NORTHWEST ENVIRONMENTAL ADVOCATES

December 16, 2021

Susan Braley
Washington Department of Ecology
P.O. Box 47696
Olympia, WA 98504-7696 *submitted via on-line portal*

Re: **Proposed Freshwater Dissolved Oxygen and Fine Sediment Criteria (WAC 173-201A)**

Dear Ms. Braley:

These comments pertain to Washington Department of Ecology's proposed changes including: (1) adding definitions to WAC 173-201A-020; (2) amending WAC 173-201A-200(1)(d), aquatic life dissolved oxygen criteria for fresh water; and (3) adding subsection WAC 173-201A-200(1)(h), aquatic life fine sediment narrative criterion. These comments also pertain to the following court-ordered requirement: "If the proposed rule is a narrative criterion, Washington will concurrently issue draft guidance regarding how it will interpret and apply its fine sediment criterion, including, but not limited to, its use in establishing Washington's CWA section 303(d) list[.]" Stipulated Order of Dismissal in *NWEA v. EPA*, No. C14-196 RSM, (October 18, 2018), ¶ 2.b.

I. LEGAL BACKGROUND

In 1972, Congress adopted amendments to the Clean Water Act ("CWA") in an effort "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." 33 U.S.C. § 1251(a). The CWA establishes an "interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife." *Id*. at § 1251(a)(2). To those ends, the CWA requires states to develop water quality standards that establish, and then protect, the desired conditions of each waterway within the state's regulatory jurisdiction. *Id*. at § 1313(a). Water quality standards "serve both as a description of the desired water quality for particular waterbodies and as a means of ensuring that such quality is attained and maintained." 64 Fed. Reg. 37,073, 37,074 (July 9, 1999); 40 C.F.R § 131.2. They are the benchmarks by which the quality of waterbodies is measured: waterbodies that do not meet these benchmarks are deemed "water quality limited" and placed on the CWA § 303(d) list. States must develop total maximum daily loads ("TMDLs") for all such 303(d)-listed waters to establish the scientific basis to clean the waters and bring them back into compliance. 33 U.S.C. § 1313(d)(1)(C).

Water quality standards must include three elements: (1) one or more designated "uses" of a waterway, such as swimming or fish propagation; (2) numeric and narrative "criteria" specifying the water quality conditions necessary to protect the designated uses; and (3) an antidegradation policy ensuring continued protection of any uses that have existed since 1975 and maintenance and protection of high quality waters, along with methods to implement the antidegradation policy. *Id.* at §§ 1313(c)(2), 1313(d)(4)(B); 40 C.F.R. Part 131, Subpart B. Implementation methods must be identified as part of the policy's adoption. 40 C.F.R. § 131.12.

States must review and revise their water quality standards at least every three years, in a process called "Triennial Review," thereafter submitting all new and revised standards to EPA for review and action. 33 U.S.C. § 1313(c)(1), (3); 40 C.F.R. § 131.20(c). EPA must review the submitted standards and determine if they meet CWA requirements. 33 U.S.C. § 1313(c)(3); 40 C.F.R. §§ 131.5, 131.13, 131.21(b). A state-developed water quality standard, including any policies affecting those standards, does not become effective until it receives EPA approval. 40 C.F.R. § 131.21(c). When EPA's approval of state water quality standards could have an adverse effect on threatened or endangered species, EPA must consult with U.S. Fish & Wildlife Service ("FWS") and National Marine Fisheries Service ("NMFS") (together "Services"), pursuant to the Endangered Species Act ("ESA"). 16 U.S.C. § 1536(a)(2), 50 C.F.R. § 402.14.

Once approved by EPA, water quality standards serve as the regulatory basis for the establishment of water quality-based controls. For point sources of pollution, EPA retains direct control—which states, such as Washington, may be authorized to carry out—to enforce effluent limitations through the National Pollutant Discharge Elimination System ("NPDES") permitting program. 33 U.S.C. §§ 1311(a), 1342. Congress did not establish an analogous federal permitting scheme for nonpoint source pollution, such as pollution from timber harvesting and agriculture. Instead, Congress assigned states the task of implementing water quality standards for nonpoint sources, with oversight, guidance, and funding from EPA. *See, e.g.*, 33 U.S.C. §§ 1288, 1313, 1329. "[S]tates are required to set water quality standards for all waters within their boundaries regardless of the sources of the pollution entering waters." *Pronsolino v. Nastri*, 291 F.3d 1123, 1127 (9th Cir. 2002) (emphasis in original).

Numeric water quality criteria are central to ensuring protection of designated uses. 33 U.S.C. § 1313(c)(2)(A); 40 C.F.R. § 131.3(b). Criteria "must be based on sound scientific rationale and must . . . protect the designated use." 40 C.F.R. § 131.11(a). Importantly, criteria "shall support the most sensitive use" of the waterbody. *Id.*

II. Ecology's Proposed Fine Sediment Narrative Criterion

Ecology has proposed a fine sediment narrative criterion that reads as follows:

> (h)(i) Aquatic life fine sediment criterion. The following narrative criterion

applies to all existing and designated uses for fresh water:

(ii) Water bodies shall not contain fine sediment (<2 mm) from anthropogenic sources at levels that cause adverse effects on aquatic life, their reproduction, or habitat. When reference sites are used, sediment conditions shall be compared to sites that represent least disturbed conditions of a neighboring or similar water body.

Proposed WAC 173-201A-200(1)(h). One primary problem with this proposed criterion is in the last sentence in which it refers to the use of "least disturbed conditions" of reference sites. The concept of "least disturbed" implies, correctly, that reference sites are generally somewhat disturbed by anthropogenic activity. The mandatory ("shall be compared") use of least disturbed conditions as a method of applying a criterion that prohibits ("shall not contain") anthropogenic sources of fine sediment is both illogical and inconsistent. The phrase "shall be compared" is just a process but it does not establish an explicit benchmark or rule; likely Ecology means that the information from the reference sites will inform its decision about whether anthropogenic sources have contribute fine sediment. For these reasons, we propose the following language as a replacement:

> <u>When reference sites are used, benchmark natural sediment conditions shall be determined by reference to measured conditions at sites and within watersheds that represent least disturbed conditions, selected within neighboring or comparable water bodies, and screened to assure that the reference site conditions do not reflect temporary fine sediment increases associated with infrequent natural events, or sustained elevation of fine sediment from past human disturbances.</u>

For an explanation of the need for this additional language regarding the need for *screening* reference site conditions, please see the comments attached by Dr. Christopher Frissell.

