POSEIDON WATER

Appendix FF
Fish Return System
Cleaning Methods

Renewal of NPDES CA0109223
Carlsbad Desalination Project

August 10, 2016

Josie McKinley
Poseidon Water
17011 Beach Boulevard, Suite 900
Carlsbad, CA 92008

Re: **Technical Memorandum: Fish Return Cleaning Methods for the Carlsbad Desalination Plant**

Dear Josie,

I am pleased to submit HDR's final technical memorandum which evaluates the cleaning methods for the fish return system at the Carlsbad Desalination Plant. I look forward to discussing our findings with you at your earliest convenience.

Sincerely,
HDR Engineering, Inc.

Timothy W. Hogan

Timothy W. Hogan
Project Manager

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Final Technical Memo: Fish Return Cleaning Methods for the Carlsbad Desalination Plant

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's (EPS) once-through cooling system 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 Agua Hedionda Lagoon (Lagoon) or the Pacific Ocean via the EPS discharge pond (Pond) (Figure 1).

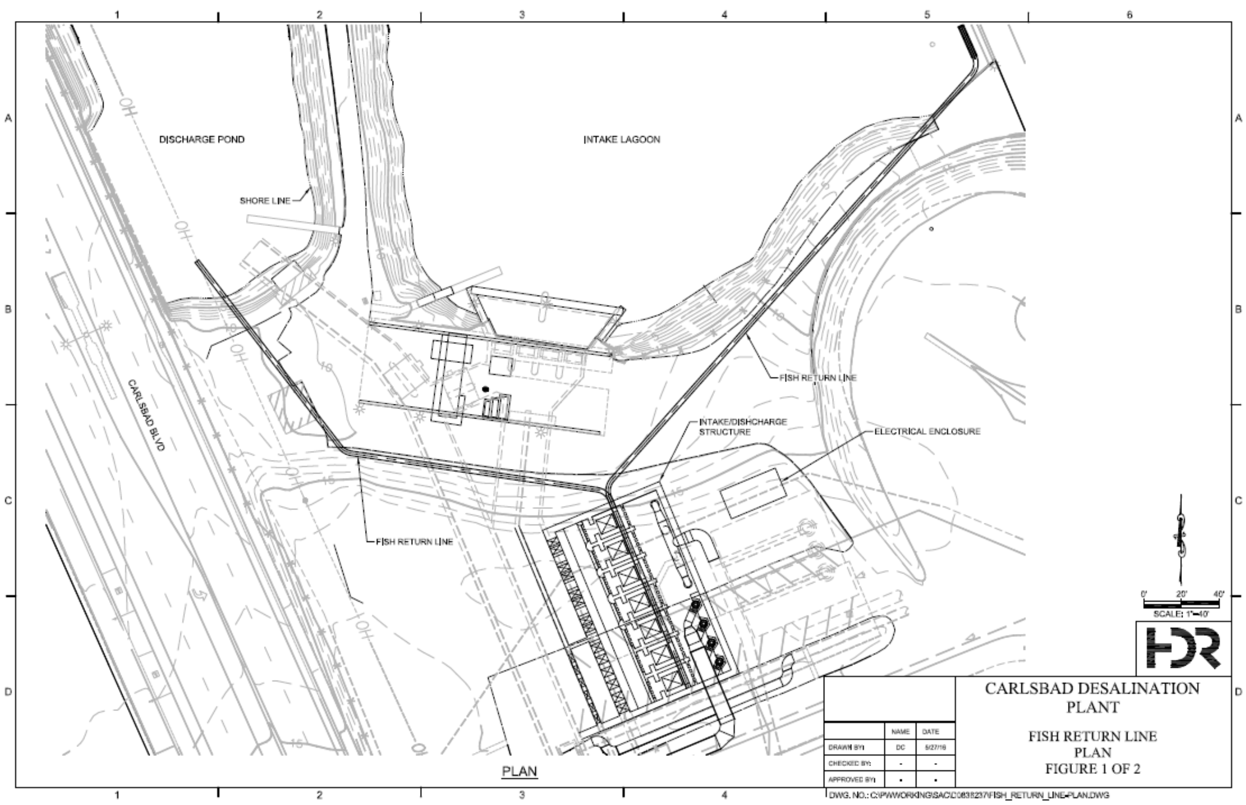

Figure 1. Long-term, stand-alone CDP New Screening/Fish-friendly Pumping Structure showing two alternative fish return/debris system discharge locations.

