ENCLOSURE 3

Responses to Supplemental Comments

Submitted by Pacific Environmental Advocacy Center to U.S. EPA Region 10 Concerning Oregon's New and Revised Aquatic Life Criteria

January 29, 2013

U.S. ENVIRONMENTAL PROTECTION AGENCY – REGION 10

The State of Oregon held public hearings in July 2003 regarding its proposed water quality standards. The State responded to the comments delivered at the public hearing as well as those mailed, faxed, and electronically delivered during the public comment period. On July 8, 2004, the State submitted its new and revised water quality standards,[1] including some modifications based on public comments, to U.S. EPA. On October 6, 2005, U.S. EPA Region 10 received a letter dated September 30, 2005 from the Pacific Environmental Advocacy Center on behalf of the Northwest Environmental Advocates which containing supplemental comments regarding the State's new and revised water quality standards. The supplemental comments were in the following two sections of the letter.

SECTION IV. OREGON'S PROPOSED WATER QUALITY STANDARDS FOR TOXIC POLLUTANTS FAIL TO MEET THE REQUIREMENTS OF THE CLEAN WATER ACT

SECTION V. SPECIFIC POLLUTANT CONCERNS

This memorandum responds to the supplemental comments in Sections IV and V. This memorandum gives several General Responses and then reproduces the comments given in Sections IV and V of the supplemental comments and gives a response to each comment.

GENERAL RESPONSES

1. The commenter cites many scientific documents throughout the letter to support issues raised about the protectiveness of Oregon's aquatic life criteria. Some of the documents cited are based on toxicity tests that do not meet EPA's threshold for consideration in developing water quality criteria. In order to provide the necessary degree of reliability, EPA derives aquatic life criteria using a standard methodology and only uses toxicity test results that meet certain criteria based on a review for relevance and quality (see Appendix 1 for a description of the review process).

   EPA uses the Ecotoxicological database (ECOTOX) that is maintained by EPA's Office of Research and Development (ORD). ECOTOX is a comprehensive database that contains toxicity test results for aquatic life, terrestrial plants, and wildlife obtained predominately from peer-reviewed literature. Test results that do not satisfy ECOTOX's acceptability requirements are excluded from the database. The review of a test result for inclusion in ECOTOX concerns whether sufficient information is available concerning the test result. For example, whether test concentrations are reported, if the tests is on a whole, live organism, if there is an explicitly identified exposure duration, etc. When EPA searches for all available test results for the derivation of an aquatic life criterion, EPA searches both ECOTOX and the broader ECOTOX holdings that are not available on the internet (those studies identified, but not yet vetted through the process, see appendix B of the technical support document), as well as several bibliographic databases of available scientific information.

[1] This action addresses Oregon's water quality standards submission of July 8, 2004. However, Oregon subsequently revised that submission. In April, 2007 and July, 2011, Oregon corrected a number of errors in the 2004 submission, such as incorrect descriptions of the criteria and erroneous cross-references to tables that had been deleted or renamed. In addition, Oregon's 2007 and 2011 revisions deleted certain criteria for arsenic and chromium; even though the deletions appear to be inadvertent, they reflect the current version of Oregon's standards upon which EPA must act. Accordingly, throughout this response-to-comment document, references to the "July 8, 2004 submission" (or textual variants thereof) should be understood to refer to the July 8, 2004 submission, as submitted by the State of Oregon on July 8, 2004, as amended by Oregon submissions in April 2007 and July 2011.

In developing water quality criteria, EPA uses only those toxicity tests that both meet the acceptability review for inclusion ECOTOX, and are also acceptable in terms of relevance and quality. Test results that are in ECOTOX might not be acceptable for use in the derivation of an aquatic life criterion for such reasons as (i) temperature varied too much during the toxicity test, (ii) the concentration of dissolved oxygen was too low during the toxicity test, (iii) the test organisms were obtained from an unacceptable source, (iv) the dilution water was unacceptable, (v) the toxicity test was too short or too long, and (vi) the concentration of test material varied too much during the toxicity test. Tests obtained from sources other than ECOTOX are also subjected to the tests acceptability and relevance review. Some test results cited by the commenter were not included in the derivation of Oregon's aquatic life criteria because they did not pass basic quality assurance, as defined in Appendix 1.

2. EPA notes that many of the sources cited by the commenter do not directly discuss Oregon's aquatic life criteria or their potential impacts on species within Oregon's waters. The sources therefore do not directly address the validity of the commenter's concerns that Oregon's aquatic life criteria might be insufficient to protect Oregon's designated uses. The commenter typically does not supply sufficient contextual information to make appropriate inferences about how to apply the cited sources to the review of Oregon's aquatic life criteria. More specific responses are supplied later in this document.

3. The commenter repeatedly refers to comments made by the Services in the California Toxics Rule (CTR) Biological Opinion to support claims concerning Oregon's criteria. However, EPA submitted a Biological Evaluation (BE) to the Services concerning approval of Oregon's aquatic life criteria. With regard to EPA's review of Oregon's aquatic life criteria, EPA consulted with the Services regarding the Oregon BE, not the CTR BE, which was specific to species and their critical habitat in California.

4. The commenter repeatedly refers to ESA listed threatened and endangered aquatic species in the comments concerning whether EPA should approve Oregon's aquatic life criteria.

   As required by the ESA, EPA has submitted a Biological Evaluation (BE) to the Services. The BE contains EPA's analysis of possible beneficial, adverse, and insignificant effects of Oregon's aquatic life criteria on ESA listed threatened and endangered aquatic species in Oregon. U.S. Fish and Wildlife finalized its Biological Opinion on July 30, 2012 (Final Biological Opinion on U.S. Environmental Protection Agency Proposed Approval of Oregon Water Quality Criteria for Toxics). The National Marine Fisheries Service finalized its Biological Opinion on August 14, 2012 (Jeopardy and Adverse Modification of Critical Habitat Biological Opinion for the Environmental Protection Agency's Proposed Approval of Certain Oregon Administrative Rules Related to Revised Water Quality Criteria for Toxic Pollutants).

5. The commenter repeatedly refers to protection of wildlife, but the current action concerns aquatic life criteria, not wildlife criteria. Wildlife criteria are derived using a different process in order to account for toxicity by the different routes of exposure.

   Aquatic life criteria are derived to protect aquatic life only; different criteria protect other designated uses, such as wildlife. See 63 FR 36742, 36762 (1998) ("There are three principal categories of water quality criteria: criteria to protect human health, criteria to protect aquatic life, and criteria to protect wildlife.") Therefore, comments expressing concern that Oregon has not actually adopted particular wildlife criteria are outside the scope of this action. EPA's CWA

303(c)(3) review is limited to a review of the new and revised aquatic life criteria that Oregon actually adopted and submitted to the Agency. It is not a venue for EPA to evaluate whether Oregon should have adopted and submitted some other criteria to protect a different designated use, and EPA therefore does not construe the absence of particular numeric wildlife criteria for a pollutant as a defect in the submitted aquatic life criteria for the same pollutant.

SECTION IV. OREGON'S PROPOSED WATER QUALITY STANDARDS FOR TOXIC POLLUTANTS FAIL TO MEET THE REQUIREMENTS OF THE CLEAN WATER ACT

COMMENT A: The Criteria Fail to Account for Additive and Synergistic Effects Caused by Multiple Pollutants

Both Oregon's proposed criteria and EPA's recommended numeric criteria for toxic pollutants suffer from the same, overarching problem: they are based on the fiction that water bodies will contain only a single pollutant and that designated uses will therefore be exposed to only a single pollutant at any point in time. Criteria for toxic pollutants are typically established by placing test organisms in a tank of static water to which a single pollutant is added. Acute and chronic toxicity levels are then established based on the percentage of the test organisms that die at set pollutant concentrations. The tests do not consider whether these toxicity levels may be affected by varying temperatures, pH levels, or the presence of other pollutants. This omission is significant, because several studies demonstrate that the presence of multiple pollutants in a waterway results in significant harm to aquatic species. EPA must consider these studies when it reviews Oregon's submitted criteria and, based on this review, disapprove the standards because they fail to include criteria that protect beneficial uses.

1. The Oregon Criteria Do Not Consider the Interactions Between Conventional and Toxic Pollutants.

   Oregon's proposed criteria do not protect designated uses because the criteria do not protect against the hazardous interactions among toxic and conventional pollutants. Oregon's aquatic life criteria are based on the amount of a single pollutant that a species can tolerate in an ideal laboratory setting. The real environment, of course, contains multiple pollutants, both conventional and toxic, that may decrease a species' tolerance for a particular pollutant. For example, low dissolved oxygen (DO) in a water body increases the acute toxicity of many metals and ammonia. In addition, a recent study demonstrates that water temperature significantly affects an organism's silver uptake. Scientists measured silver accumulation by rainbow trout in warm water (16 degrees C) and cold water (4 degrees C). The trout in the warm water "accumulated [silver] more quickly in all sampled compartments compared to 'cold' fish." The rate of silver uptake and accumulation in the liver was more than four times faster in the trout exposed to warm water. The study's authors concluded that greater silver accumulation in warmer water is the result of increased metabolic rates at higher temperatures. Based on this study's conclusion, it is likely that exposure to warmer water will result in increased uptake and concentration of other pollutants as aquatic species' metabolic rates increase. The Oregon criteria, however, do not consider these effects.

   Nor do Oregon's proposed criteria consider the way in which species' exposure to toxic pollutants can reduce those species' ability to adapt to lower water quality. Studies show that toxic pollutants may increase an organism's sensitivity to conventional pollutants, such as temperature and low DO. Selenium, for example, may damage the gills of fish and decrease the efficiency of oxygen uptake. In waterways impaired due to low dissolved oxygen, selenium exposure can therefore exacerbate the problems associated with oxygen deprivation.

The harmful interaction among toxic pollutants, temperature, pH, and dissolved oxygen is particularly dangerous in Oregon, where several thousand miles of rivers are 303(d)listed as water quality limited for temperature, over one thousand miles of rivers are listed for low dissolved oxygen, and 47 segments are listed for pH violations. Given the prevalence of high temperatures in Oregon's waters and the absence of any indication that Oregon's waters will meet temperature criteria any time in the upcoming decades, EPA must assume, in reviewing Oregon's proposed criteria for toxic pollutants, that Oregon's waters exceed temperature criteria. This has two-fold implications for toxic criteria. First, EPA must consider the interaction between temperature and other pollutants in its review of these criteria. Second, EPA must consider that many species are currently at risk due to elevated temperatures in most of Oregon's waters. Oregon's criteria do not account for these factors. They are therefore insufficient to protect designated uses in Oregon.