Additionally, for the reasons explained in Dr. Frissell's comments, the following language should also be added: "<u>All methods of evaluating the impacts of fine sediment shall be demonstrated to be reliable indicators of salmonid-egg-to-fry survival</u>." The ambiguity inherent in the narrative criterion combined with the "weight of evidence" approach Ecology includes in its draft and incomplete implementation guidance for this narrative criterion demonstrates Ecology's clear intention to allow the use of fine sediment measurements that are *not* reliable for the purpose of assessing the effect of fine sediment on the egg-to-fry life cycle stages of salmonids, and to allow those measurements to override others that do provide an indication of unacceptable fine sediment. The example of the weight of evidence approach offered by Ecology fails to weigh evidence according to its scientific veracity and the reliability of inference that can be drawn from it. Thus, it implies that several categories of poor data or indicators that only weakly relate to salmonid-egg-to-fry survival could be used to override one or more categories of far more inherently scientifically reliable data or indicators of well-established consequence to salmonid survival. For this reason, it is essential that the narrative criterion explicitly prohibit the use of fine sediment measures that are not sensitive to the impacts on the very existing and designated uses the narrative criterion seeks to protect.

The narrative criterion refers to prohibiting "levels that cause adverse effects." Ecology is hiding the ball here. What are these levels that cause adverse effects? If there is one level, why are there multiple levels? Assuming that Ecology does not know what these levels are, or it would propose numeric criteria, the narrative criterion must link the prohibition on such adverse effects to the methods set out in the guidance. For this reason, we propose the addition of a new subsection (iv) to read "All methods of evaluating the adverse effects of fine sediment shall be demonstrated to be reliable indicators of salmonid-egg-to-fry survival." In order to make the rule more clear, we suggest moving the discussion of reference sites to its own subsection.

Finally, we propose that Ecology explicitly address the greater need for protection of the most sensitive designated uses, namely those threatened and endangered species whose population numbers are on a downward trend. We propose that the following language be added to modify the protection of the beneficial uses: "taking into account the population status of threatened and endangered species." The currently precipitously small population sizes for these species amplifies the harmful effects that fine sediment has on the species' remaining populations and critical habitat. As Ecology is well aware, Puget Sound Chinook salmon continue to be in significant decline and are today at greater risk of extinction than when the species was first listed. The total Puget Sound Chinook run size in 2021, including both hatchery and wild fish but not including spring Chinook, is down 11 percent from the 2020 forecast of 233,000 fish and two percent below the recent 10-year average of that run. The most recent 10-year average for wild Puget Sound Chinook is 28 percent below the 10-year average for this species in 1999, when it was first listed as threatened pursuant to the federal Endangered Species Act. *See, e.g.,* Washington Department of Fish and Wildlife, *Chinook Historical Run Size—Puget Sound*, *available at* https://wdfw.wa.gov/fishing/management/puget-sound-management-plan#status (last visited December 15, 2021).

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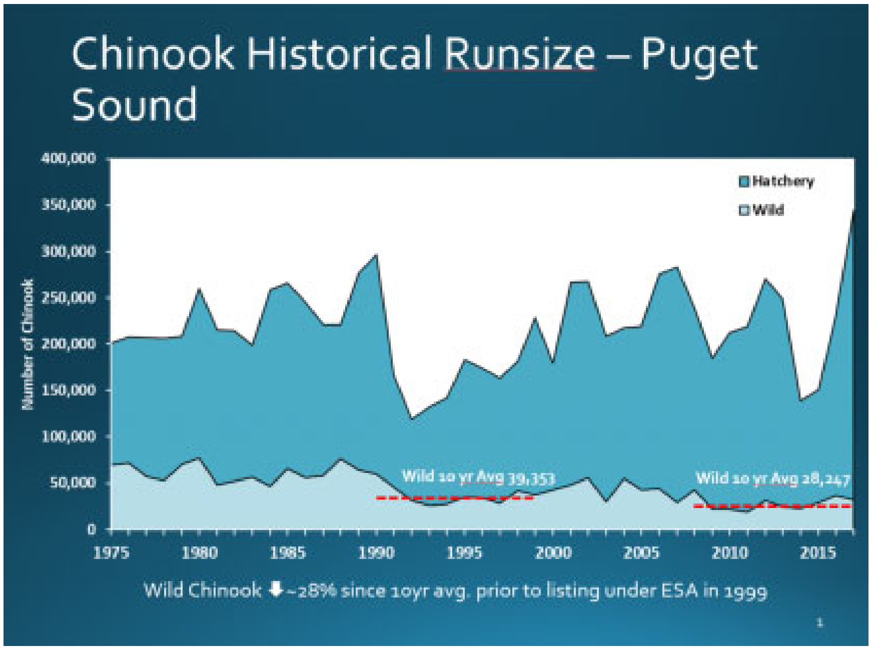

Puget Sound Chinook are in crisis with a future status predicted by the Washington Department of Fish and Wildlife to be less than 25 percent of the recovery goal. Washington Department of Fish and Wildlife, *Status and Trends Analysis of Adult Abundance Data, Prepared in Support of Governor's Salmon Recovery Office 2020 State of Salmon in Watersheds Report* (January 31, 2021), *available at* https://data.wa.gov/Natural-Resources-Environment/FINAL-WDFW-Status-and-Trends-Analysis-Report-Packa/7ir3-4v4j (last visited December 15, 2021) at 16. Similarly, Lake Ozette sockeye, Snake River spring/summer Chinook, Puget Sound steelhead, and Upper Columbia spring Chinook, are in crisis, with populations projected to reach less than 25 percent of the recovery goal in the near future. *Id.* Other populations are deemed to "not keeping pace" include Lower Columbia River coho, Lower Columbia River Chinook, Upper Columbia River steelhead, and Middle Columbia River steelhead. *Id*. Bull trout populations are also decreasing. U.S. Fish and Wildlife Service, *Bull Trout (Salvenlinus confluentus) 5- Year Review: Summary and Evaluation* (2008) at 44 (identifying a "decreasing trend" in bull trout abundance).