Modified traveling water screens require fish/debris return systems to safely transport collected organisms and debris from the screens back to the Lagoon or ocean. The fish return/debris design must minimize, to the extent practical, abrasion, turbulence, shear, and excessive velocity for the transported fish. In addition, the fish/debris return system must be designed to

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minimize the settlement of debris and to allow regular cleaning and inspection. The fish return system will utilize standard means for controlling fouling.

The State Water Resources Control and Regional Water Quality Control Boards (Boards) have requested that San Diego County Water Authority: "*describe the methods that will be used to clean the fish return pipe and the discharge pipe following the permanent cessation of operations at the EPS.*" Therefore, the objective of this technical memorandum (memo) is to further describe the method of cleaning anticipated for the fish/debris return system.

Minimize Debris Accumulation

The initial approach for maintaining the fish/debris return system will be to minimize the probability of settlement of debris. This will be accomplished by providing a continuous down gradient slope that will result in flow velocities that will promote self-cleaning. The flow velocity within the fish/debris return system will be significantly higher than the flow velocity that carried the debris into the intake system which will reduce the potential for debris accumulation in the fish/debris return system pipe.

In addition, at the point of discharge (whether to the Lagoon or the Pond, Figure 1), the fish/debris return would transition from a pipe to an open trough. Relative to a submerged pipe with full flow, an open trough with a free surface will limit the upstream movement of fouling organisms into the pipe.

Fish Return Pipe Material

The method selected for cleaning a fish/debris return pipe is dependent upon the type of material used for the pipe. The American Society of Civil Engineers (ASCE) provided guidelines for fish conveyance structures noting that fiberglass, polyethylene, and coated steel are suitable materials to prevent injury to fish (ASCE 1982). For purposes of this memo, high density polyethylene (HDPE), fiberglass reinforced pipe (FRP), and coated steel were considered as potential materials for a fish/debris return pipe.

Coatings

Non-toxic coatings can be used to prevent fouling in a fish/debris return pipe; however, only certain pipe materials can accept coatings. Due to the surface adhesion properties of HDPE, coatings are difficult to apply and are not likely to be successful. Similarly, FRP would not be coated. Therefore, this discussion on coatings does not apply to HDPE or FRP.

If steel is chosen as the fish/debris return pipe material, a non-toxic coating that has anti-fouling properties and provides a smooth surface for fish protection may be applied.

A major consideration in choosing anti-fouling coatings is the use of biocides in the coating. Historically, anti-fouling coatings have used biocides to prevent fouling. Over time, though, these coatings have become increasingly subject to environmental regulations due to biocide leaching. The biocidal metals that are incorporated into many coatings (e.g. copper and zinc) have been found to leach into the water. Such leaching would pose a risk for the CDP relative to the National Pollutant Discharge Elimination System (NPDES) permit discharge limit for this

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outfall (PSU 2009). Biocide-free coatings are available as silicone-based, foul-release products. The silicone-based oils are considered to be inert in aquatic environments (PSU 2009). Biocide-free coatings reduce the ability of organisms to attach to the surface. Although organisms can attach to these foul-release surfaces, the attachment is weak and they can be removed easily by flowing water or light cleaning (PSU 2009).

The expected lifetime of a coating can vary based on its site-specific application. It is possible to reapply a coating to the pipe in place once the original coating has been determined to be ineffective. The fish/debris return pipe would need to be shutdown for a period of time to allow for the new coating to cure.

If steel is chosen as the pipe material for the fish/debris return pipe, foul-release coating and anti-foul coatings have potential for reducing the impacts of fouling in the fish/debris return system. A silicone-based foul-release coating offers the benefits of being environmentally friendly while also acting as an inhibitor to micro- and macro-fouling. Anti-foul coatings may provide good fouling control properties; however, further investigation would be required (e.g., to determine biocide leaching). If HDPE/FRP is chosen as the pipe material, no further investigation into coatings is needed.