Indeed, the Services have previously recognized that EPA's method of developing criteria through purified univariate laboratory analysis is simply not realistic and therefore not protective of designated uses. For example, the Services concluded that EPA's recommended criteria for PCP, which Oregon has proposed to adopt, do not consider the "interactive effects of pH, dissolved oxygen or temperature on toxicity of PCP to fish. These factors exacerbate the deleterious effect of PCP toxicity on salmonids at the proposed concentrations." EPA must now consider the synergistic effects of conventional and toxic pollutants to ensure that the proposed toxic criteria are protective.

As it currently stands, Oregon's proposed criteria, which roundly ignore the effects of common conventional pollutants on toxicity, cannot be found to protect designated uses. While scientists are continuing to explore the complex interactions between conventional and toxic pollutants, EPA must, at a bare minimum, apply current scientific knowledge to protect designated uses from the adverse effects of known pollutant interactions (e.g., DO and metals, temperature and metals). EPA should also apply a precautionary approach to set more protective standards for those pollutant interactions that likely exist but have not yet been studied. EPA must therefore disapprove Oregon's proposed criteria because Oregon did not consider the effects of conventional pollutants on toxicity.

2. The Oregon Criteria Do Not Consider the Additive and Synergistic Effects of Species' Exposure to Multiple Toxic Pollutants in a Waterway.

Oregon's proposed numeric criteria do not protect designated uses because the criteria fail to consider the additive and synergistic effects of pollutants that radically increase the toxicity of a pollutant. It is rare for a pollutant to exist in the environment in isolation. Rather, waterways typically contain a wide array of multiple pollutants at various locations. For example, in Oregon, the United States Geological Survey (USGS) found 48 pesticides at 40 sample sites in the Willamette Basin. The median number of pesticides detected at each site was 8. USGS detected 29 different pesticides at a single sample site on Johnson Creek near Mt. Angel in the Willamette Basin. Non-pesticide contaminants, including heavy metals and organochloride compounds, are also abundant, especially near urban areas. Oregon's waterways contain complex mixtures of multiple toxic pollutants, but Oregon's proposed water quality standards are based on the myth that each pollutant can be isolated from the others. As a result, Oregon's proposed criteria fail to protect designated uses.

The existence of complex additive, antagonistic, and synergistic relationships among pollutants is well known. In one study, researchers measured the toxicity of several metals (As, Cd, Cr, Cu, Hg, Pb, Ni, Zn) on daphnia and trout. At doses below or near Oregon's criteria for individual metals, mixtures of the metals produced additive chronic toxicity for individual survival of trout and daphnia. In addition, the mixture produced additive effects on the population growth of daphnia. These results demonstrate that Oregon's criteria, which are designed to protect aquatic life from a pollutant in isolation, do not protect against the real-world problem of multiple pollutants with additive toxic effects.

Another study exposed daphnia, fathead minnows, and rainbow trout to a combination of arsenic, cadmium, copper, mercury, and lead at pollutant levels established in EPA's proposed 1984 water quality criteria. At the 1984 acute criteria levels, the combination of five common metals killed ninety-five percent of the rainbow trout and one hundred percent of the daphnias. In addition to this massive mortality, there were important sublethal effects. After just seventy days, fathead minnows showed a thirty percent weight reduction compared to controls. After seven days, the combination of pollutants caused an eighty percent reduction of young production in daphnia. The dramatic mortality and sublethal effects highlight the danger of metal combinations that are common in the aquatic environment. Because the tests were conducted at pollutant levels similar to the Oregon proposed criteria, the high rate of mortality and sublethal effects demonstrate conclusively that the Oregon criteria do not protect aquatic life.

Yet another study documented the interaction of heavy metals (Cu, Cd, and Pb) on plant growth. The researchers exposed *Cucumis sativus* to single metals, as well as binary and ternary metal mixtures in the soil. The results demonstrate the unpredictability of multiple contaminants on an organism. The mixtures produced antagonistic, additive, and synergistic responses, depending on the combination. In addition, the researchers observed inhibited or enhanced bioaccumulations of individual metals in the mixtures, varying due to metal combinations. The authors stated that the combined effects of mixtures must be taken into account for ecological risk assessment. In developing its proposed water quality criteria, Oregon has not considered the effects of multiple heavy metals on designated uses. Oregon's proposed criteria are therefore not protective of designated uses.

Moreover, complex interactions between pollutants are not limited to metals. One study reported dramatic synergistic effects among PCBs and dioxins. Scientists conducting the study fed rats a congener of PCB (PCB 153 or 156 and/or TCDD 2,3,7,8 (a dioxin)). Rats that received only one of the pollutants experienced slight increases in hepatic porphyrin accumulation (increased porphyrin accumulation indicates disease), reaching maximum levels of hepatic porphryin that were double the control values. When the PCBs and TCDD were administered together, there was a strong synergistic effect, producing porphyrin accumulation at eight hundred times control levels. This study is but one example of the way in which the combination of only two pollutants can have overwhelmingly detrimental impacts on designated uses. In Oregon's waterways, in which dozens of pollutants may regularly be found at any single location, it likely that the synergistic effects of multiple pollutants are even more striking and harmful. Despite these acknowledged synergistic impacts, Oregon's proposed criteria for toxic pollutants were developed based on the fiction that such pollutant interactions do not exist. Moreover, Oregon has no method of interpreting and applying its narrative criterion in order to fill this gap. Oregon's criteria are therefore patently inadequate and must be disapproved.

The clear weight of scientific evidence shows that pollutants occur together and that additive or synergistic toxic responses are common. Oregon's criteria do not consider additive or synergistic effects and are therefore cannot and do not protect designated uses.

EPA's Response to Comment A:

EPA disagrees with the comment that Oregon's new and revised aquatic life criteria fail to protect Oregon's Fish & Aquatic Life designated use, due to a failure to account for additive and synergistic effects caused by multiple pollutants. EPA's rationale is explained in its responses to the two specific issues raised by the commenter.

1. *The Oregon Criteria Do Not Consider the Interactions Between Conventional and Toxic Pollutants*.

   A number of Oregon's new and revised aquatic life criteria (e.g., ammonia, cadmium, copper, lead, nickel, silver, etc) do account for water quality characteristics such as temperature, pH, and/or hardness. In the case of these pollutants, the relationships between these water quality characteristics and the toxicities of the pollutants have been adequately demonstrated. But EPA does not assume that such interactions take place, in the absence of studies to document them. When an effect on toxicity has been adequately demonstrated, EPA takes it into account when deriving an aquatic life criterion. For example, when hardness (and/or water quality characteristics that co-vary with hardness) has been adequately demonstrated to affect the toxicity of a pollutant, such as in the case of the acute criterion for silver, the criterion is expressed as an equation in which hardness is an independent variable.

   The commenter cited a study concerning the uptake of silver by rainbow trout at 16 and 4 degrees C. The commenter suggested that it is likely that exposure to warmer water will result in increased uptake and concentration of silver, ammonia, and other pollutants as the metabolic rates of aquatic species increase. Rate of uptake is independent of temperature in many cases, especially where active biochemical mechanisms are in play. In addition, changes in the rate of uptake and rate of accumulation do not necessarily mean that the bioconcentration factor (BCF) is higher or that there are increased effects. It is possible that an increased rate of uptake, if it occurs, will show that the concentration in the organism at which equilibrium occurs will be reached faster during the toxicity test, without increasing the toxic effect. The commenter is making an unjustified extrapolation of the results of this uptake test. Additionally, ASTM Standard E729 recommends that acute toxicity tests with rainbow trout be performed at 12 degrees C.

   The commenter stated that selenium exposure can exacerbate the problems associated with oxygen deprivation. EPA knows of no evidence in the scientific literature to support this contention, and the comment does not offer such evidence.

2. *The Oregon Criteria Do Not Consider the Additive and Synergistic Effects of Species' Exposure to Multiple Toxic Pollutants in a Waterway.*

EPA considered such variables when designing the approach represented in the *1985 Guidelines*. Available data suggest that in real world situations, additivity is generally not a significant issue, because most of the toxic stress is attributable to a single pollutant, even in systems receiving complex mixtures of discharges from large metropolitan areas.[2]

To illustrate this, EPA collected 50 samples throughout New York Harbor, a large area extending from the Hudson River to New York Bight, which receives a large volume of wastewater and runoff from a highly diverse set of discharges, representing a wide range of municipal, industrial, and agricultural activities. Six metals (Ag, Cd, Cu, Ni, Pb, and Zn) were measured using clean techniques. For each sample, the toxic equivalent of each metal was calculated as the metal concentration divided by its criterion. Assuming perfect additivity of toxicity, the toxic equivalents in each sample were added together to obtain the total toxic equivalents. One metal consistently dominated the toxic equivalents in each sample. On average, the combined toxic equivalent of all six metals was only 10 percent greater than the toxic equivalent of the dominant single metal. Among the 50 samples, the maximum ratio of the combined toxic equivalents to the dominant single toxic equivalent was only 19 percent greater than the single dominant toxic equivalent. Consequently, even assuming perfect additivity, the combined contribution of the other metals was minor compared to the contribution of the dominant toxicant (Battelle Ocean Sciences. 1992. Evaluation of trace-metal levels in ambient water and tributaries to New York/New Jersey Harbor for wasteload allocation. U.S. Environmental Protection Agency, Office of Wetlands Oceans and Watersheds, and Region 2. Contract 68-C8-0105. January 9, 1992). No specific examples of additivity have been provided to indicate these experimental observations do not hold true regarding Oregon's waters.

EPA has reviewed two publications cited by the commenter [Enserink et al. 1991; Spehar and Fiandt. 1986]. The studies gave different results with different mixtures of metals and species; some tests showed additivity, some showed less than additivity, and some possibly showed synergism. As the commenter acknowledged, some combinations of pollutants had antagonistic effects, not additive effects. Antagonistic relationships occur when one contaminant reduces the toxicity of another contaminant. Such relationships are common among metals, as noted by Lloyd (1987).[3] Aquatic life criteria do not address simultaneous exposure to more than one pollutant because quantifying the significance of pollutant interactions (conventional or toxic) is difficult, if not impossible. Few data are available, and the data that are available do not support the development of useful principles because of the many possible combinations of pollutants. The commenter does not offer a sound scientific approach for addressing the issue of pollutant interactions.

The many possible combinations of pollutants present in a water body make assessing the aquatic life effects resulting from exposure to pollutant mixtures a very site-specific analysis that requires data regarding the presence and concentrations of chemicals present in the

[2] CTR, Response to Comments, Response to CTR-026-002b, California Department of Fish and Game, Specific to concerns over Synergistic/Additive Effects; http://www.epa.gov/waterscience/standards/ctr/responses.pdf.