Southern Resident killer whales continue to be significantly affected by pollution problems including those that affect their essential prey, Chinook salmon. Today there are only 73 Southern Resident killer whales, down from 78 individuals in 2016 when NMFS completed its last five-year review. NOAA, Southern Resident Killer Whale (*Orcinus orca*) *available at* https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/southern-resident-killer-whale-orcinus-orca (last visited December 15, 2021) (identifying Southern Resident killer whale abundance for 1996); NMFS, *Southern Resident Killer Whales (Orcinus orca) 5-Year*

Review: Summary and Evaluation (December 2016) at 16 (identifying abundance for fall 2016); Orca Network, Births and Deaths, *available at* https://www.orcanetwork.org/Main/index.php?categories_file=Births%20and%20Deaths (last visited December 15, 2021) (reporting Southern Resident killer whale abundance as 73 individuals as of September 20, 2021). As the primary food source for Southern Resident killer whales, the continued decline in Chinook populations directly affect the whale's continued decline. *See* Lacy, R.C., Williams, R., Ashe, E. *et al. Evaluating Anthropogenic Threats to Endangered Killer Whales to Inform Effective Recovery Plans*, 7 *Sci Rep* 14119 (2017), *available at* https://doi.org/10.1038/s41598-017-14471-0.

These species' continued declines make them more vulnerable to the effects of fine sediment. Small populations have disproportionately higher chances of going extinct because environmental and biological forces function differently in these smaller populations and may result in positive feedback loops driving them towards extinction. The forces acting on small populations in "extinction vortices" include increased vulnerability to stochastic impacts, Allee effects on population dynamics, genetic deterioration from inbreeding and genetic drift, increased vulnerability to environmental stressors, such as pollution, and synergistic impacts. *See* Michael *Gilpin and Michael E. Soulé, Minimum Viable Populations: Processes of Species Extinction in CONSERVATION BIOLOGY: THE SCIENCE OF SCARCITY AND DIVERSITY 13-34 (M. E. Soulé ed., 1986*; Barry. W. Brook, Navjot S. Sodhi, and Corey J.A. Bradshaw, *Synergies among extinction drivers under global change*, 23 Trends in Ecology and Evolutionary Biology 453, 455 (2008); Anna-Marie Winter, Andries Richter, and Anne Marie Eikeset, *Implications of Allee effects for fisheries management in a changing climate: evidence from Atlantic cod*, 30 Ecological Applications (2020); Priyanga Amarasekare, *Allee Effects in Metapopulation Dynamics*, 152 The American Naturalist 299 (1998); Marty Kartos, *et. al*, *The crucial role of genome-wide genetic variation in conservation*, 118 Proc. Nat. Acad. Sci. (2021). The continued declines and increasingly low abundances of these species put them at a disproportionately greater risk of extinction than they would be if their populations were abundant, making protection of these designated uses more sensitive than they would be otherwise. Criteria to protect these species must be adjusted accordingly.

Taken as a whole, we propose the following changes in the proposed narrative criterion:

(h)(i) Aquatic life fine sediment criterion. The following narrative criterion applies to all existing and designated uses for fresh water:

(ii) Water bodies shall not contain fine sediment (<2 mm) from anthropogenic sources at levels that cause adverse effects on aquatic life, their reproduction, or habitat<u>, taking into account the population status of threatened and endangered species</u>. ~~When reference sites are used, sediment conditions shall be compared to sites that represent least disturbed conditions of a neighboring or similar water body~~.

<u>(iii)</u> <u>When reference sites are used, benchmark natural sediment conditions shall be</u>

determined by reference to measured conditions at sites and within watersheds that represent least disturbed conditions, selected within neighboring or comparable water bodies, and screened to assure that the reference site conditions do not reflect temporary fine sediment increases associated with infrequent natural events, or sustained elevation of fine sediment from past human disturbances.

(iv) All methods of evaluating the adverse effects of fine sediment shall be demonstrated to be reliable indicators of salmonid-egg-to-fry survival.

III. ECOLOGY'S FINE SEDIMENT IMPLEMENTATION GUIDANCE

The draft implementation guidance is, in fact, no guidance at all on how it "will interpret and apply its fine sediment criterion, including, but not limited to, its use in establishing Washington's CWA section 303(d) list[.]" Most obviously, this draft guidance fails to explain how Ecology will use the new narrative criterion for the purposes of CWA section 303(d) assessments as is evidenced by its own statements:

> The addition of a narrative fine sediment criterion *will require the development of a methodology to evaluate when the fine sediment standard is being exceeded*. Ecology will provide guidance on the parameters used to characterize fine sediment in a waterbody. Subsequently, the listing methodology to determine a fine sediment-based impairment will be developed by the water quality program through a public process. Appendix A provides sampling recommendations and approaches for making a determination of an exceedance of fine sediment criteria. The final methodology for assessing fine sediment will be in a revision to Water Quality Program Policy 1-11.

Ecology, *Preliminary Rule Implementation Plan Chapter 173-201A WAC, Water Quality Standards for Surface Waters of the State of Washington Salmon Spawning Habitat Protection Rule* (October 2021) ("Draft Guidance") at 7 (emphasis added); *see also id*. at 31 ("The methods to determine a fine sediment impairment for purposes of the Clean Water Act Section 303(d) *will be finalized* in Ecology's Water Quality Policy 1-11, Chapter 1. However, the following recommendations may be useful in *developing* an approach to determining a fine sediment exceedance.") (emphasis added). Ecology's use of the *future* tense in its draft guidance demonstrates that this is, in fact, no guidance at all on how the narrative criterion will be used for the purpose of 303(d) listings or other regulatory actions.