Pigging

Pigging is a process used to clean (and inspect) pipelines by creating a pressure differential behind a device referred to as a "pig" to drive it through a pipe. A pigging system would involve the installation of a launching station and a retrieval station. The launching station would be a permanent structure accessed through bypass piping. It would need to be installed near the beginning of the fish/debris return where the pipe transitions from a half pipe exiting the screenhouse to a full, enclosed pipe. This launching station would essentially be a bypass pipe with an access point where a pig could be inserted. A flange behind the pig would enable the line to be pressurized. The driving pressure could potentially be provided by pumping water from a point downstream of the traveling water screens to the pig launching point. A retrieval system (e.g., basket) would need to be installed at the discharge end of the return pipe (whether to the Lagoon or the Pond, Figure 2) to catch the pig. The support for the retrieval basket would be permanent, but the basket would only be needed during pigging operation.

In order to prevent damage to a coated pipe or HDPE/FRP pipe, coated polyurethane foam pigs may be used. Pigging would need to occur on a regular schedule should the pipe experience problems with fouling due to organisms. The frequency of a pipeline pigging would be determined based on operational observation of the fouling rate. If the inside of the pipe became mussel infested, the effectiveness of pigging would decrease.

Pigging will require additional investment in maintenance. As with recoating, the pigging process would require for the fish/debris return to be shutdown. Figure 2 depicts the location of the pig launch and retrieval stations.

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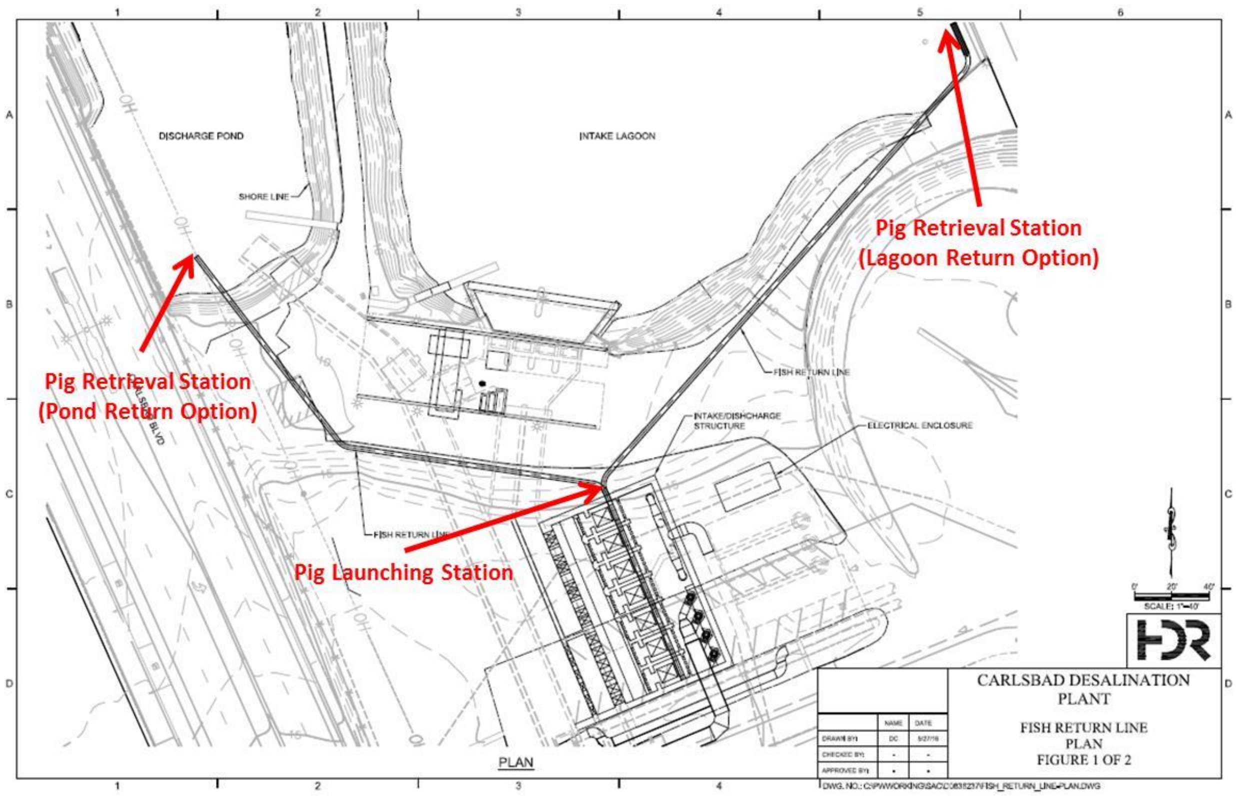

