Memorandum

To:	Tonia Tabucchi Herrera	Project:	Hemphill Diversion Project
From:	Jon Burgi Kevin Jensen	cc:	
Date:	11/23/2021	Job No.:	21-0125
Subject:	Farmers Horizontal Screen use in Hemphill Canal		

1.0 Background

The Hemphill Diversion is located in Auburn Ravine near the city of Lincoln, Placer County, California. The diversion structure is used to divert water from Auburn Ravine into the Hemphill Canal. Nevada Irrigation District (NID) has proposed a project that would remove the existing concrete structure with a nature-like roughened channel that would allow for the upstream passage of aquatic species. Additionally, NID will install a fish screen to exclude fish from entering the canal system.

Alternatives that had previously been considered include a vertical flat plate screening and fish return system that would be located in Hemphill Canal, an infiltration basin with a pump, and cone screens located in Auburn Ravine prior to the Hemphill Canal headgate (ECORP Consulting Inc, 2021).

During the conceptual design phase, the McMillen Jacobs design team reviewed the alternatives that had been presented previously. In consideration of the characteristics of the Hemphill diversion, specifically the low water surface elevation at the headgate due to the removal of the existing diversion dam, and the sediment loading that has been experienced, the design team recommended the use of a different screening approach. The purpose of this memorandum is to present additional information related to the use of a Farmers Horizontal Screen in Hemphill Canal. Since this is an alternative that has not been considered at this site, further explanation and application of the horizontal screen has been requested.

2.0 Farmers Screen: Biological Studies

The Farmers Screen is an innovative, horizontal fish screen technology that allows the diversion of water without harming fish or trapping debris. This screen technology was developed by farmers in the Hood River basin in Oregon and is patented and sold by Farmers Conservation Alliance (FCA).

The first official study conducted by an outside source was performed by the U. S. Bureau of Reclamation, in the Water Resources Research Laboratory in Denver, CO from 2000-2001 (USBR, 2005). A biological test was also performed in the same laboratory using the same prototype model by the Larval Fish Laboratory of Colorado State University (Beyers & Bestgen, 2002).

This early laboratory testing of prototype designs provided a foundation for understanding the hydraulic performance of horizontal flat plate screens in relation to specific design components. The testing also pointed to some areas for improvement in the design to provide more favorable hydraulic characteristics for both fish protection and debris and sediment management. This testing yielded critical and significant changes to the design of the Farmers Screen.

A biological test examined the effects on juvenile coho salmon and steelhead trout as they pass through a Farmers Screen system under various hydraulic and operating conditions. Specifically, it analyzed injury and mortality rates as well as potential to cause delay in out-migration of salmonids. The results of the testing showed a very high level of protection—exceeding NMFS standards—including 100% protection (i.e., 0% injury or mortality) and 99.6% of test fish passing over the screen without hesitation or delay.

The testing was conducted on a recently installed Farmers Screen at the Oxbow Fish Hatchery in Cascade Locks, Oregon. This testing was performed by the United States Geological Survey (USGS), Western Fisheries Research Center, Columbia River Research Laboratory (Mesa, Rose, & Copeland, 2010).

A field-based evaluation of the Farmers Screen was completed in 2011 and published in 2012 (Mesa, Rose, & Copeland, 2012). Juvenile coho salmon and steelhead were released at the upstream end of a Farmers Screen and allowed to volitionally move downstream. The study concluded that when provided with adequate inflow and configured to maintain appropriate water depth, the Farmers Screen offers a useful alternative for irrigators. The importance of properly designing, constructing, operating, and maintaining the screen was reiterated in the study. The Herman Creek screen, where these tests were conducted, maintained a water depth across the screen of 10 cm (4 inches).

3.0 Farmers Screen: Hydraulic Studies

During the early design phase of the Derby Dam Horizontal Fish Screen Project, which is the largest Farmers Screen installation to date, a hybrid computational fluid dynamics (CFD) and physical model was developed to investigate the hydraulic performance of the proposed screen and to compare hydraulic model results with established criteria (Gilkes, 2019) (FCA, 2020). Results of the model indicated the following:

- Sweeping Velocity: Minimum sweeping velocity was predicted to be 5.8 ft/s, exceeding the design requirements of a minimum of 2.5 ft/s.

- Approach Velocity: Ranges from 0.10 ft/s to 0.22 ft/s, which was below the maximum design requirements of 0.25 ft/s.