In addition to the lack of a methodology for using the narrative criterion in 303(d) listing, Ecology's draft implementation guidance also fails to address the other regulatory contexts in which it will need to interpret and apply the criterion, namely the following: (1) in the development of total maximum daily loads under CWA section 303(d); in the establishment of best management practices for nonpoint sources under CWA section 319 and the Coastal Zone Act Reauthorization Amendments (“CZARA”), 16 U.S.C. § 1455b(b)(3) (each state shall provide for the “implementation and revision of management measures” for nonpoint sources “that are necessary to achieve and maintain applicable water quality standards under [CWA] section 1313 of Title 33 and protect designated uses”); and in the issuance of National Pollutant Discharge Elimination System (“NPDES”) permits pursuant to CWA section 402. The purported draft guidance does none of these things.

CONCLUSION

Just days ago, Washington Governor Jay Inslee published his *Governor’s salmon strategy update; Securing a future for people and salmon in Washington* (December 14, 2021). Under the heading “How we will improve wastewater management to achieve clean water for salmon and people” his strategy update includes “Revise and implement water quality standards to respond to aquatic ecosystem needs.” *Id.* at 7. Numerous other provisions in this strategy update reference the need to meet water quality standards, for example that agriculture needs to meet “water quality standards for salmon rearing and spawning.” *Id*. at 6. In order for Ecology’s water quality standard for fine sediment to fully support the Governor’s strategy, the agency must significantly strengthen the narrative criterion as well as fully set out implementation guidance for that narrative.

Sincerely,

Nina Bell
Executive Director

Attachment: Letter from Dr. Christopher Frissell, Frissell & Raven, to Susan Braley, Ecology, Re: *Comments on Proposed Freshwater Dissolved Oxygen and Fine Sediment Criteria (WAC 173-201A)* (December 16, 2021).

Frissell & Raven

Hydrobiological & Landscape Sciences

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16 December 2021

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Subject:
Comments on Proposed Freshwater Dissolved Oxygen and Fine Sediment Criteria (WAC 173-201A)

1. **Introduction**

During 2020-2021 I served on the Science Panel established by Washington Department of Ecology (hereafter "Ecology") to help inform development of the fine sediment and dissolved oxygen criteria. Here I offer comments focusing on three topics; 1) how and whether input of the Science Panel is reflected in the draft narrative criteria and guidance, in particular the Fine Sediment Criteria; 2) certain content of the draft implementation guidance document that ostensibly supports attainment of the narrative criteria for fine sediment, and 3) the scope of science considered during Science Panel review process.

I have some reservations about the rationale employed by Ecology to support the proposed dissolved oxygen standard, but in the context of implementation in the field, I believe those concerns will have relatively minor consequence. Overall, in my opinion the Science panel process for dissolved oxygen was more rigorously and completely conducted that that for fine sediment, hence the outcome for dissolved oxygen is more defensible. Accordingly, I focus my comments herein on the fine sediment criteria.

2. Maintaining or Restoring Beneficial Use of Salmonid Spawning

Ecology defines the beneficial use as providing habitat conditions sufficient to fully support the recovery of threatened, endangered, and declining salmonid populations. Conversely, to provide for clarity and precision in developing protective criteria, a clear and concise definition of impairment is also needed. I suggest that appropriate language would be as follows: *Impairment is any human-caused change in habitat conditions that reduces the capability of threatened endangered, and declining populations to recover to stable, self-sustaining and status sufficiently productive to support commercial and sport fisheries.* The lack of a clear definition of what condition, action, effect, our outcome is to be governed by the standard and guidance lead to troublesome early confusion in the Science Panel proceedings. I believe my wording accurately captures the consensus that developed among the participating scientists as the discussions progressed, although I cannot speak with certainty about all non-Ecology participants. And I would add that it was not at all clear from their verbal input at the Science panel meetings that Ecology-employed participants would agree with my wording.

I would further offer that in my participation in the Science Panel process, I assumed that these criteria for protection and impairment applied broadly to water quality-related actions by Ecology and the state of Washington, including: point source permitting; designation of impaired water bodies; establishing effective targets and implementation plans for TMDLs; and evaluation of effectiveness or “bestness” of so-called best management practices for non-point source pollution control.

With regard to the biological underpinning that determines this specific beneficial use, it is difficult to conceive how density-independent mortality of fish at the egg-to-fry stage, where fine sediment conditions conditions most acutely affect survival, does not impair recovery and productivity of salmonid populations whose status is known to be declining or greatly reduced in abundance. By contrast, density-dependent mortality processes that prevail at other life stages can often be "absorbed" and biologically self- compensated at the population level in several ways (e.g., reduced density of juveniles may increase individual growth and thus per capita survival rates). In support of my point, pleas see Karieva et al. (2000) and Honea et al. (2009), who modeled life-stage specific survival of spring-run Chinook salmon to evaluate the magnitude of net effect of habitat change on whole-life-cycle survival and population trend. Both studies concluded that survival at the egg-to-fry stage generally is the most consequential stage, or is among the two most consequential stages, at which improvement in habitat conditions could increase population productivity and adult population size. Conversely, therefore, degrading spawning habitat conditions can have or has had the largest magnitude of negative life cycle impact.

Although Ecology has not facially disputed the conclusions in the preceding paragraph, at the same time Ecology’s draft guidance is premised on assumptions that plainly contradict those conclusions. In particular, Ecology provides no biological or physical rationale to support the existence of a threshold in terms of acceptable or sustainable egg-to-fry survival or mortality. Nevertheless, in its draft guidance document Ecology advances the implicit assumption that deterioration and impairment of existing streambed sediment conditions in spawning habitat when below 20% fines (<2mm diameter) would not equal impairment. I see no logical basis in available science to assume that fine sediment conditions that currently exist below any given threshold metric are not impaired by any increase in sediment. In other words, there is no reliable evidence that a "safe level" of fine sediment exists (at 20% or any other concentration, and certainly not a concentration greater than 10%), nor that a given addition of human-caused fine sediment to any system, regardless of present state, would be free of harm and not cause impairment. See the next section of my comments for more detailed discussion of this concern.