[3] Lloyd, R. 1987. Special Tests in Aquatic Toxicity for Chemical Mixtures: Interactions and Modification of Response by Variation of Physicochemical Conditions. In Methods for Assessing the Effects of Mixtures of Chemicals. Edited by V. B. Vouk, G. C. Butler, A. C. Upton, D. V. Parke and S. C. Asher.

particular body of water, as well as data concerning interactions between all of the chemicals. Oregon's current aquatic life criteria address 120 priority pollutants, of which none, some, or all could occur in a given body of water. Additionally, Oregon has aquatic life criteria for such water quality characteristics as pH, dissolved oxygen, and temperature and these criteria vary from site to site depending on the particular water body characteristics. The effect that a given mixture of chemicals would have on aquatic life is likely to vary from one body of water to another.

The pertinent conditions affecting individual sites will vary significantly. Consequently, determining ambient criteria for chemical and conventional pollutant mixtures would have to be done on a site-specific basis and would require extensive data regarding each site. As stated above, EPA allows derivation of site-specific criteria to provide for site-specific consideration of factors such as temperature, level of protection, and multiple pollutants.

Respecting synergism, the commenter contends that "[t]he clear weight of scientific evidence shows that pollutants occur together and that additive or synergistic toxic responses are common." However, the particular studies cited by the commenter do not themselves constitute a clear weight of scientific evidence to establish that synergistic effects are characteristically an important factor in the toxicity of effluent. To the contrary, field studies of effluent toxicity and laboratory tests with specific chemicals support the conclusion that synergism is a rare phenomenon[4] (see 57 FR 60877-60878). (Also see response to comments regarding the 1985 Guidelines, Comment #9, 45 FR 79358, November 28, 1980.)

With respect to the commenter's suggestion that mixtures of dioxins and PCBs may have radical synergistic effects, the World Health Organization (WHO) concluded and reconfirmed that the combined effects of dioxin and dioxin-like compounds (e.g., PCBs) generally are consistent with dose additivity (not synergism) (van den Berg et al., 1998[5], 2006[6]). In addition, the National Academy of Sciences supported the use of an additivity assumption in its report on EPA's NAS review draft dioxin reassessment, concluding that "Additivity in biochemical and toxic responses by the indicated DLCs [dioxin-like compounds] has been supported by numerous controlled mixture studies in vitro and in vivo and is scientifically justifiable" (NAS, 2006, p. 80)[7]. The commenter cites four scientific studies regarding additive and synergistic effects, but two of the cited studies concern tests with rats and terrestrial plants, not aquatic organisms. The other two studies concern tests with daphnids, fathead minnows, and rainbow trout on combinations of metals.

If there is an indication of increased risk from a particular combination of pollutants at a particular site in Oregon, it might be desirable to derive a site-specific criterion for that site. However, no information regarding the specific combinations of these chemicals at specific sites in Oregon has been provided.

[4] Technical Support Document for Water Quality-based Toxics Control; March 1991; Page 24 http://www.epa.gov/npdes/pubs/owm0264.pdf

[5] van den Berg, M; Birnbaum, L; Bosveld, AT; et al. (1998) Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife. Environ Health Perspect 106(12):775−792.

[6] van den Berg, M; Birnbaum, LS; Denison, M; et al. (2006) The 2005 World Health Organization re-evaluation of human and mammalian toxic equivalency factors for dioxins and dioxin-like compounds. Toxicol Sci 93(2):223−241.

[7] NAS (National Academy of Science). (2006) Health risks from dioxin and related compounds: evaluation of the EPA reassessment. National Academies Press, Washington, DC. Available online at http://www.nap.edu/catalog.php?record_id=11688.

Comment B: Oregon's Proposed Criteria Will Be Less Protective Due to DEQ's Decision to Switch From a "Total Recoverable" To a "Total Dissolved" Method For Assessing Pollutant Concentrations.

Oregon has proposed to switch from using a "total recoverable" to a "total dissolved" method of measuring pollutant concentrations in Oregon's waters. Under this proposal, pollutant concentrations will be measured only after water samples have first been filtered out to remove particulate matter and any pollutants attached to the particulates. This type of measurement ignores the fact that designated uses are exposed to particulate matter in natural waterways and is based on an erroneous assumption that the "total dissolved" method of analysis represents a closer approximation of the amount of any given pollutant that is bioavailable for uptake by designated uses. The underlying premise of the "total dissolved" method is not supported by science and cannot therefore form the basis of Oregon's water quality standards. Oregon's proposal to switch to the "total dissolved" method is thus scientifically flawed.

Perhaps recognizing that the "total dissolved" method of measuring pollutants is inadequate, EPA has proposed mitigating factors that are designed to increase the protectiveness of the "total dissolved" method. These mitigation measures include a "conversion factor" and "translators," both of which are employed in an attempt to compare pollutant levels based on the "total recoverable" method with those established through the "total dissolved" method. As discussed in detail below, these mitigation measures fail to account for the serious scientific problems inherent in assuming that species present in a natural waterway will be exposed only to filtered water. Oregon's proposed use of the "total dissolved" method is simply not based on scientific realities and cannot be justified through conversion factors, translators, or any other mitigation measures. EPA cannot legally approve the use of the "total dissolved" method.

1. The "total dissolved" method does not adequately account for particulates.

   The Oregon proposed criteria do not protect designated uses because the "total dissolved" method adopted by Oregon does not adequately regulate toxic particulate metals. Particulate metals are single atoms or metal complexes absorbed to, or incorporated into, silt, clay, algae, detritus, or plankton found in the water column. EPA and the states are required to establish water quality criteria that regulate the concentration of these pollutants in the water column. The "total dissolved" method, which allows states to base their toxic criteria on the fiction that the water column is free of any sort of particulate matter or particulate metals, fails to protect designated uses.

   Although current EPA guidance allows states to measure the concentration of pollutants found in waterways using one of two methods, only the "total recoverable" method is based on conditions present in the natural environment. The "total recoverable" method analyzes an unfiltered sample of water, which includes pollutants in the dissolved and particulate forms. In contrast, the "total dissolved" method filters out the particulate matter so that only those pollutants that have dissolved in the water column are analyzed and considered. This latter methodology bears no resemblance to natural conditions and, as discussed below, cannot legally form the basis for Oregon's water quality criteria for toxic pollutants.

   The underlying premise by which EPA has promoted use of the "total dissolved" method has been seriously criticized by the Services. Inexplicably, EPA has claimed that the "total dissolved" method more closely approximates the bioavailable fraction of the pollutant in the water column than the “total recoverable” method. This claim appears to be premised on EPA’s unfounded belief that organisms will uptake only those pollutants that have dissolved into the water column and not those that have bound themselves to particulate matter. The Services, however, have made clear that particulate metals remain bioavailable to aquatic species. The Services stated, “particulate metals have been removed from the [regulatory] equation even though chemical, physical, and biological activity can cause these metals to become bioavailable.” In fact, the Services concluded that the CTR was not protective of aquatic life because, in part, the criteria were based on the “total dissolved” method: “While the CTR criteria proposed for metals are based on the dissolved fractions of these metals only, aquatic organisms in natural waters are exposed to additional, waterborne, particulate metal forms.” EPA’s continued use of the “total dissolved” method is troubling, at best, in light of the Services’ comments.

2. The “total dissolved” method allows for increased discharges of toxic pollutants.

Another overarching problem with the “total dissolved” method is that it allows for an increased mass of toxic pollutants to be discharged into waterways that already have high concentrations of particulate pollutants. The CTR BiOp compared discharges of total metal concentrations under the National Toxics Rule (which measured “total recoverable” metals) and the CTR (which measured “total dissolved” metals). The Services reported that the mass of metals discharged pursuant to National Pollutant Discharge Elimination Systems (NPDES) permits would increase dramatically under the CTR due to the switch to using the “total dissolved” method for metal regulation. For a waterway that received twenty percent of its pollutant load in the dissolved form, a situation not uncommon in California, the CTR “total dissolved” method increases the total zinc discharge by four hundred seventy-six percent over the National Toxics Rule. At twenty percent dissolved load, the “total dissolved” method increases arsenic discharges by four hundred forty six percent and cadmium discharges by five hundred twenty six percent. This massive increase in total discharge indicates that the “total dissolved” method does not protect Oregon’s designated uses. EPA’s - and by extension, Oregon’s - continued use of the “total dissolved” method, in light of the Services’ rejection of this method in other contexts, cannot withstand either scientific or judicial scrutiny.

3. The conversion factors used to equate the “total recoverable” method to the “total dissolved” method are not protective.

The conversion factor is a tool used by EPA in an effort to equate values established under the “total recoverable” method with values established through the “total dissolved” method. Most of studies on which EPA (and hence, Oregon) has relied in developing its water quality criteria for toxic pollutants are based on the “total recoverable” method. To derive the final criterion, the “total dissolved” criterion that is determined in the laboratory is multiplied by the conversion factor. The conversion factor lowers the final criterion, in theory, to make up for the particulate metals that are present in natural water, but are not measured in the “total dissolved” test.

To accomplish this “lowering,” a conversion factor is always less than one (1), except for arsenic, which equals one (1). The conversion factor is meant to reflect the percentage of pollutants that are dissolved in any given water body. For example, if the particulate fraction of a metal in a water body were forty percent, the dissolved fraction would be sixty percent. The conversion factor for this water body should be 0.6 (i.e. sixty percent). When applying the conversion factor to a water quality criterion established through the "total recoverable" method, the "total dissolved" criterion would be reduced by forty percent. Thus, if, based on the "total recoverable" method, EPA established a recommended criterion for lead of 10 mg/L, the "total dissolved" criterion in that water body would be 6 mg/L (10 mg/L * 0.6 conversion factor), or forty percent lower than the "total recoverable" factor.

While, on its face, the conversion factor seems to mitigate concerns created by shifting between the "total recoverable" and "total dissolved" methods, the conversion factors in Oregon's proposed water quality standards do not adequately reduce the criteria to account for the particulates in natural water. The conversion factors used in Oregon's criteria are all close to one. This assumes that the metal fraction in water bodies is nearly one hundred percent dissolved metals. This assumption is not environmentally realistic, as evidenced by the fact that California waters commonly contain an eighty percent particulate fraction. The California Fish and Game noted that particulate fractions in natural waters in California are commonly in the range of 80 percent, which should result in a conversion factor of 0.2. The Services, moreover, believe that the conversion factors are unrealistic, stating, "[t]he [conversion factor] values approach one hundred percent for several metals because they are ratios determined in laboratory toxicity test solutions, not in natural waters where relative contributions of waterborne particulate metals are much greater." Because the conversion factors proposed by Oregon do not accurately depict the waterborne concentrations of particulates in natural waters, Oregon's criteria are not protective of designated uses.

In addition, the Services noted that EPA developed the conversion factors with a limited database. For example, the conversion factor values for chromium were based on only two studies. The conversion factor for lead was based on three studies. The three studies were small, each containing only three records. As a result of the limited database, the Services concluded that "[a]lthough additional confirmatory studies were performed to develop the conversion factors, the database available appears to be limited and calls into question the defensibility of the conversion factors determined for these metals." The Services' skepticism of the conversion factors demonstrates that the Oregon proposed criteria do not protect designated uses.

