to the RWQCB.