To establish a threshold of safe and acceptable fine sediment conditions in a scientifically defensible way, Ecology would need to determine the prevailing fine sediment conditions in spawning habitat within streams where previously declining or depleted salmonid populations have been shown to have recovered, or at least to have demonstrated a sustained long-term recovery trend (e.g., survival to adult return increasing over at least three fish generations, or at least *ca*. 12-15 years). To my knowledge, and judging by what I have seen in the record of writing and presentations by Ecology, no such analysis has been conducted.

3. Thresholds in the Fine Sediment Relationship to Survival?

A key question pertaining to establishment of a fine sediment standard concerns the oft-assumed existence of some threshold concentration fine sediments, below which egg-to-fry survival is not measurably impaired. In regulatory terms, this equates to the assumption that a “safe level” of fine sediments exists; fine sediment increases are presumed to have no effect on survival until this threshold is breached. For example, this assumption is embraced in Ecology’s Draft Guidance, e.g. on pp. 31-32. The threshold effect assumption is convenient because if true, it provides some rationale for establishing a fine sediment standard that confers regulatory flexibility to allow increases in fine sediment pollution in streams where spawning gravel conditions are currently excellent. That is, where fine sediment concentrations are well below a presumed ”safe” threshold, fine sediment increases could be tolerated, permitted or allocated. However, that level of detail about consequences is seldom voiced to support a threshold-based criterion. Most often, a presumed threshold is simply considered by agencies as a convenient way to dismiss the probability of adverse impacts or injury over a broad sweep of conditions, with the intent of easing or simplifying a regulatory burden.

However, in the present context, as a scientific matter the assumption of a “safe” threshold for fine sediment is wholly untenable. During Science Panel meetings, supported by submitted published material, I contended that data from most available studies do not in fact support the existence of such a threshold, instead indicating a linear or possibly somewhat inflected curvilinear reduction in survival as fine sediments increased, beginning at fine sediment percentages of 10% or less.

Experimental work in Montana on bull trout and westslope cutthroat trout survival to emergence (Weaver and Fraley 1991, and see Reiman and McIntyre 1993 for further interpretation) included enough data points at fine sediment percentages of less than 20% to show a clear linear decrease in survival between 0 and 20 percent fine sediment concentration (Fig.1). In their field experiment employing a wide range of sediment mixtures, Weaver and Fraley (1991) reported that survival to emergence of both species in a 0% fines mixture was significantly greater than survival in all other mixtures with greater fines except 10%, and survival at 10% was significantly greater than survival at mixtures above 30 percent fines. Higher variation in survival in the range of 20-30 percent fines within the study reach was likely a result of groundwater upwelling mitigating the effect of fine sediment colmation in certain sites; however, a handful of higher- survival cases should not be invoked to obscure trend of a clear decline in mean survival rate through the range of increasing fine sediment percentage (Rieman and McIntyre 1993). Note that this study used a larger diameter to classify fine sediments than does Ecology's proposed narrative criteria, but based on Jensen et al. (2009) and other sources, this should have minimal impact on the basic shape of the response curves.

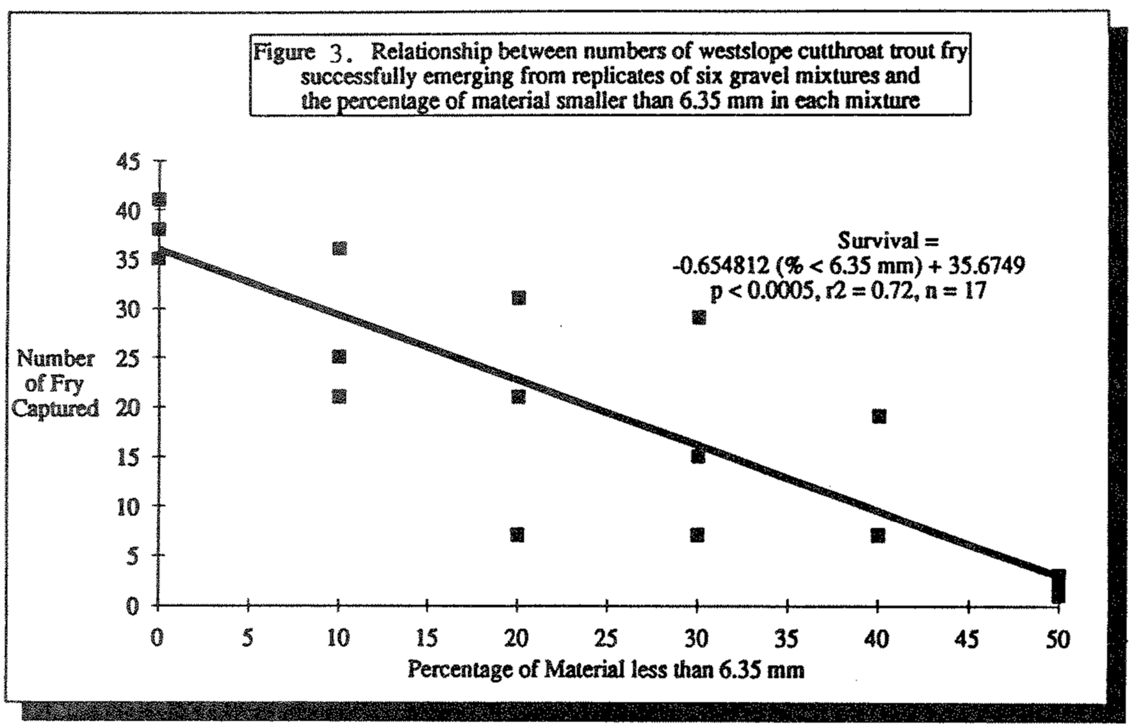

Fig. 1. Weaver and Fraley (1991) Fig. 3 (p. 20), survival to emergence of westslope cutthroat trout eyed eggs in relation to percent fines (<6.35 mm diameter). Note that in salmonids generally eyed eggs are less sensitive than green eggs to fine sediment effects (in this case green eggs were too sensitive to survive the experimental implantation procedure).