4. The translators used to convert "total dissolved" metals to "total recoverable" metals are not protective of designated uses.

In addition to using a conversion factor, Oregon has proposed to adopt EPA's proposed "translators," which are numbers used to translate the now converted "total dissolved" criteria back into "total recoverable" figures for use in permits, Total Maximum Daily Loads (TMDLs) and other regulatory mechanisms. For example, to establish a water quality criterion for use in a TMDL, the dissolved criterion must be translated back to a "total recoverable" value so that the TMDL and other regulatory calculations can be performed. The translator is also important to the regulatory community because translators are necessary to calculate discharge limits in NPDES permits.

EPA's preferred translation method is to determine a site-specific translator by measuring site-specific ratios of dissolved-to-total metals and dividing the dissolved criterion by the translator. If there is a high fraction of the total metal in the receiving water, the translator allows for a corresponding increase in the total amount of pollutants discharged. Thus, not only does the "total dissolved" method neglect particulate metals, including those lodged in sediment (neglecting the physical, biological, and chemical means by which the metal becomes bioavailable), but the translators actually allow an increase in the discharge of the total metals. By no means is this protective, particularly in water bodies in which aquatic species and other designated uses are already imperiled.

The State of California and EPA previously determined that using the recommended site-specific translators would decrease dischargers' costs by almost fifty percent. "This reduction in cost in [sic] directly related to the less stringent effluent limitations that result for the use of site-specific translators." The Services noted this same large cost savings is directly related to the discharge of more pollutants: "This implies a strong economic incentive for dischargers to reduce costs by developing site-specific translators and ultimately being allowed to discharge more total metals." The Services' conclusion is supported by documents they received from EPA in which EPA performed a sensitivity analysis on the effect of the site-specific translator. The study showed that use of a translator to calculate criteria would result in greater releases of 0.4 to 124 million "toxic weighted" pounds of metals discharged in California. These data demonstrate that EPA's "total dissolved" method of establishing toxic criteria and the associated translators result in benefits to polluters, but not to aquatic life or other designated uses.

As in California, there is no doubt that the state of Oregon proposed the use of the "total dissolved" method, along with the unprotective translators, to benefit industrial and municipal polluters. Indeed, DEQ's director acknowledged as much: "[t]he Department initially proposed 'total recoverable' metal for public comment and received much comment from industries and municipalities that the environmental benefit associated with 'total recoverable' metals criteria did not justify the cost." The translators will result in increased discharges of total metals into waterways, such as the Willamette River, that already suffer from the presence of too many toxic pollutants in the sediment and the water column. EPA cannot lawfully approve criteria that weaken protections for aquatic life, wildlife, and threatened and endangered species, particularly when the only apparent justification for weakening the criteria is cost. EPA must therefore reject Oregon's attempt to use "total dissolved" metals criteria and the translators as a means to appease industry and sacrifice water quality.

5. Oregon's decision to propose a "total dissolved" method for assessing toxic pollutants was a political decision that EPA must reject as scientifically indefensible.

Both EPA and Oregon have recognized the problems inherent in the "total dissolved" method. While EPA stated that it "believed, and continues to believe, that when a state develops and adopts its standards, the state, in making its risk management decision, may want to consider sediment, food chain effects, and other fate-related issues and decide to adopt total recoverable or dissolved metals criteria," EPA has never convincingly explained why the "total dissolved method" is protective of existing and designated uses. Oregon's scientists (the TAC) recognized this and advised the state to adopt the "total recoverable" method, because the "total dissolved" method did not consider the toxicity resulting from suspended metals and because most of the data used to calculate criteria came from studies using the "total recoverable" method. As matter of science, both DEQ and EPA know that the "total recoverable" method provides the necessary protections for designated uses in Oregon.

Unfortunately, DEQ allowed politics to trump science when DEQ decided to ignore its scientific advisors and propose the "total dissolved" method. DEQ thus proposed to abandon the "total recoverable" method to appease industry's unspecified cost concerns. While it may be true that there are costs associated with providing adequate levels of protection to imperiled species, DEQ and EPA have no legal authority to weaken protections for designated uses based on cost considerations. EPA regulations provide that "[s]tates must adopt those water quality criteria that protect the designated use. Such criteria must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use." This rule does not allow a state to consider economic costs when adopting criteria. Nor does the CWA, which requires water quality standards to be "such as to protect the public health or welfare, enhance the quality of water and serve the purposes of the this chapter." EPA must reject DEQ's attempt to abandon species protections in favor of political expediency.

6. EPA must perform an antidegradation review of the proposed revisions to Oregon's water quality standards for toxic pollutants.

   By allowing Oregon to switch from a "total recoverable" to a "total dissolved" method for establishing toxic criteria, EPA is allowing Oregon to revise – and indeed, lower – its water quality criteria for toxic pollutants, without performing an antidegradation review. The CWA makes clear that "any water quality standard established under this section, or any other permitting standard may be revised only if such revision is subject to and consistent with the antidegradation policy established under this section." 33 U.S.C. § 1313(d)(4)(B) EPA's failure to require or perform an antidegradation review for the toxic criteria, and particularly for the switch from a "total recoverable" to a "total dissolved" methodology violates the clear requirements of the CWA.

EPA's Response to Comment B:

EPA disagrees with the comment that Oregon's new and revised aquatic life criteria for metals fail to protect Oregon's Fish & Aquatic Life designated use, as a result of Oregon's change from expressing its criteria for metals in terms of total recoverable metal to expressing its criteria for metals in terms of dissolved metal. EPA's rationale is explained in its responses to the six specific arguments made by the commenter.

1. *The "total dissolved" method does not adequately account for particulates.*

   EPA derives its national aquatic life criteria so that they protect water-column organisms from exposure to pollutants that are present in the water column. The primary mechanism for water column toxicity is adsorption at the gill surface which requires metals to be in the dissolved form.

   The scientific evidence indicates that particulate-bound metals do not contribute toxicity when suspended in the water column. Two expert workshops, one held in Annapolis in 1993 (58 FR 32131, June 8, 1993) and one held in Pensacola in 1996 (Bergman, H.L. and E.J. Dorward-Kind (eds.), Reassessment of Metal Criteria for Aquatic Life Protection. SETAC Press. Pensacola, FL. 1997) were sponsored to discuss this issue. Both workshops recommended that EPA express its aquatic life criteria for metals in terms of dissolved metal. EPA agrees with the recommendations of the expert workshops and with the supporting rationales. Therefore, EPA now expresses its aquatic life criteria for metals in terms of dissolved metal instead of total recoverable metal because dissolved metal more closely approximates toxic metal in the water column than does total recoverable metal.[8] Toxicity testing is performed under conditions which increase the toxic fraction of metal and as such, present data that compensates for the raised concerns as addressed by the workgroups.

EPA disagrees with the statements that the dissolved method is based on "the fiction that the water column is free of any sort of particulate matter or particulate metals" and that EPA has assumed that "species present in a natural waterway will be exposed only to filtered water." EPA has made no such assumptions. The scientific consensus (discussed later in this response) is to apply criteria to the dissolved metal fraction because that is the bioavailable fraction. Metal that is bound in particulate phases is essentially not bioavailable. But in no case is the particulate phase assumed to be absent.

Toxicity tests on metals are performed by adding simple salts to relatively clean water, of defined composition, in terms of factors such as total organic carbon content, an approach used to ensure comparability across tests and chemicals, and which in effect makes the tests more protective. Because of the likely presence of substantial concentrations of agents that bind metals (especially suspended and dissolved organic matter) in discharges and ambient waters, metals in toxicity tests would generally be expected to be more bioavailable (and hence more toxic) than metals in discharges or in ambient waters.[9]

The commenter states that the Services "have made clear that particulate metals remain bioavailable to aquatic species." This is an incorrect summation of the particulate metals issue. In fact, the Services stated that particulate metals *might* become bioavailable due to some future shift in the environment. However, neither the commenter nor the Services provided any scientific evidence to support a premise that metals would desorb to yield a higher dissolved concentration than was in equilibrium with the particles to begin with, and therefore could cause the criterion to be exceeded.

The dissolved concentration allows accurate prediction of both the concentration of the pollutant in the water column (µg pollutant/L water), and the degree to which the particulates in equilibrium with the water column is contaminated (µg of pollutant/kg particles). Even when particulates settle to bottom, the water trapped in the pore space will retain a dissolved pollutant concentration similar to that of overlying water. This is because the pollutant dissolved in pore water, like the pollutant dissolved in the overlying water, is in equilibrium with the pollutant bound to the sediment particles.

By contrast, the total concentration measurement advocated by the comment is dependent not only the degree of adsorption to particulate matter, but also on the amount of particulate matter that happens to be suspended in the water column at a particular point in time. But only the first value, the degree of contamination, is predictive of toxicity. The total concentration measurement is a less accurate measure of toxicity to aquatic life because it is also affected by the second factor - the degree to which particulate matter happens to be suspended in the water column. This second factor is irrelevant to the partition equilibrium which exists between particle-bound contaminant and dissolved contaminant, and has no effect on toxicity to aquatic life. Gobas and Morrison (2000) explain the central importance of the dissolved concentration

[8] *ibid*

[9] EPA. 1993. Memorandum: Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria.

in controlling the behavior of chemicals in the environment.[10]

Because of these issues, criteria based on total recoverable metals could be over-protective (if most of the metals are in particulate form) or under-protective (if most of the metals are in dissolved form). In order to protect aquatic life, the critical issue is the concentration of metals dissolved in the water column, because that is the form in which the metals are toxic. Thus establishing criteria based on the dissolved metals fraction is the most scientifically valid approach to protecting the aquatic life.

2. *The "total dissolved" method allows for increased discharges of toxic pollutants.*

Switching from expressing aquatic life criteria for metals in terms of the total recoverable method to expressing such criteria in terms of the dissolved method may result in allowing the discharge of more total recoverable metal, when the characteristics of the discharge and the receiving water are such that much of the metals discharged will be in non-toxic particulate form; it could also result in the discharge of *less* total recoverable metal, if most of the metals discharged are in the toxic dissolved form. In either case, the switch will not allow the concentration of bioavailable (toxic) metal in the water column to increase. Oregon's use of the dissolved method will protect the designated use because it limits the concentration of dissolved metal, which more accurately reflects the concentration of bioavailable, and hence potentially toxic, metal than the concentration of total recoverable metal.