Figure 2. General locations of potential pig launching and retrieval stations on the CDP fish/debris return system.

Debris from Cleaning

As described above, the initial approach for maintaining the fish/debris return system will be to minimize the probability of settlement of debris. However, to the extent that debris or fouling organisms accumulate in the fish return system, they must be removed. There is, therefore, potential for debris from cleaning to be discharged from the fish/debris return system.

For the Pond return location (Figure 1), debris would be returned to the Pond and flushed out to the Pacific Ocean through the existing outfall as is currently done by the EPS. This does not represent a change from existing EPS operations, so no new impacts are anticipated.

For the Lagoon return location, the potential for recirculation to the intake would be minimized based on the distance from the intake and the ambient currents. The Boards have previously expressed a concern about the potential impacts of debris discharge on the existing nearby eelgrass beds in the Lagoon (Figure 3). If cleaning debris were to be discharged to the Lagoon, the risk of increasing turbidity would be low since the fine debris/sediments will likely fall out of suspension well before reaching the fish return system. Larger debris discharged to the Lagoon would have to be removed periodically. During subsequent permit renewals for the future dredge cycles, Poseidon could request authorization to remove any debris that may have accumulated in the vicinity of the fish return discharge.

Figure 3. 2015 post-dredge eelgrass survey, showing tentative location of the Lagoon-based fish/debris return (modified from Merkel and Associates, Inc. 2015).

Conclusion/Recommendation

It is important that the initial design of the fish/debris return system be such that the potential for settlement of debris or the colonization of biota is minimized. This is the best means to minimize future cleaning problems in the fish/debris return system. Sound hydraulic design is the primary approach for maintaining the fish/debris return system in a clean condition. The design will also include cleaning approaches as a back-up. In order to establish a specific cleaning methodology for the fish/debris return pipe at the CDP, a material must be selected for the return pipe. Once selected, the next step would be to determine a cleaning methodology.

HDR's recommendation at this stage of design is to use HDPE or FRP for the fish/debris return pipe. No coatings would be applied to HDPE or FRP, thereby eliminating a potential maintenance cost. Based on initial hydraulic analysis[1] of the conceptual fish/debris return pipe, the minimum velocity in the pipe would be 4.5 – 5 feet per second (fps). This velocity should be sufficient to preclude settlement of most fouling organisms and exceeds the velocity at which sedimentation would be expected to occur (less than 2 fps). As a result, pigging would not be required initially. However, we recommend that the pipe be monitored for potential mussel growth (e.g., use access/clean out points to visually inspect the inside of the pipe). When the fish/debris return pipe is installed, a pig launching station (as described in the pigging section) could be installed to allow for pigging in the event that visual monitoring reveals that fouling organisms are beginning to attach to the HDPE/FRP pipe. Figure 1 depicts the location of the pig launching station and the pig retrieval stations for fish return systems that discharge to either the Lagoon or the Pond.

References

American Society of Civil Engineers (ASCE). 1982. Design of Water Intake Structures for Fish Protection.

Merkel and Associates, Inc. 2015. Post-dredge eelgrass survey in support of the Encina Power Station, Agua Hedionda 2014-2015 Dredging Project at Agua Hedionda Lagoon (Outer Lagoon), Carlsbad, CA. 5 pp.

Portland State University (PSU). 2009. A Review of the Use of Coatings to Mitigate Biofouling in Freshwater.

[1] The hydraulic analysis consisted of using Manning's Equation to solve for water depth and velocity in the least sloped portion of the full pipe (slope = 1.00%) using the design capacity for seven spray wash pumps (114.5 gpm per pump, 801.5 gpm total).

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