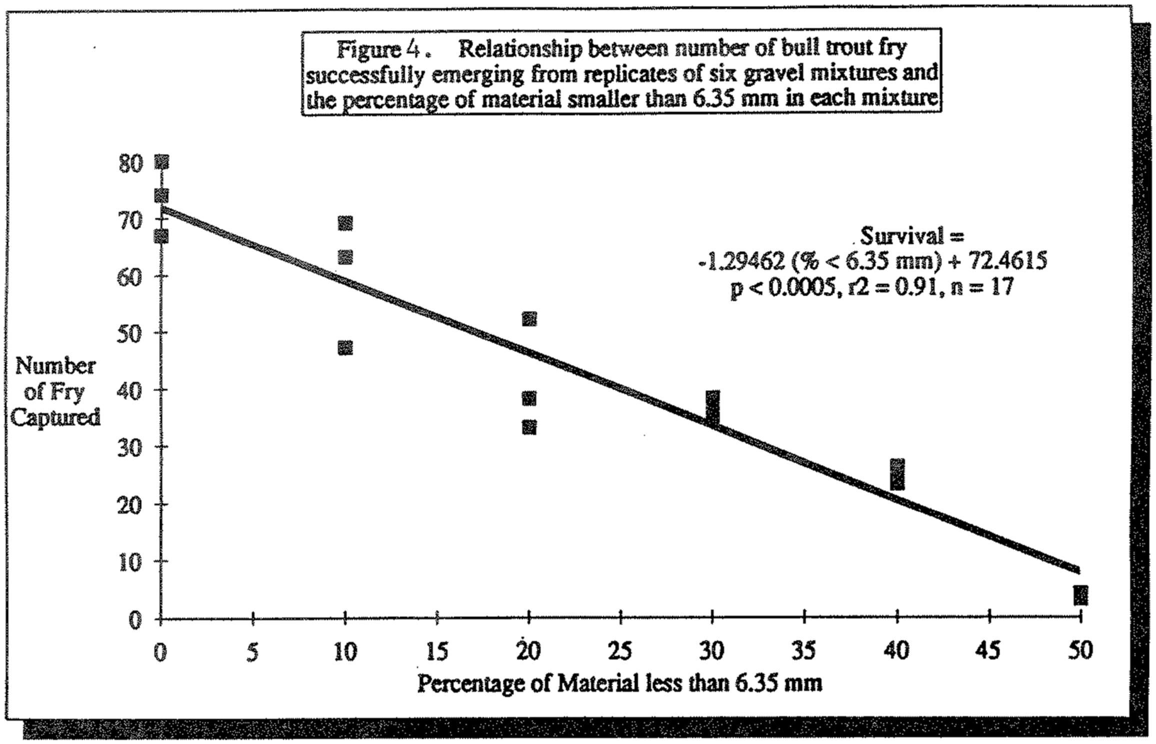

Fig. 2. Weaver and Fraley (1991) Fig. 3 (p. 25), survival to emergence of green eggs of bull trout in relation to percent fines (<6.35 mm diameter).

Newcomb and Jensen's (1991) meta-analysis and synthesis examining fine sediment impacts across all fishes also identified no generalized "safe level" of fines, rather concluded the general pattern is for cumulative increases in harm with each increment of increase in suspended or deposited fine sediment. Regardless of this science, Ecology's draft guidance document embraces the presumption of a "no effect" threshold of fine sediment for salmonids of 20% fines (<2mm diameter), without citation, and with no response to the input I provided and the sources supporting it.

Perhaps the state-of-art publication on the nature of the relationship between survival of Pacific salmon eggs and fry and fine sediments in stream gravels is the meta-analysis by Jensen et al. (2009). This study, which is of obvious central importance to inform fine sediment criteria for salmon and steelhead, was available to Ecology and was discussed during the Science Panel process, so it is puzzling that Ecology's draft guidance should be in conflict with it. Jensen et al. (2009) compiled data from available sources with quantitative data on egg-to-fry survival of Pacific salmon and steelhead in relation to fine sediment concentrations, and among other analyses, fitted general percentage survival curves, as well as estimating per capita survival probability, to the massed data set. I include as Fig. 3 here Figure 1 from Jensen et al. as a straightforward summary of the results plotted from multiple studies, for chinook salmon, coho salmon, steelhead, and chum salmon. The first point to note is that green eggs are far more sensitive to fine sediments at relatively low concentrations than more mature eyed eggs. Accordingly, sediment standards must be established to protect the most sensitive and vulnerable stage, that is, less mature "green" eggs.

Of the four panels in Jensen et al. Fig. 1, only panel d depicting the survival relationship for eyed eggs shows a fitted curve that implies a threshold below which fine sediment increases have no measurable effect on survival. In the other three panels, including panel c plotting the relationship for green eggs, the curves fitted to the massed data show virtually no evidence of a low-sediment-concentration survival threshold. As I argued in Science Panel meetings, the best-fit curves do not support the notion that a "safe level" of fine sediments exists; instead they suggest decreasing survival with increasing fine sediment percentage across essentially the entire range of the data. In fact, the only clear threshold evident is that *above a value of roughly 30 percent fine sediments, coho and chinook survival declines to effectively zero.*