3. *The conversion factors used to equate the "total recoverable" method to the "total dissolved" method are not protective.*

The commenter's criticism of the conversion factors is invalid. The results of most toxicity tests on metals have been expressed in terms of total recoverable metal. Conversion factors were developed to account for the possible presence of particulate metal in the laboratory toxicity tests (62 FR 42172) in order to obtain an accurate measure of the dissolved metal concentration that is protective of aquatic life. For example, the commenter says "The conversion factor is meant to reflect the percentage of pollutants that are dissolved in any given body of water." This is incorrect. The conversion factor is not meant to reflect the percentage of the metal that is dissolved in a body of water; the conversion factor is meant to reflect the percentage of the metal that is dissolved in the toxicity tests on which the criterion is based. This allows the derivation of a criterion on the basis of dissolved metal in toxicity tests rather than on the basis of total recoverable metal in toxicity tests for the purposes of standardization.

The commenter states that the conversion factors do not accurately depict the waterborne concentrations of particulates in natural waters, and states that conversion factors should take into account the ratio of total recoverable metal to dissolved metal in the receiving water. However, the purpose of a conversion factor is to take into account the ratio of total recoverable metal to dissolved metal in the *test solutions* in the toxicity tests on which the criterion is based. Conversion factors are not intended to reflect natural waters. They are intended to reflect aspects of the dilution water used in the toxicity tests on which the criteria are based. Conversion factors are used to convert results of toxicity tests expressed in terms of total recoverable metal to results of toxicity tests expressed in terms of dissolved metal. If

[10] Gobas, F.A.P.C., and H.A. Morrison. 2000. Bioconcentration and Biomagnification in the Aquatic Environment. Handbook of Property Estimation Methods for Chemicals. CRC Press.

dissolved metal had been measured in the test solutions used in the toxicity test, the result of the test could have been calculated directly in terms of dissolved metal and there would be no need to use conversion factors to convert a total recoverable test result to a dissolved test result.

EPA recognizes that many of the conversion factors published in the draft report are very close to 1.0. EPA chose to use experimentally determined conversion factors rather than using assumed conversion factors. Conversion factors are not related to protectiveness. The conversion from total recoverable to dissolved metal does not alter the protectiveness of a criterion. EPA believes that this approach is technically sound.

Results of most toxicity tests on metals have been expressed in terms of either total recoverable metal or dissolved metal, but not both. In order to calculate a conversion factor, however, it is necessary for both total recoverable metal and dissolved metal to be measured in the same solution. Therefore, in order to derive conversion factors, special studies were performed to allow careful measurement of both total recoverable metal and dissolved metal at concentrations close to criteria concentration in solutions that were similar to those that occurred in toxicity tests that were important in the derivation of the criteria. (Response to Final Biological Opinion on California Toxics Rule, USEPA, p. 9; Derivation of Conversion Factors for the Calculation of Dissolved Freshwater Aquatic Life Criteria for Metals, draft dated 3-11-95, C. E. Stephan).

4. *The translators used to convert "total dissolved" metals to "total recoverable" metals are not protective of designated uses.*

Oregon's new and revised criteria, submitted to EPA on July 8, 2004, can be found at OAR 340-041-0033 and in Tables 33A and 33B in the Water Quality Criteria Toxic Criteria Summary. Although Oregon provided conversion factors to convert its aquatic life criteria for some metals from "total recoverable" to "dissolved", it did not provide any "translators" to convert the "total dissolved' criteria back into "total recoverable" concentrations for use in permits or other regulatory mechanisms. Therefore, translators are not part of Oregon's submission of new and revised standards and are therefore not a part of this regulatory action.

The commenter states "If there is a high fraction of the total metal in the receiving water, the translator allows for a corresponding increase in the total amount of pollutants discharged..." The translator is not based on the fraction of the total metal in the receiving water; the translator is based on the percentage of the total recoverable metal in the effluent that becomes dissolved in the downstream water. Regardless of whether aquatic life criteria are expressed in terms of total recoverable metal or dissolved metal, permit limits are based on total recoverable metal. Therefore, when an aquatic life criterion is expressed in terms of dissolved metal, an effluent-specific translator is needed to take into account the fact that only a portion of the total recoverable metal in the effluent becomes dissolved in the receiving water.

In order to provide permitting authorities and other authorities methods by which to convert dissolved metals criteria to total recoverable permit limits, EPA has provided guidance in "The Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit From a Dissolved Criterion" (EPA 823-B-96-007, June 1996). The Guidance provides that a translator may take one of three forms: (1) it may be assumed to be equivalent to the criteria guidance conversion factors, (2) it may be developed directly as the ratio of dissolved metal to total recoverable metal in the receiving water; and (3) it may be developed through the use of a partition coefficient that is functionally related to the number of metal binding sites on the binding agent in the water column (e.g. concentrations of total suspended solids or TSS). (62 FR 42173). In this way, Oregon's criteria can be applied and translated to reflect the site-specific characteristics of the water body where a permit would apply.

The commenter states that any use of translators for NPDES permits and TMDLs would result in an increase in metals within the waters of Oregon, and therefore would not sufficiently protect the designated uses. The commenter cites the Services' criticisms of the CTR. EPA and the Services have already resolved those criticisms and the CTR continues to express aquatic life criteria for all metals except aluminum in terms of dissolved metal. The Services have not objected to the use of dissolved metals criteria in connection with Oregon's aquatic life criteria, which are at issue here.

5. *Oregon's decision to propose a "total dissolved" method for assessing toxic pollutants was a political decision that EPA must reject as scientifically indefensible.*

When Oregon decided to express its aquatic life criteria for metals in terms of dissolved metal, Oregon was adopting an approach that EPA recommends and has itself promulgated (in the California Toxics Rule and in the Interim National Toxics Rule), and therefore an approach that EPA concurs with, as long as it is implemented correctly in the calculation of permit limits. As stated earlier, two expert workshops, one in Annapolis in 1993 (58 FR 32131, June 8, 1993) and one in Pensacola in 1996 (Bergman, H.L. and E.J. Dorward-Kind (eds.), Reassessment of Metal Criteria for Aquatic Life Protection. SETAC Press. Pensacola, FL. 1997) were held to discuss this issue. Both workshops recommended that EPA express its aquatic life criteria for metals in terms of dissolved metal. EPA agrees with the recommendations of the expert workshops and the supporting rationales. Consequently, the Office of Water recommended use of dissolved metal to set and measure compliance with water quality standards as scientifically appropriate, because dissolved metal more closely approximates the bioavailable fraction of the metal in the water column than does total recoverable metal (EPA 1993). EPA's decision to express aquatic life criteria in terms of dissolved metal rather than total recoverable metal is based on science; it is not based on cost and it is not based on political expediency.[11],[12]

The commenter states that EPA must reject Oregon's aquatic life criteria for metals, arguing that the decision to adopt the "total dissolved" method was based on impermissible considerations. EPA notes that a state has the discretion to adopt standards based on either dissolved metal or total recoverable metal. EPA recommends that State water quality standards for aquatic life be based on dissolved metal. EPA will also approve a State decision to adopt standards based on total recoverable metal, if those standards are otherwise approvable (EPA 1993), but in this case, Oregon opted to adopt EPA recommendations. For the reasons described above, EPA believes there is a sound scientific basis to conclude that Oregon's aquatic life criteria for metals, which were calculated using the total dissolved method, are sufficient to protect Oregon's fish and aquatic life designated use.

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[11] Stephan, CE. 1995. Derivation of Conversion Factors for the Calculation of Dissolved Freshwater Aquatic Life Criteria for Metals. U.S. EPA, Office of Research and Development, Environmental Research Laboratory, Duluth, MN.

[12] Lussier, SM, WS Boothman, S Poucher, D Champlin, A Helmstetter. 1995. Derivation of Conversion Factors for Dissolved Saltwater Aquatic Life Criteria for Metals. U.S. EPA, Office of Research and Development, Environmental Research Laboratory, Narragansett, RI.

6. *EPA must perform an antidegradation review of the proposed revisions to Oregon's water quality standards for toxic pollutants.*

EPA's regulations instruct States to adopt antidegradation policies and identify antidegradation implementation methods around three categories of water quality protection, commonly called "tiers." 40 CFR 131.12. Antidegradation reviews occur, consistent with such policies, in the context of a specific authorization to discharge, such as an NPDES authorization.

However, neither the CWA nor its implementing regulations require an antidegradation review by a state prior to adopting a new or revised WQS, or by EPA prior to approving a new or revised WQS.[13]

EPA does not read the phrase, "any water quality standard established under this section" in CWA Section 303(d)(4)(B), to stand alone, as a separate trigger for antidegradation review. Rather, that phrase serves as a modifier describing the antecedent clause "any effluent limitation," such that revisions of "any effluent limitation based on . . . any water quality standard . . . may be revised" only if consistent with a State's antidegradation policy. The legislative history of the CWA confirms that the antidegradation review required under 303(d)(4)(B) must be construed in concert with the antibacksliding principles of Section 402(o)(1), and that it applies to revisions of water quality-based effluent limitations, and not to revisions of water quality standards themselves. See., e.g., 133 Cong. Rec. 850 (1987). Congress only required an antidegradation review in the context of revisions to effluent limitations in an NPDES permit proceeding, where a particular activity responsible for proposed increased discharges is known and can be properly assessed. EPA's guidance also construes Section 303(d)(4)(B) to require a State antidegradation review for revisions of effluent limitations based on water quality standards rather than for revisions to water quality standards themselves. See, e.g., Attachment to Draft Interim Guidance on Implementation of Section 402(o) Anti-backsliding Rules for Water Quality-Based Permits, at 6 & n.9 (Sept. 1989) (available at http://www.epa.gov/npdes/pubs/owm0354.pdf).

COMMENT C: The Water Effects Ratio Is Not Protective of Designated Uses.

Oregon's proposed criteria for certain metals also include a Water Effects Ratio (WER), which is a number greater than or equal to one (1). The WER "purportedly accounts for the difference in toxicity of a metal in a site water relative to the toxicity of the same metal in reconstituted laboratory water," by raising the applicable criterion (i.e., making the criterion less protective) in an effort to account for the binding effect of constituents in natural waters. The underlying premise used to justify the use of a WER is that natural waters may contain constituents, such as dissolved organic carbon (DOC), that are not present in pure laboratory water. These constituents may act to bind metals and possibly reduce the bioavailability of the metals in certain circumstances. The WER is therefore designed to account for the presence of the constituents in natural water, so as to allow for greater concentrations of pollutants to be discharged into these natural waters.

Whatever their underlying purpose may be, the use of improper WERs developed by EPA and proposed by Oregon will undermine the protectiveness of Oregon's criteria. In the CTR BiOp, the

[13] EPA's interpretation of the law been subject to judicial review, and upheld. See Native Village of Point Hope v. U.S. Environmental Protection Agency, No. 11-cv-00200, slip op. at 25 (D. Alaska Sept. 13, 2012).

Services concluded that criteria derived from WERs do not protect aquatic life. Oregon's proposed criteria, which include the same WERs that the Services criticized in the CTR BiOp, suffer from three primary flaws.

