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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, WA 98115

May 25, 2011

Mr. Roy Elicker
Director, Oregon Department of Fish and Wildlife
3406 Cherry Avenue NE
Salem, Oregon 97303-4924

Dear Mr. Elicker:

Thank you for your letter regarding horizontal juvenile fish screens. We appreciate the Oregon Department of Fish and Wildlife's (ODFW's) efforts to help Farmers Conservation Alliance (FCA) develop their horizontal screen technology, and provide potential tools to minimize the loss of fish from a variety of water withdrawals.

We also appreciate the contributions of ODFW in the Fish Screen Oversight Committee (FSOC) of the Columbia Basin Fish and Wildlife Authority. The FSOC has historically played a strong role in fish screen issues in the Pacific Northwest, including the development of regional juvenile fish screen criteria for anadromous salmonids common to all three Pacific Northwest states. We understand your desire to increase the tools available for fish protection, but believe these tools would be better suited for regional application if they were collaboratively developed and assessed by FSOC, using an experimental fishway design evelopment process such as that of the National Marine Fisheries Service (NMFS) or American Fisheries Society Bioengineering Section.

Revised Horizontal Screen Criteria

In response to efforts by FCA, NMFS has revised criteria and guidelines for the design of horizontal screens. NMFS has modified its regional policy, expanding and clarifying design criteria and guidelines for use in horizontal screen design for the protection of juvenile salmonids. The previous version of horizontal screen design included in our February 2008, document titled "Anadromous Salmonid Passage Facility Design" will be superseded with the text contained in Enclosure A. These revisions are the result of extensive technical discussions within our own engineering staff, and discussions with FCA and state and Federal fisheries agencies during meetings of the FSOC. In addition, consideration was given to information from water users at FCA screen sites, internal trip reports from horizontal screen site visits, and a variety of biological evaluations of horizontal screens conducted by the U.S. Geological Survey (USGS) and others.

FSOC acceptance of revised horizontal screen criteria

ODFW collaborated and provided its technical perspective in the FSOC when these revised criteria were developed. Voting FSOC members agreed that it was appropriate to consider technical approval of the draft criteria developed by NMFS based on recent horizontal screen installations by FCA. In the January 2011, FSOC meeting, after extensive discussion which included ODFW, there were no objections to a motion to approve the revised horizontal screen criteria as appropriate for protecting anadromous salmonids in Oregon, Washington and Idaho. As such, FSOC passed the motion.

Potential further revision of horizontal screen criteria

Acceptable hydraulic operation leading to safe, timely and effective fish passage narrows with decreasing flow depth over a horizontal screen. Since operator error, operator intent, inadequate or incomplete design criteria, design error, inadequate site selection, and construction error can all directly affect the biologically safe operation of horizontal screens, NMFS believes that shallow depth horizontal screens are not suitable for programmatic approval at this time.

In FSOC discussion, FCA has been asked to develop a design table that indicates design criteria based on the USGS lab results, including design parameters of flow depth, sweep velocity and approach velocity based on design flow amount. These steps are paramount to translate lab test results into useable fish screen design criteria suitable for repeated application at a variety of field sites. These steps remain to be completed by FCA.

At the Widows Creek FCA screen sites, located in the John Day Basin in Oregon, site visits by NMFS staff and others have revealed problems with these six-inch depth horizontal screens. The Widows Creek screens have been observed to retain angular sediment, yielding a sandpaper-like screen surface. This material is extremely hard to remove, and if it remains in place poses high risk for any fish that are in the proximity, especially if the minimum design depth is not maintained. Sediment accumulates beneath the screens, impairing water flow. Maintaining the minimum six-inch design depth over the screens and providing required irrigation flow has been a problem, but design retrofits may be successful in rectifying the problem. In fact, at numerous FCA screen sites throughout the region that have used the FCA horizontal screen design with a six-inch screen depth, there have been mixed success and failure in maintaining the fish screen hydraulics deemed to be safe for fish by U.S. Geological Survey testing. Generally, there have been more reported examples of failure than success in maintaining self-cleaning attributes of the screen and maintaining the minimum six-inch depth. Failure to maintain the design criteria that have proven to be safe for fish poses an unacceptable risk, especially for those species listed under the Endangered Species Act.

