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Memorandum

TO: Dave Ward, Chairman, Fish Screening Oversight Committee

FROM: Matthew G. Mesa and Brien P. Rose

RE: Response to proposed criteria for horizontal screens developed by NMFS

We recently reviewed the proposed criteria for horizontal screens developed by NMFS and have several comments or questions for the FSOC to consider in their deliberations. In general, there seems to be an almost universal disregard for the recent research conducted on horizontal screens in the development of these criteria (Beyers and Bestgen 2001; Frizell and Mefford 2001; Rose et al. 2008; Mesa et al. 2010). Much of what was learned during these studies just seems to have been ignored, and we wonder why. This is particularly egregious considering that much of our work was in direct response to queries or suggestions by personnel from NMFS. Or, to put it another way, we thought this research was being done to provide the data necessary for the development of valid criteria for horizontal screens—but this doesn't seem to be the case. We hope that our comments and questions below, based on the different sections of the proposed criteria, will at least provide a different viewpoint for FSOC members to consider in their discussions about these criteria.

11.6.1.7

--While it is possible for horizontal screens to become dewatered, we submit that this is a highly unlikely scenario *if the screens are operated within their design criteria*. We think it's a bit overdramatic to state that *"there is high likelihood that fish will become impinged and killed on the screened surface"*. If *anything* is operated or maintained outside of their design criteria, trouble could ensue (e.g., flying a plane, driving a car, operating turbines, etc.)—so what does this statement really tell us? Again, it is very unlikely that fish will become impinged or die on these screens if they are operated and maintained properly.

--Please provide references or empirical evidence for this statement at the end of paragraph 1: *"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"*. Aren't all screen types designed to work with their bypass structure to move outmigrating fish *downstream* to the bypass outfall with a minimum of injury or delay (see

NOAA screen criteria section 11.9.1.1)?

11.6.1.7.3

--Please provide information on the prototypes referred to here—as written, it's vague. If there are prototypes, slopes, and geometries that are being targeted, why not just state them here?

11.6.1.7.4

--The criterion that "*Horizontal screens must not be used in stream or river channels*" needs justification. Our research (Rose et al. 2008) showed that the "in-stream inverted weir design" provided excellent protection for fish passing over these screens. Were the results of this study considered? Is there other information that prompted the development of this criterion?

11.6.1.7.6

--The criteria that "*the approaching conveyance channel is completely parallel and in line to the screen channel (no skew) for at least twenty feet or two screen channel lengths upstream of the screen civil works (whichever is greater)*", needs some justification—particularly with regards to the length of the conveyance channel. We are curious where the "*two screen channel lengths"* came from—what is the reasoning behind this, its biological justification, etc. While we agree that a straight and parallel conveyance is appropriate, we're perplexed by the length requirement stated here—it seems excessive. Further, it can, in many circumstances, lead to undue costs and environmental alterations. For example, the Davenport screen is about 160 ft long, which means, under this criterion, that it would require a conveyance of at least 320 ft. Is this really necessary? Is it really necessary to damage this much riparian habitat to put in a "required" length of conveyance when there is apparently no scientific justification for it? Finally—is this criterion standard for vertically oriented screens? If not, why? If the intent is to ensure that fish approach a screen in a natural orientation, does it make any difference what type of screen it is?

11.6.1.7.7

--Why the recommendation of a minimum one foot depth? Our research clearly showed that depths as low as six inches would provide excellent protection for fish passing over the Farmers, and other, screens. This is an example where the criteria being proposed contrasts with the available data. Why is this—shouldn't criteria be developed using the best available data? Please explain.

11.6.1.7.9

--Shutting off the diversion flow for many horizontal screens will be difficult. Where would the engineers suggest this be done—at the intake gate? It would be possible to route all diverted flow back to the stream, perhaps in open channel delivery systems.

11.6.1.7.11

--We are not aware of horizontal screens with automated mechanical cleaning devices, but suppose they could be developed. By these criteria, is there no allowance for variation in AV

over the entire screen surface area? Does this same standard hold for vertically oriented screens? If so, by what means and how often are screens evaluated to confirm that they are staying within criteria?

11.6.1.7.12

--Please provide the empirical evidence supporting the statement that SV's must "…*gradually increase for the entire length of screen*". Also, if SV's must exceed twice the AV, then SV's must be at least 0.4 – 0.8 ft/s—correct? However, later it is stated that SV's "…*should never be less than 2.5 ft/s*…" Thus, as it reads, SV's should really never be less that 2.5 ft/s—period. We suggest that the ratio of SV:AV (e.g., 30:1) is the important metric and recommend that the fish screen engineers and mangers try to include this in their criteria. This notion is conceptually discussed in Section 11.6.1.7.13 with regards to self cleaning, but it is also relevant to the biological performance of horizontal screens. Unfortunately, with these restrictive hydraulic criteria (i.e., SV and depth in particular), designing and operating flat plate fish screens for some small diversion sites may not be possible and would preclude their use in areas where passive screens might be the best option. For example, to meet the criteria proposed by NMFS (i.e., an AV $\leq$ 0.4 ft/s, an SV $\geq$ 2.5 ft/s, and a water depth of at least one foot), the inverted weir screens that we tested (Rose et al. 2008) would be required to bypass 30 – 70 CFS, which is 4 – 5 times the total flow in the rivers where they are located. In other words, in some cases, the math doesn't work out and horizontal screens may be eliminated from consideration at the start, even though from a site perspective they may be the most desirable screen type. This needs to be reconciled.

11.6.1.7.14

--Do these inspection and maintenance criteria hold for other types of screens, or just horizontal ones?

11.6.1.7.15

--As per our comment above, do all screens require preparation and submission of an inspection log? If not, why not?

References

Beyers, D.W., and Bestgen, K.R., 2001, Bull trout performance in a horizontal flat plate screen: Final report to the Bureau of Reclamation, Water Resources Research Group, Denver, Colorado.

Frizell, K., and Mefford, B., 2001, Hydraulic performance of a horizontal flat plate screen: Final report to the Bureau of Reclamation, Water Resources Research Group, Denver, Colorado.

Mesa, M.G., Rose, B.P., and Copeland, E.S., 2010, Biological evaluations of an off-stream channel, horizontal flat-plate fish screen—The Farmers Screen: U.S. Geological Survey Open-File Report 2010–1042, 16 p.

Rose, B.P., Mesa M.G., and Zydlewski G.B., 2008, Field-base evaluations of horizontal flat plate fish screens: North American Journal of Fisheries Management, v. 28, p. 1702–1713.