First, the calcium-to-magnesium ratio used in laboratory water overestimates the proportion of calcium in natural waters, which results in less protective standards. "The Services observed that imbalances in the Ca-to-Mg ratios between site waters and dilution waters may result in WERs which are overestimated because calcium ions are more protective of metals toxicity than are magnesium ions." By basing its raw, laboratory-derived criteria on an underprotective and unrealistic calcium-to-magnesium ratio, EPA has premised its use of the WERs on the unsupported assumption that laboratory-developed criteria are more protective than necessary in the natural environment. The harmful effects of that erroneous assumption are only amplified by the use of WERs, which further weaken the criteria. The use of WERs is thus inappropriate and fails to protect designated uses.

Second, EPA developed the WERs based on an inadequate number of test species and thus cannot claim that its use of WERs is scientifically sound. Unlike EPA's metals criteria, which are based on over nine hundred records of laboratory toxicity tests performed on many genera and trophic levels, the WERs may be determined with only two or three test species that do not encompass multiple genera or trophic levels. Two or three test species do not adequately represent the toxic sensitivity of millions of species. Indeed, the use of the WERs has the perverse result of allowing two or three tests to dramatically alter criteria that were established based on data from hundreds of species. EPA's use of WERs is thus questionable at best.

Third, the bioassays upon which national and site-specific criteria and WERs are based may not have used the most sensitive life stage of the organism tested. For example, most bioassays use the asexual life stage of daphnia, a common test organism. Yet, researchers found that sexual reproduction in daphnia is the most sensitive life stage. As a result, the Services concluded, "EPA procedures for determining WERs for metals may result in criteria that are not protective of threatened or endangered aquatic species. Thus, WERs of three or less are unacceptable because they are likely within the variance of toxicity tests." These findings are equally applicable to the use of WERs adopted by Oregon in its proposed numeric criteria for metals. The WERs proposed by Oregon are thus insufficient to protect aquatic life, including threatened and endangered species.

Moreover, as discussed in detail below, the underlying premise of the WERs - that metals that bind to other constituents are not bioavailable and thus present less risk to designated uses is flawed. Any effort to weaken the otherwise applicable criteria must therefore be rejected.

EPA's Response to Comment C:

EPA disagrees with the comment that use of water-effect ratios (WERs)[14] results in certain of Oregon's new and revised aquatic life criteria failing to protect Oregon's Fish & Aquatic Life designated use. Oregon's new and revised aquatic life criteria can be found at OAR 340-041-0033 and in Tables 33A and 33B in the Water Quality Criteria Toxic Criteria Summary. Oregon did not use any WERs in the derivation of their submitted criteria for metals. Consequently, the use of the water-effect ratio is not part of this action.

[14] Interim Guidance on Determination and Use of Water-Effect Ratios for Metals (EPA-823-B-94-001, 1994)

Comment D: The Proposed Oregon Criteria Do Not Protect Designated Uses, Because They Fail to Address Exposure Pathways From Particulates and Contaminated Food.

The proposed Oregon criteria fail to protect designated and existing uses from dermal exposure and dietary exposure to particulate metals and contaminated food sources. As noted above, Oregon's proposed aquatic life criteria are based exclusively on exposure to dissolved metals in the water column.

By basing the proposed criteria on the "total dissolved" method, DEQ has ignored the reality that aquatic species, wildlife, and other designated uses are exposed to toxic metals via particulates in the water column and the consumption of contaminated food. Unless the criteria protect species from these exposure pathways, they cannot possibly be considered protective.

1. Oregon's proposed water quality standards for toxic pollutants do not adequately protect species from exposure to sediments and particulates.

   Aquatic species and wildlife are exposed to significant amounts of toxic pollutants through sediments and particulate matter. A United States Army Corps of Engineers study summarized these exposure pathways as follows:

   > Sediments may serve as sinks by binding and sequestering contaminants that are entering aquatic systems where they can accumulate to much higher concentrations than in the overlying water. Sediments may then serve as secondary sources for biotic exposure to the materials, particularly when sediments are disturbed by physical perturbations such as storm events, bioturbation, or dredging and aquatic placement of dredged material. Sediment-sorbed contaminants may accumulate sufficiently in the tissues of prey organisms to elicit direct adverse effects, and they may be transferred to consumers through dietary intake or by increased concentration in the water column. Aquatic organisms that bioaccumulate contaminants from water or sediment may transfer these contaminants to predators that forage on them. The extent to which these sediment-associated contaminants can move through aquatic food webs and thus potentially affect organisms at higher trophic levels is a crucial issue for environmental decision-making.

   The Services similarly note, "Dredging and disposal operations can result in substantial re-suspension of particulates in the water column, including those contaminated with metals." From its work on the Portland Harbor Superfund site, EPA is well aware that dredging, suction dredging, and natural events disturb contaminated sediments in Oregon. Thus, there can be no doubt that sediments and particulates expose designated and existing uses to significant levels of bioavailable pollutants.

   Despite the clear weight of evidence showing that contaminated sediments and particulates present risks to designated uses, Oregon DEQ has insisted on using the "total dissolved" metals method, which ignores these important exposure pathways. EPA cannot legally approve Oregon's proposed criteria, in light of this significant omission.

2. Oregon's proposed water quality standards for toxic pollutants do not adequately protect species from gill exposure to particulates.

Oregon's criteria do not protect designated uses because the criteria fail to protect against dermal exposure to toxic particulate metals via the gills. EPA developed (and Oregon adopted) water quality criteria for metals based on the concentration of a pollutant in the water column. This assumes that the only exposure pathway is via contact with dissolved metals across the gills during respiration. However, as the Services have explained, gill contact with toxic particulates also adversely affects fish: "Through respiratory uptake, aquatic organisms are exposed to metals in addition to those measured in the dissolved fraction of ambient waters. As fish ventilate, a nearly continuous flow of water pass across their gills and particulate metals suspended in the water column may become entrapped. At the lowered pHs occurring near gill surfaces entrapped particulate metals may release soluble metal ions, which are the forms EPA considers most bioavailable and efficiently taken up by aquatic organisms." As a result, the Services concluded that "the proposed EPA metals criteria in the CTR for aquatic life should not exclude particulate forms of any metal, unless and until EPA demonstrates that exposures of threatened or endangered species to these contaminants are unlikely to cause adverse effects in natural waters." EPA has not demonstrated, in the five years since the Services released the CTR BiOp, that the current EPA-recommended criteria protect species from gill exposure to toxic particulates. Thus, the proposed Oregon criteria, which rely on the same unproven assumptions regarding gill exposure to toxic pollutants, unlawfully exclude toxic pollutants and thereby fail to protect aquatic uses.

3. Oregon's proposed water quality standards for toxic pollutants do not adequately protect species from dietary exposure to particulates.

Although dietary exposure is a critical exposure pathway for toxic pollutants, EPA has largely ignored the effects of dietary exposure on water quality and species protection. EPA did not consider dietary exposure when it established its recommended criteria for toxic pollutants, and, as a result, the EPA recommended criteria greatly underestimate an organism's exposure to toxic pollutants. In March of 2000, the Services noted that "EPA has not assessed whether the food base of aquatic organisms may accumulate excessive metal residues under CTR proposed criteria." Likewise, neither EPA nor Oregon has assessed whether organisms may accumulate heavy metals as a result of dietary exposure to toxic pollutants for which Oregon has proposed water quality criteria. The failure of the agencies to consider this vital aspect of toxic exposure undermines the protectiveness – and thus the legality – of the criteria overall.

Dietary exposure is an extremely important pathway for species exposure to toxic pollutants. "The consensus of research studies is that most of the selenium in fish tissue results from selenium in diet rather than the water (Cumbie and Van Horn 1978; Lemly 1982,1985a; Finley 1985, Hamilton et al. 1986; Woock et al. 1987; Besser et al. 1993; Coyle et al. 1993)" Studies show that dietary exposure to toxic pollutants has adverse effects on aquatic life and wildlife. For example, in a study comparing young rainbow trout that were fed contaminated invertebrate prey with young rainbow trout that were fed clean prey, the trout that were fed the contaminated prey showed reduced growth and survival, while the control group showed no reductions in growth. Both study groups were placed in clean water, and the only variable at issue was the level of contamination in the prey. This study demonstrates that contaminated prey has adverse effects on trout, notwithstanding the presence of dissolved pollutants in the water body. The presence of contaminated food sources is particularly important as the contaminants work their way up the food chain. As an example, "[b]enthic organisms can tolerate body burdens of selenium far greater than the dietary toxic level for fish and aquatic birds without suffering ill effects. Thus, the most important aspect of selenium residues in sediments is not direct toxicity to benthic organisms themselves, but rather the dietary source of selenium they provide to fish and wildlife species that feed on them." It is thus indisputable that contaminated food may have a negative impact on designated and existing uses in Oregon's waters.

Oregon's proposed water quality standards for toxic pollutants fail to consider dietary uptake of pollutants via contaminated prey and contaminated benthic organisms. By failing to consider this important exposure pathway, Oregon's criteria fail to protect designated and existing uses. EPA must therefore disapprove these criteria as failing to meet the requirements of the CWA.

EPA's Response to Comment D:

EPA disagrees with the comment that Oregon's new and revised aquatic life criteria all fail to protect Oregon's Fish & Aquatic Life designated use because of a failure to address exposure pathways from particulates and contaminated food. EPA's rationale is explained in its responses to the three specific claims made by the commenter.

1. *Oregon's proposed water quality standards for toxic pollutants do not adequately protect species from exposure to sediments and particulates.*

   In regards to exposure to particulates, EPA discussed many aspects of this issue in its response to claim 1 in Comment B concerning the expression of aquatic life criteria for metals in terms of dissolved metal rather than total recoverable metal.

   A great deal of scientific evaluation has been invested in the issue of sediments and toxicity to benthic organisms.[15,16,17] However, the new and revised Oregon criteria before EPA for action are aquatic life criteria, not sediment criteria. EPA derives its national aquatic life criteria, which Oregon adopted, for metals to protect water column organisms from exposure to pollutants present in the water column. Gobas and Morrison (2000) and Ankley et al. (1996) discuss these concepts of partitioning between dissolved and solid phases.[18],[19]

   The fact that dissolved metal criteria limit not only equilibrium conditions but also to *nonequilibrium* conditions, caused by time variability of water-column concentrations, provides an additional margin of safety. The peak concentrations to which the water-column criteria apply are greater than the average concentration in the water column, often by a wide margin.

[15] Hansen, D.J., J.D. Mahony, W.J. Berry, S. Benyi, J. Corbin, S. Pratt and M.B. Able. 1996. Chronic effect of cadmium in sediments on colonization by benthic marine organisms: An evaluation of the role of interstitial cadmium and acid volatile sulfide in biological availability. Environ. Toxicol. Chem. 15:2136-2137.