In the 2009 Biological Opinion for the Widows Creek screens, NMFS required site monitoring and reporting of operational issues to investigate the viability of six inch horizontal screen depth design. By 2013, NMFS will complete its review of monitoring reports and may conduct site visits to ascertain design corrections made to the FCA design at horizontal screen sites with six inch screen depth. At that time, NMFS will revisit the FCA request to revise the depth criterion from twelve to six inches. If operation reports are convincing, NMFS will consider further updates to our design manual after collaboration with FSOC.

Conclusion

The NMFS has high regard for FCA and their intent to assist in fish recovery in the Pacific Northwest by providing an alternative fish screen design, and especially the coordination efforts to match water users with funding options. NMFS fish passage engineers collectively have over 100 years experience in screen design and have worked on thousands of screen designs in the Region. This experience has led to a defined design process, criteria and guidelines that provide a predictable biological result when the design process is used. The revised horizontal screen criteria and guidelines in Enclosure A directly reflect the hard work done by FCA, and the collaboration between FCA, FSOC and NMFS engineering staff.

NMFS understands that this revision did not include the entire extent of FCA's desired criteria changes, which limits suitable sites for FCA screen installation. It is important to note that the role of the NMFS fishway design document is to describe designs that could be covered under programmatic Endangered Species Act (ESA) consultations. The revised criteria and guidelines do not preclude any FCA screen design proposed for a water diversion site from being considered in formal ESA consultation with NMFS. Please understand that if formal ESA consultation does occur and a FCA screen is installed that does not achieve the criteria of Enclosure A, NMFS will likely require a period of site monitoring and possible screen replacement if unacceptable results occur. The findings from this monitoring will be a major consideration for future modifications to horizontal screen criteria.

Thank you for clarifying your perspective regarding FCA screens. We hope that the information provided above clarifies our perspective as well. Please contact Bryan Nordlund (360-534-9338) if you have questions or comments.

Sincerely,

William W. Stelle, Jr.
Regional Administrator

Enclosure

cc: Dave Ward – FSOC

11.6.1.7 Horizontal Screens: Horizontal screens have been evaluated as experimental technology, because they operate fundamentally different than conventional vertically oriented screens. This fundamental difference relates directly to fish safety, because when inadequate flow depth exists with vertically oriented screens, there is no potential for fish to get trapped over the screened surface. In contrast, when water level on horizontal screens drops and most or all diverted flow goes through the screens, there is high likelihood that fish will become impinged and killed on the screened surface. In addition, if depths become shallow and flow rate is high over a horizontal screen, the resulting cross-section velocity may be too high to allow fish to swim away from the horizontal screen surface.

Unless specified differently below, general screen and bypass criteria and guidelines specified in section 11 apply for horizontal screens as well. Horizontal screens are considered biologically equivalent to conventional screens only if the following criteria and guidelines are achieved in design and operation:

11.6.1.7.1 Design Development: Since site-specific design considerations are required, NMFS engineers must be consulted throughout the development of the horizontal screen design.

11.6.1.7.2 Hydrologic and Hydraulic Analysis: The horizontal screen design process must include an analysis to verify that sufficient hydrologic and hydraulic conditions exist in the stream so as not to exacerbate a passage impediment in the stream channel (see Section 4.1), or in the off-stream conveyance, including the screen and bypass. This analysis must conclude that all criteria listed below can be achieved for the entire juvenile outmigration season, as defined by section 3. If the criteria listed below cannot be maintained per this design analysis, a horizontal screen design must not be used at the site. If this analysis concludes that removal of the bypass flow required for a horizontal screen from the stream channel results in inadequate passage conditions or unacceptable loss of riparian habitat, other screen design styles must be considered for the site and installed at the site if adverse effects are appreciably reduced.

11.6.1.7.3 Screen Geometry: Horizontal screens must be set at specific slopes and geometry consistent with prototypes approved by NMFS. The screen design must include reference material for an example prototype that confirms the adequacy of the design.

11.6.1.7.4 Site Limitation: Horizontal screens must not be installed spanning the entire width of stream or river channels, or in stream or river channels where hydraulic conditions on the screen cannot be maintained as specified below, or where the screen cannot be easily accessed for maintenance. Upstream fish passage must not be impeded by installation of a horizontal screen. In general, very few instream sites may be appropriate for installation of a horizontal screen.