- The water depth over the screen surface is set by the weir wall height and would be above the minimum design requirement of 1.0 feet.

After the project was constructed, commissioning exercises included in-depth acoustic Doppler current profiler (ADCP) measurements of flow to determine the flow split between canal water and bypass water. Results are summarized in Figure 1 below and indicate a bypass flow that is a relatively constant 6% of the total inlet flume flow.

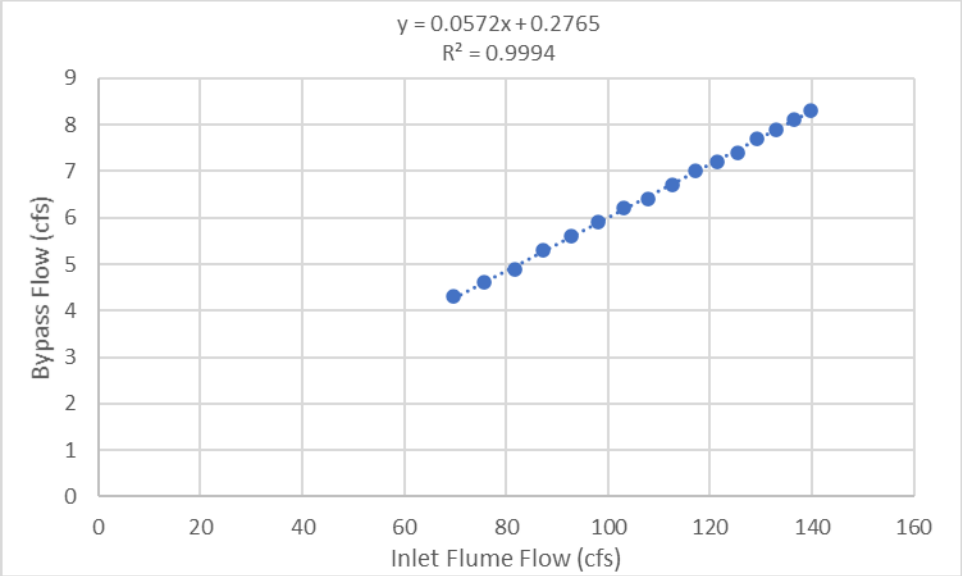

Figure 1. ADCP Flow Measurements at the Derby Dam Horizontal Screen

4.0 Sediment Management

To date there have not been any studies or reports published relating to the management of sediment through the Farmers Screen. There are additional steps that can be taken in the design and construction of the Farmers Screen that will provide for the removal of sediment from the attenuation bay. A series of perforated pipes are attached to the bottom of the attenuation bay and connected through a valve and return pipe to the stream. When sediment begins to collect in the attenuation bay, the valve can simply be opened until the flow of water draws the sediment into the pipe and back to the stream. Since this sediment removal system resides downstream of the weir wall, it is hydraulically disconnected from the water flowing over the screen and thus has no affect on the depth of water over the screen.

FCA has provided contact information for two irrigation districts that both operate multiple Farmers Screens within their district. Nevada Irrigation District and/or NOAA-NMFS or CDFW are welcome to contact either of these districts to discuss their experience with the effects of sediment on the horizontal screens.

1. Les Perkins, Manager, Farmers Irrigation District – FID owns and operates several Farmers Screens and has years of experience with them. http://www.fidhr.org/index.php/contact-us
2. Craig DeHart, Manager, Middle Fork Irrigation District – MFID have screens located high up in the Mt. Hood watershed and handle a lot of suspended and bedload sediment throughout the irrigation season. http://www.mfidp.com/

5.0 Conclusion

Based on the benefits of the Farmers Screen, McMillen Jacobs has proposed this approach for use at the Hemphill Diversion. These benefits include passive screening (no power), low head loss, cost effective construction, minimization of in-water work, and sediment management options. We also understand that design, manufacture, installation, operation, and maintenance must all work together to result in a successful screen that protects fish. Additionally, we understand that some screens do not work in certain situations. Based on our experience of designing and constructing fish screens we believe that the Farmers Screen is the best option for this location.

Additional Links:

- Screen overview video: https://www.youtube.com/watch?v=HWE3B_QBaWk
- Underwater video: https://www.youtube.com/watch?v=TYU0iX8N8x4

6.0 References

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