[16] Hare, L., R. Carignan and M.A. Huerta-Diaz. 1994. A field experimental study of metal toxicity and accumulation by benthic invertebrates; implication for the acid volatile sulfide (AVS) model. Limnol. Oceanogr. 39:1653-1668.

[17] Lee, B.-G., H.-S. Jeon, S.N. Luoma, J.-S. Yi, C.-H. Koh. 1998. Effects of AVS (Acid Volatile Sulfide) on the bioaccumulation of Cd, Ni, and Zn in bivalves and polychaetes. Abstract: 19th Annual Meeting of the Society of Environmental Toxicology and Chemistry. Charlotte, NC.

[18] Gobas, F.A.P.C., and H.A. Morrison. 2000. Bioconcentration and Biomagnification in the Aquatic Environment. Handbook of Property Estimation Methods for Chemicals. CRC Press. http://research.rem.sfu.ca/downloads/rem-610/readings/gobas.pdf accessed 2012-11-28.

[19] Ankley, G.T., et al. 1996. Technical basis and proposal for deriving sediment quality criteria for metals. Environ. Toxicol. Chem. 15(12): 2056-2066.

Sediment concentrations, by contrast, reflect long-term average concentrations of the contaminant on the settling particles.

See General Response 5 concerning wildlife.

2. *Oregon's proposed water quality standards for toxic pollutants do not adequately protect species from gill exposure to particulates.*

   As was noted in response to claim 1 in Comment B, EPA derives its national aquatic life criteria so that they protect water column organisms from exposure to pollutants that are present in the water column. The primary mechanism for water column toxicity is absorption at the gill surface, which requires metals to be in the dissolved form and bioavailable. Therefore, protection of aquatic life is provided using the quantification of dissolved metals as proposed by Oregon.

   The total dissolved method proposed in the CTR and NTR is consistent with the best available scientific evidence for non-bioaccumulative metals.

   Please see General Response 4 concerning ESA listed species and consultation with the Services.

3. *Oregon's proposed water quality standards for toxic pollutants do not adequately protect species from dietary exposure to particulates.*

   Aquatic life criteria are derived to protect organisms from exposure to pollutants in the water column. Studies of the importance of other routes of exposure, such as pollutant ingestion via food, are much less common than water-only toxicity tests, and do not have well standardized methods. Where there is strong experimental evidence that, for a particular metal, dietary exposure is a primary source of exposure, EPA is able to take dietary exposure into account (e.g., the 1987 selenium criterion and the draft revised selenium criteria under development).

   The likelihood of exposure to particulate matter is very waterbody-specific because it depends on the flow, hydrology, and geomorphology of the waterbody. These would need to be modeled for each waterbody, because, for example, the flow and hydrology of rivers are much different than the flow and hydrology of lakes, wetlands, and estuaries. Such considerations are most appropriately taken into account in the derivation of site-specific criteria.

   Although data clearly show that fish accumulate some specific metals through the diet, at present it is not clear to what degree such metal accumulation produces negative effects or ecological risk. Results of experiments performed using dietary metal introduced in different forms conflict as to the degree of uptake and the existence of negative effects resulting from those exposures (e.g., compare Woodward et al. 1994[20], Mount et al. 1994[21], and Julshamn et

[20] Woodward, D.F., W.G. Brumbaugh, A.J. Delonay, E.E. Little, and C.E. Smith. 1994. Effects on rainbow trout fry of a metals-contaminated diet of benthic invertebrates from the Clark Fork River, Montana. *Trans. Amer. Fish. Soc.* 123: 51-62.

[21] Mount, D.R., A.K. Barth, T.D. Garrison, K.A. Barten, and J.R. Hockett. 1994. Dietary and waterborne exposure of rainbow trout (*Oncorhynchus mykiss*) to copper, cadmium, lead and zinc using a live diet. *Environ. Toxicol. Chem.* 13:2031-2041.

al. 1998[22]). Further, comparison of data from water-borne and dietary exposures of metals shows no significant relationship between metal accumulated in tissue and the presence or absence of biological effects (e.g. compare Marr et al. 1996[23] with Woodward et al. 1994[24] and Mount et al. 1994[25]). Differences among the results of these studies demonstrate why the assessment of the ecological relevance of metals requires more than a demonstration of accumulation, because the presence of contaminant in diet or tissue is not itself a biologically meaningful effect.

The primary experiments suggesting the existence of risk from dietary metal exposure (Woodward et al. 1994[26] and later studies from the same laboratory) used designs that preclude unequivocal assignment of cause and effect to single metals, mixtures of metals, or other factors. As a result, these experiments are useful for focusing attention on the need to further examine the importance of dietary exposure, but they do not provide an approach for taking such exposure into account in the derivation of aquatic life criteria.

As with many other scientific issues, EPA recognizes that additional studies are desirable to better define the relative importance of dietary exposure to particulates. If such work were to indicate that ingestion substantially adds to the adverse effects caused by dissolved metal, EPA would include the new data in its review of new and revised aquatic life criteria to ensure that they account for dietary exposure to particulates. But presently available evidence does not support that conclusion.

EPA does not agree that EPA's recommended selenium criterion fails to account for bioaccumulation. In fact, the National Ambient Water Quality chronic criterion for selenium, which was adopted by Oregon, does account for bioaccumulation. It is a field-based criterion that is based on data obtained at Belews Lake (in North Carolina), the food chain of which was contaminated by selenium. Contamination of Belews Lake waters yielded elevated concentrations in aquatic plants, which in turn yielded elevated concentrations in invertebrates and fish – that is, bioaccumulation was occurring and accounted for the observed effects in Belews Lake. Although the comment discusses the importance of dietary selenium exposure, it provides no evidence or discussion to support its contention that EPA's selenium chronic criterion fails to account for bioaccumulation.

The commenter stated that the Services noted that "EPA has not assessed whether the food base of aquatic organisms may accumulate excessive metal residues under CTR proposed criteria." As addressed above, the accumulation of metal in the diet is not a basis for criteria development. In cases where dietary uptake has been scientifically demonstrated to occur and is directly relevant to ecological risk, the EPA incorporates such data into criteria development.

See General Response 5 concerning wildlife.

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[22] Julshamn, K., K.J. Andersen, O. Ringdal and J. Brenna. 1988. Effect of dietary copper on the hepatic concentration and subcellular distribution of copper and zinc in the rainbow trout (*Salmo gairdneri*). *Aquaculture* 73: 143-155.
[23] Marr, J.C.A., J. Lipton, D. Cacela, J.A. Hansen, H.L. Bergman, J.S. Meyer and C. Hogstrand. 1996. Relationship between copper exposure, duration, tissue copper concentration, and rainbow trout growth. *Aqua. Toxicol.* 36: 17-30.
[24] *Ibid.*
[25] *Ibid.*
[26] *Ibid.*

Comment E: Oregon's Proposed Criteria Do Not Protect Designated Uses, Because They Fail to Address Bioaccumulation of Toxic Metals and Organic Pollutants

Oregon's proposed criteria fail to account for the bioaccumulative nature of toxic metals and other toxic pollutants. The proposed criteria thus fail to consider the increased risks that bioaccumulation presents to designated and existing uses. Moreover, Oregon's rules, which allow mixing zones for bioaccumulative pollutants and which exempt known sources of bioaccumulative toxics from compliance with water quality standards, exacerbate the harms presented by bioaccumulative pollutants. Oregon's proposed criteria thus fail to protect designated uses and must be disapproved.

1. Oregon's criteria do not protect against bioaccumulation.

   Oregon's proposed standards fail to regulate bioaccumulation of toxic pollutants. The proposed criteria for toxic pollutants are based on the concentration of pollutants in the water column. As such, the criteria do not account for bioaccumulation, which, by definition, is an increase in the concentration of a pollutant above the ambient water concentration. This increased concentration adversely affects the beneficial uses. By failing to account for bioaccumulation, the Oregon criteria fail to protect designated and existing uses.

   There are many pollutants that bioaccumulate, including arsenic, mercury, selenium, DDT, PCBs, endrin, and toxaphene, and the bioaccumulative nature of these pollutants makes them particularly harmful. Pollutants may be concentrated or magnified in successive trophic levels. In a study of Lake Ontario, PCBs were magnified 2.8 million times in lake trout and 25 million times in herring gulls. In aquatic ecosystems, bioaccumulation has the greatest adverse effect on top predators, such as Oregon's ESA-listed salmonid species - Chinook, Coho, chum, sockeye, and steelhead - because they eat prey from high trophic levels. Moreover, as EPA has noted about Bioaccumulative Chemicals of Concern (BCCs): "[Human] exposure to BCCs can result in decreased fertility, premature labor, spontaneous abortion, reproductive hormone disorders, increased stillbirths, lack of mammary function, reduced libido, and delayed estrus. Children may be at greater risk than adults… Risks to infants and children include central nervous system effects, mortality, low IQ scores, cataracts, congestive heart failure, skin disorders, cancers, immune system dysfunction and immunosuppression, skeletal disorders, neurological/behavioral effects, and endocrinological disorders." BCCs also adversely affect fish and wildlife.

   EPA has recognized that bioaccumulation is important, and EPA guidelines indicate that tissue residue studies should be used to assure that criteria protect against bioaccumulation. The guidelines, however, have not been implemented. The Services noted, "criteria documents for metals include the discussion of bioaccumulation studies but final criteria are based on acute and chronic toxicity studies. EPA has not considered results of investigations which indicate that exposures of salmonids to metals-contaminated invertebrate diets may result in adverse effects." The Services conclude that "without due consideration of the bioaccumulation potential of metals in aquatic ecosystems the proposed CTR criteria for metals are not protective of threatened or endangered species." Because Oregon simply adopted EPA's recommended criteria without considering the effects of bioaccumulation, the Services comments apply equally to Oregon.

   Oregon's proposed criteria for toxic pollutants are not protective of aquatic life or wildlife because they do not protect against bioaccumulation and instead regulate only the contaminant levels in the water column. For example, EPA's - and thus Oregon's - recommended criteria for metals were derived "solely on the results of aquatic toxicity tests where metal exposures occur only across the gills or other respiratory surfaces. This is because toxicity tests used to develop the criteria are performed with controlled laboratory water with little particulate metals and do not include realistic dietary or other exposures." Toxicity to fish and wildlife, however, is highly influenced by how much of the toxic pollutant is partitioned to the food chain, rather than the water column concentration.

While Oregon's proposed criteria do consider the risk of elevated organic contaminants in fish tissue eaten by humans, the criteria do not consider how contamination of fish tissue affects the fish itself. Nor do the criteria consider the effects of bioaccumulation on aquatic invertebrates, even though these animals are a designated use and form a critical component in the food chain. Degradation of the aquatic invertebrates affects the larger predators, including threatened and endangered salmon. Oregon's proposed criteria fail to protect designated uses because the standards do not consider how bioaccumulation will adversely affect aquatic organisms themselves. The criteria thus cannot be considered protective of designated and existing uses.