REVIEW OF EGG-TO-FRY SURVIVAL OF PACIFIC SALMON 353

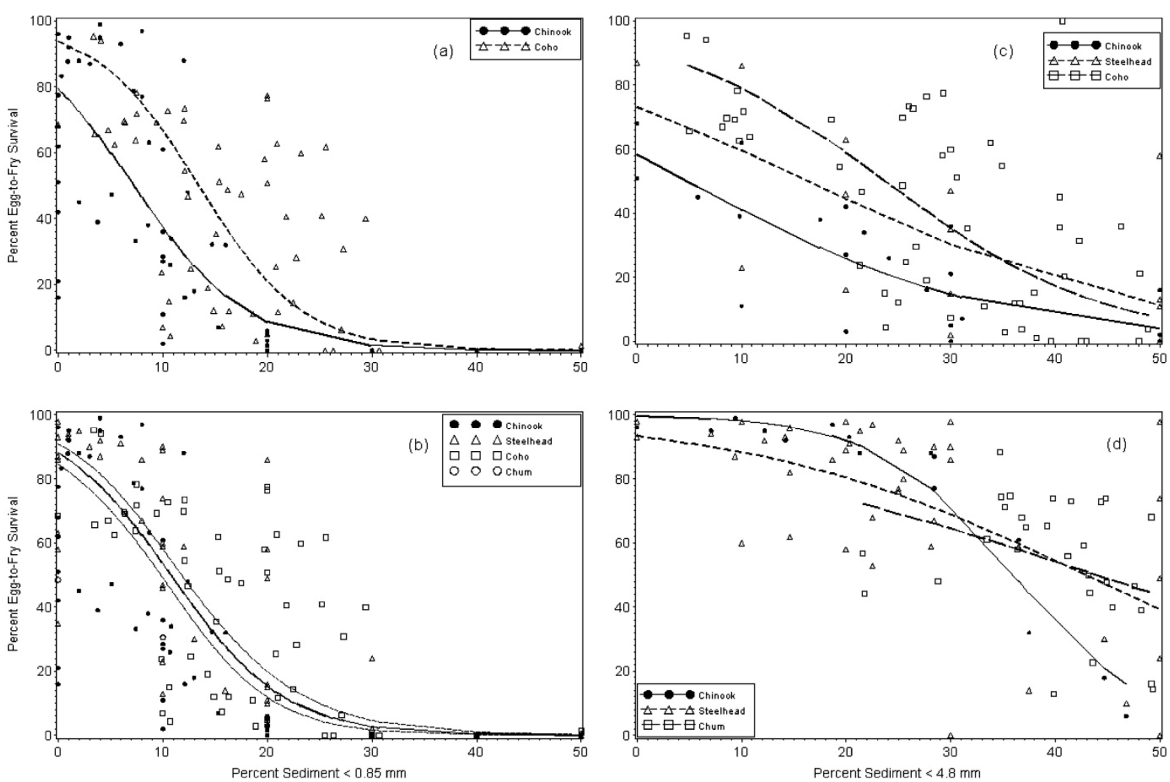

Figure 1 Relationship between egg-to-fry survival and percent sediment, showing data from the literature used in analysis. (a) Data and modeled egg-to-fry survival of Chinook and coho salmon vs. percent sediment < 0.85 mm.. (b) Egg-to-fry survival for Chinook, coho, and chum salmon vs. percent sediment < 0.85 mm. Line is the modeled mean survival based on data from all species and includes the 95% confidence interval. (c) Data and modeled green egg-to-fry survival for Chinook salmon, steelhead, and coho salmon vs. percent fines < 4.8 mm. (d) Data and modeled eyed egg-to-fry survival for Chinook salmon, steelhead, and chum salmon vs. percent fines < 4.8 mm.

Fig. 3. Fig. 1 Excerpted from Jensen et al. (2009).

Of all studies considered in Jensen et al.'s meta-analysis, only one, Tappel and Bjornn (1983), suggests a threshold of no measured impact below about 15-20 percent fines (see Jensen et al., Fig. 2). It appears all others do not suggest such a threshold is present. It is curious that Tappel and Bjornn (1983) remains the most commonly cited paper on survival of chinook eggs and fry in relation to fine sediments, considering it is an extreme high outlier (across all levels of fine sediment) among comparable studies.

What does this all mean for a fine sediment standard? First, in the absence of locally or regionally specific data and a rigorous finding to the contrary, *no protective standard should assume a "safe threshold" of fine sediment exists*. Second, and consequently*, a narrative or quantitative standard should protect against any increase in fine sediment over existing conditions.* Third where and when existing fine sediments appear to be in excess of natural background (e.g., relative to fine sediment conditions measured at least-impacted reference sites in minimally altered watersheds), *a protective standard must mandate a trend of decreased fine sediment concentrations over time in sediment-impaired waters.* There is nothing unusual or impractical about establishing trend-based standards for fine sediment concentrations, especially in impaired waters; for a review and numerous examples, see the state of Idaho's *Guide for Selection of Sediment Targets for Use in Idaho's TMDLs* (Rowe et al. 2003).

Ecology's draft guidance offers no such clarity or direction to inform implementation to inform and enforce the proposed narrative criterion that "Water bodies shall not contain fine sediment (<2 mm) from anthropogenic sources at levels that cause adverse effects on aquatic life, their reproduction, or habitat…" In fact the so-called guidance defers not only the specific methods of implementation, it seems to defer on a vast portion of the general and specific scientific content that the Science Panel provided input on over multiple meetings. More specifically, the inclusion of a threshold value for percent fines in the "weight of evidence" example described in the draft guidance would essentially give all streams in Washington with a fine sediment concentration (fines <2mm diameter) a "free pass." This is so regardless of the fact that a stream with natural low mean concentration of fine sediment of 10 percent, for example, has or is expected to have the concentration of fines doubled to 19 or 20 percent. An examination of panel c in Figure 1 of Jensen et al. will clearly show that an increase from 10 percent fines to 20 percent fines is expected decrease the mean egg-to-fry-survival rate from 50% to roughly 17%. So for this simple example, a 66 percent loss of egg to fry survival would be permitted by Ecology under its suggested guidance. In my opinion, that does not remotely qualify as a protective standard. In fact it's an effective recipe to allocate future man-made sediment inputs and habitat degradation to the streams that are presently those least impacted and most productive. This should help illustrate why it seems clear to me that Ecology has not adequately or accurately accounted for the available most relevant science in preparing the guidance document.

4. Reference Site Applications

Employing reference sites to establish an estimated or assumed natural condition as a baseline is a valid approach to measuring and assuring stream resource protection for many physical and biological factors, including fine sediment. This approach is implemented in other states, including Idaho and California, to tailor quantitative criteria regionally and locally to ensure that narrative criteria are appropriate to potential natural conditions (Rowe et al. 2003). On a positive note, the draft guidance provided does acknowledge limitations of Ecology's reference site data for this purpose, and seems to make clear that the limitations need to be explicitly accounted for implanting this approach. That said, no road map or direction is provided to suggest what the limitations of the data might be, and how they might be accommodated and accounted for in an effective analysis. By contrast, in Idaho's guidance (Rowe et al. 2003) includes or refers to numerous examples of *a priori* analysis to systematically stratify streams by ecoregion and empirically validate potential benchmark fine sediment conditions by stream geographic grouping.