11.6.1.7.5 Flow Regulation: For a horizontal screen to be installed, the site must have a good headgate, capable of maintaining sufficiently consistent diversion rates to allow a horizontal screen and bypass to operate within these criteria and guidelines.

11.6.1.7.6 Channel Alignment: Horizontal screens must be installed such that the approaching conveyance channel is completely parallel and in line with the screen channel (no skew) such that uniform flow conditions exist at the upstream edge of the screen. A straight channel should exist for at least twenty feet upstream of the leading edge of the horizontal screen, or up to two screen channel lengths if warranted by approach flow conditions in the conveyance channel. Flow conditions that require a longer approach channel include turbulent flow, supercritical hydraulic conditions, or uneven hydraulic conditions in a channel cross section. Horizontal screens must be installed such that a smooth hydraulic transition occurs from the approach channel to the screen channel (no abrupt expansion, contraction, or flow separation).

11.6.1.7.7 Bypass Flow Depth: For horizontal screens, the bypass flow must pass over the downstream end of the screen at a minimum depth of one foot.

11.6.1.7.8 Bypass Flow Amount: Bypass flow is used for transporting fish and debris across the plane of the screen and through the bypass conveyance back to the stream. Bypass flow amounts must be sufficient to continuously provide the hydraulic conditions specified in this section, and bypass conditions specified in section 11.9. In general, for diversion rates less than 100 cfs, about 15% of the total diverted flow should be used as bypass flow for horizontal screens. For diversion rates more than 100 cfs, about 10% of the total diverted flow should be used for bypass flow for horizontal screens. Small horizontal screens may require up to 50% of the total diverted flow as bypass flow. The amount of bypass flow must be approved by NMFS engineers.

11.6.1.7.9 Diversion Shut-off: If inadequate bypass flow exists at any time (per Sections 11.6.1.7.7 and 11.6.1.7.8), the horizontal screen design must include an automated means to shut off the diversion flow, or a means to route all diverted flow back to the originating stream.

11.6.1.7.10 Sediment Removal: The horizontal screen design must include means to simply and directly remove sediment accumulations under the screen, without compromising the integrity of the screen while water is being diverted.

11.6.1.7.11 Screen Approach Velocity: Screen *approach velocity* is calculated by dividing the maximum flow rate by the *effective screen area,* and must be less than 0.25 ft/s and uniform over the entire screen surface area (see section 15.2). The horizontal screen design must include *approach velocity* and *sweeping velocity* consistent with the prototype example submitted per 11.6.1.7.3. Recent

prototype development has demonstrated that better self-cleaning of a horizontal screen is achieved when the ratio of sweeping velocity and approach velocity exceeds 20:1, and *approach velocities* are less than 0.1 ft/s. If equipped with an automated mechanical screen cleaning system, screen *approach velocity* must be less than 0.4 ft/s and uniform over the entire screen surface area (see section 15.2).

11.6.1.7.12 Screen Sweeping Velocity: For horizontal screens, *sweeping velocity* must be maintained or gradually increase for the entire length of screen (see section 11.9.1.8). The design *sweeping velocity* must be consistent with the prototype example submitted per 11.6.1.7.3. Higher *sweeping velocities* may be required to achieve reliable debris removal and to keep sediment mobilized. *Sweeping velocity* should never be less than 2.5 ft/s, or an alternate minimum velocity based on an assessment of sediment load in the water diversion system.

11.6.1.7.13 Screen Cleaning: For passive horizontal screens, *approach velocity* and *sweeping velocity* must work in tandem to allow self cleaning of the entire screen face and to provide good bypass conditions. If the proposed design has not been demonstrated to have cleaning capability and hydraulic characteristics similar to a successful prototype, the screen design must include an automated screen cleaning system.

11.6.1.7.14 Inspection, Maintenance and Monitoring: Daily inspection and maintenance must occur of the screen and bypass to maintain operations consistent with these criteria. Post construction monitoring of the facility must occur for at least the first year of operation. This monitoring must occur whenever water is diverted, and include a inspection log (in table form) of date and time, water depth at the bypass, debris present on screen (including any sediment retained in the screen openings), fish observed over the screen surface, operational adjustments made, maintenance performed and the observer's name. A copy of the inspection log must be provided annually to the NMFS design reviewer, who will review operations and make recommendations for the next year of operation.