It has been extremely disappointing to me that during the process of development of the narrative standard and proposed draft guidance, Ecology never produced a shred of data from reference sites, let alone a simple example of how such a comparative analysis might be conducted, to offer to the science panel for review. I was extremely frustrated by this lack of an example to validate the concept and provide specifics of a methodology, because in theory it could be a key approach and a cornerstone of a protective standard. However, through other research experience I am familiar with some concerning limitations with Washington's reference site data. These limitations mean that exactly how these data are selected for relevance, screened for quality assurance, then qualified, summarized, and analyzed to establish a benchmark, are all critical to assure accurate assessment of potential conditions, hence effective resource protection, will result. Whether by intent, or through inability to muster the person-hours to follow through, Ecology kept all of these critical questions of reference site data limitations, appropriate analytic design, and other aspects of quality assurance off the table and outside the scope of Science Panel review.

5. <u>Problems with Quasi-Proposed Weight of Evidence Approach</u>

The "weight of evidence" approach rather loosely proposed by Ecology on p. 21-32 of the draft guidance document suffers from several conceptual and operational problems that in my opinion would very likely result in bad decisions that would fail to be protective, and would allow or permit impairment of salmonid spawning habitat. It almost seems as if the procedure was intended to ease the path toward putative support of decisions that would result in increased fine sediments and impairment of spawning and incubation habitat, especially in higher-quality areas (see discussion above). The problems all partially overlap and interrelate, but they can be enumerated as follows: 1) an unqualified assumption of parity among different categories and sources of information; 2) the lack of any screening process to assess what are sure to be fundamental relevance, veracity, reliability and uncertainty of data from the different categories; 3) the lack of a weighting process to give greater credence to more reliable data sources and types; and 4) built-in incentives to cherry pick what data are included in the assessment, and to include poor quality data to deliberately offset the implications of higher-quality data. That is, data with low sensitivity, reliability and relevance could be introduced to “stack the deck” and cancel out the clear implications of date with high sensitivity, reliability and relevance.

The most likely outcome from applying this scheme as described by Ecology is be doubly concerning, from the standpoint of protecting salmonid spawning and incubation habitat. First, prediction of adverse effects of fine sediment increases can easily be watered down with regard to magnitude of impact and the certainty of the determination. Second, and equally important, the prediction of presumed benefits from actions intended to reduce fine sediments could be greatly inflated and exaggerated. Either of these outcomes would jeopardize the ability of Ecology to implement the narrative standard in a way that ensures protection and (where necessary) restoration of spawning habitat, fish populations, and fisheries. It is easy to anticipate that those outcomes are pretty much the same in process and outcome to the prevailing status quo, which as ESA listings of salmonids abundantly demonstrate, are systematically non-protective.

The literature on environmental assessment offers a number of general logical and practical criteria that should be applied to accurately inform a weight of evidence approach to decision-making (e.g., EFSC Scientific Committee 2017, USEPA 2016, Hull and Swanson 2006). That literature also makes clear the many ways a weight of evidence approach can fail, whether through ignorance or deliberate manipulation, if it is naively or artfully applied. Ecology offers no hint that these lessons and methods to guard against misapplication have been considered or are in place here to ensure the proposed weight of evidence approach is sound.

Besides the above-mentioned lack of procedures and criteria for assessing the relative relevance, veracity, reliability and magnitude of impact of information, Ecology’s example is tainted by the imposition of arbitrary, undefended and likely indefensible assumptions about cause and effect and biological responses to sediment conditions. The most obvious example is Ecology’s invocation in its example of a <20% fine sediment level as a “pass” criterion. As described above, this criterion is not defensible in the face of available scientific research. I am certain had provision been made for the Science Panel to review this proposal before its publication, this aspect of the proposed approach, among others, would have been roundly criticized. Nevertheless, the example serves as a highly instructive illustration of how a carelessly defined and non-peer-reviewed procedure for a weight of evidence approach can too easily produce outcomes that fail to protect the target beneficial use.

6. <u>Constraints on Science Panel Review</u>

Ecology repeatedly insisted during Science Panel meetings that Ecology was specifically not interested in entertaining independent peer input on specific means of implementing a standard or narrative criterion. Several times various Science Panel members pointed out the problem that this limitation severely constrained the ability of the panel to evaluate and offer comment on the defensibility, feasibility, and potential effectiveness of Ecology’s proposed narrative standard for fine sediment. Both the means of measurement of fine sediment and the relationship between fine sediment conditions and biological uses, including fish survival, are clearly matters of scientific endeavor, and the Science Panel members demonstrated extensive and deep expertise in these matters. Preventing the Panel from assessing and providing input on specific implementation guidance essentially equated to disallowing Science Panel members from being able to form opinions on the adequacy of a proposed standard, especially given how vague and general the proposed narrative standard is.

The proposed very general narrative criterion could in theory be protective if adequately implemented—but it could also be wholly non-protective if not adequately and rigorously implemented. The draft guidance piece belatedly document provided by Ecology does little to inspire a presumption of adequate and rigorous implementation, as outlined in my comments above. In sum, I was personally very disappointed in Ecology's management of the science panel process and in particular the deliberate limitations established to prevent the panel from reviewing implementation guidance.

In the its present form—that is, in the absence of rigorous, feasible guidance refined and supported by peer review—the proposed narrative criterion for fine sediment is little more than a tautological restatement of the agency's plain legal imperative. It's as if the Clean Water Act asks, "What will the state of Washington do to protect spawning habitat to support fisheries beneficial uses and meet ESA obligations for listed fish species?" and after one or two years of deliberation (following at least four decades of foot-dragging), the state's reply is "Yes the state of Washington will do something to protect spawning habitat." If this were how one of my students answered an exam question, I would alas be obligated to score it a zero.

Thank you for considering my comments, and for the opportunity to participate in Ecology's advisory science panel.

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