2. Oregon's rules and policies weaken any protections against bioaccumulative pollutants that the criteria may provide.

In addition to failing to account for bioaccumulation in its proposed criteria, Oregon has adopted rules and policies that further limit the protectiveness of its water quality standards. Oregon's water quality program ignores bioaccumulation in several key policies that greatly weaken the standards.

First, Oregon's rules, in effect, exempt forestry and agriculture from water quality standards. Regarding agriculture and forestry on federal lands, the rules state, "water quality standards are expected to be met through the development of water quality restoration plans, best management practices and aquatic conservation strategies." Thus, under Oregon's proposed rules, water quality standards will not apply to agricultural runoff. Instead, Oregon rules exempt major sources of pollution and rely on vague "restoration plans" and "best management practices" that do not adequately address or monitor water quality standards. No agricultural water quality management plans expressly address bioaccumulative pollutants and agricultural water quality management plans themselves are vague and unenforceable. As a result, known sources of bioaccumulative pollutants will go unchecked. Selenium, for example, concentrates in subsurface irrigation drainage and may discharge into surface waters. Thousands of fish and waterfowl were poisoned in the Kesterson National Wildlife Refuge, CA because selenium leached from the soil of adjacent agricultural areas. Oregon's water quality standards will not prevent the same from happening in Oregon.

Second, Oregon rules do not require a sampling frequency that protects against bioaccumulative pollutants, which may accumulate in the food chain after a rapid mass loading. Even if the criteria were protective, mass loadings of pollutants could go unnoticed and have a long-term effect on organisms.

Third, Oregon's standards do not protect designated uses because state rules allow the discharge of toxic pollutants, including pollutants that bioaccumulate in the environment, into mixing zones. Oregon's rules allow point sources to discharge BCCs into mixing zones at levels higher than the applicable numeric criteria. Oregon and EPA view a mixing zone as a localized concentration of pollution that is diluted by the surrounding water such that the water body as a whole still protects designated uses. BCCs and other toxic pollutants that bind to sediment are not appropriate for mixing zones, however, because these pollutants do not dilute. Because Oregon's rules allow mixing zones to apply to discharges that will not dilute, the rules allow for increased discharges of bioaccumulative toxic pollutants and thus fail to protect designated uses.

EPA has acknowledged that mixing zones are not appropriate for bioaccumulative toxic pollutants. EPA promulgated a rule that prohibits mixing zones for BCCs in the Great Lakes System (GLS), which includes Illinois, Indiana, Michigan, Minnesota, and Wisconsin. In this rulemaking, EPA found that "BCCs, due to their persistent and bioaccumulative nature, are incompatible with mixing zones. By definition, BCCs are chemicals that do not degrade over time... Because the effects of these chemicals are not mitigated by dilution, using a mixing zone to 'dilute' BCC discharges is not appropriate." EPA recognized that it is the mass, not just the concentration, of these chemicals that poses a problem. As in the GLS, reproductive failure due to BCCs occurs in Oregon rivers, such as the Columbia and the Willamette. Oregon industries discharge many of the same chemicals, Oregon waters have similar designated uses, and Oregon has heavily polluted, large bodies of water. Thus, as with the GLS, in Oregon, "using a mixing zone to 'dilute' BCC discharges is not appropriate."

EPA's Response to Comment E:

EPA disagrees with the comment that Oregon's new and revised aquatic life criteria all fail to protect Oregon's Fish & Aquatic Life designated use due to a failure to consider bioaccumulation. EPA's rationale is explained in its responses to the three specific claims made by the commenter.

1. *Oregon's criteria do not protect against bioaccumulation.*

For water-column organisms, bioconcentration is uptake from water whereas bioaccumulation is uptake from both water and food. Therefore, bioaccumulation is bioconcentration (i.e., uptake from water) plus dietary exposure (i.e., uptake from food). Bioconcentration can occur during every toxicity test, depending on the specific chemical and species under study. Dietary exposure via bioaccumulation on food after addition in chronic tests may occur to some degree, particularly for a partially live food such as YCT, but no quantification of this phenomenon has been performed and would likely be inconsequential in the scope of the test. The issue concerning bioaccumulation is the same as issue 3 in Comment D concerning dietary exposure and is addressed in the response to that response.

See General Response 4 concerning ESA listed species and General Response 5 concerning wildlife.

2. *Oregon's rules and policies weaken any protections against bioaccumulative pollutants that the criteria may provide.*

EPA's adjudicatory authority under CWA 303(c)(3) is limited to the State's particular submission of new and revised water quality standards. In this case, EPA's action is limited to approving or disapproving Oregon's new or revised water quality standards that were submitted to EPA on July 8, 2004, as updated by its 2007 and 2011 submissions. The forestry and agricultural rules cited by the commenter are part of a set of water quality standards revisions submitted to EPA in 2003, which are not the subject of this action. The 2003 submission is the subject of a separate action, which is proceeding in accordance with a Stipulated Order on Nonpoint Source and Endangered Species Act Remedies. Northwest Environmental Advocates v. United States Environmental Protection Agency, No. 05-1876 (D. Or.) (order issued January 7, 2013).

Comment F: Oregon's Proposed Criteria Are Not Protective Because They Are Derived From LC_{50} Concentrations, Which Are Established Through A Flawed And Underprotective Methodology.

Oregon's proposed criteria are established through a flawed methodology that does not assure protection of designated and existing uses. Specifically, for many of the toxic pollutants for which Oregon has submitted proposed criteria, Oregon has proposed to adopt EPA's recommended criteria. EPA's recommended criteria are, in turn, derived from so-called LC_{50} tests, which are tests that determine, on a pollutant-by-pollutant basis, the concentration of any given pollutant that will kill fifty percent of the exposed species population that is being tested. Once EPA determines the concentration that will result in death to half the test population, EPA then divides that number in half to establish the applicable criterion. Although EPA believes that it is establishing a protective criterion through this method, the LC_{50} method is, in fact, a crude methodology that does not protect imperiled populations or account for sublethal effects of toxic pollutants.

By its very nature, the LC_{50} does not protect imperiled species, because it allows up to half of a population to die and fails to protect against sublethal effects. The Services noted as much in the CTR BiOp when they concluded that EPA's recommended criterion for PCP was not protective of aquatic life based, in part, on the use of LC_{50} to derive the criterion. The Services stated, "[by] definition the LC_{50} is the concentration at which half the organisms are expected to die, and cannot be used to determine the concentration that would be lethal to low numbers of salmonid trout exposed for a short period of time."

Furthermore, Oregon's criteria do not consider sublethal effects on populations. The LC_{50}-based criteria are designed only to keep some portion of a population alive, but not necessarily healthy or viable. Oregon assumes the safety factor of two prevents toxicity to aquatic life. The safety factor, however, does not prevent, or even consider, adverse effects that result in harm less than death. These sublethal effects are especially dangerous for chronic exposures, which occur at a much lower threshold. Sublethal effects are also dangerous to threatened and endangered species, which, by definition, are on the brink of extinction and cannot handle any additional stress. EPA cannot approve Oregon's criteria because the criteria do not consider sublethal effects.

Because Oregon has not shown what percentage of a population is protected by its criteria, EPA cannot assume that the criteria are protective of designated uses. Failure to protect aquatic life is a violation of 40 C.F.R § 131.11. In addition, the ESA prohibits a take of any threatened or endangered species. Oregon's criteria violate the ESA because the criteria are not designed to protect one hundred percent of the populations.

EPA's Response to Comment F:

EPA disagrees with the comment that Oregon's new and revised aquatic life criteria fail to protect

Oregon's Fish & Aquatic Life designated use because the criteria are derived from LC_{50}s.

The commenter's arguments are based on a misunderstanding of the methodology Oregon relied on for the derivation of its aquatic life criteria. EPA derives water quality criteria for use by States and Tribes based on a rigorous methodology that is set forth in the *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and their Uses* (Stephan et al. 1985, hereafter referred to as the Guidelines). These Guidelines provide a scientifically defensible methodology for deriving both an acute criterion concentration (to protect against short-term lethality and, in some cases, other short-term severe effects) and a chronic criterion concentration (to protect from sublethal and long-term effects such as reduced survival, growth, or reproduction).

The commenter's statement that "the LC_{50} does not protect imperiled species, because it allows up to half of a population to die" is not valid. Although LC_{50}s reported from toxicity tests are used during the derivation of criterion, the criteria are not set at the level of the LC_{50}, but rather at a level that yields toxicity essentially un-differentiable from controls, a concentration of one-half the LC_{50} of the 5^{th} percentile of all represented genera. An LC_{50} serves as the basis for defining the sensitivity of a genera, which is then used in conjunction with all other available genera level data to calculate a 5^{th} percentile to derive acute and chronic criteria for the protection of the aquatic environment via the following methodologies:

The <u>acute criterion</u> concentration is derived, based on the Guidelines, as follows:

> The acute criterion concentration is based on acute toxicity tests, which are sometimes called "LC_{50} tests". The Guidelines require that the acute criterion concentration be based on effects that reflect the total adverse acute impact of the pollutant on the test organisms. For most species, the acute test result is the 48 or 96 hour (depending on the species) LC_{50} or EC_{50} based on a combination of the percentage of organisms exhibiting loss of equilibrium plus the percentage of organisms immobilized plus the percentage of organisms killed. This is more protective than simply considering the percentage killed (i.e., LC_{50}). For early life stages of bivalve mollusks, the acute effect is the 96-hour EC_{50} based on a combination of the percentage with incompletely developed shells plus the percentage killed.
>
> If the available data indicate that one or more life stages are at least a factor of two more acutely sensitive than one or more other life stages of the same species, test results for the more resistant life stages are not used in the calculation of the Species Mean Acute Value (SMAV) because a species can be considered protected from acute toxicity only if the most sensitive life stage is protected.
>
> For each species for which at least one acceptable acute value (LC_{50} or EC_{50}) is available, the SMAV is calculated as the geometric mean of the acceptable results of flow-through tests in which the concentrations of test material were measured. For a species for which no such test result is available, the SMAV is calculated as the geometric mean of all acceptable acute values, i.e., results of flow-through tests in which the concentrations were not measured and results of static and renewal tests based on initial concentrations of test material. The genus mean acute values (GMAV) are then calculated as the geometric mean of the SMAVs that are available for each genus. EPA uses geometric means instead of arithmetic means because acute values are more likely to be log normally distributed than normally distributed.

When acceptable acute tests are available for species in eight specified families, all of the GMAVs are ranked from the least to the most sensitive. A regression analysis is performed using the four GMAVs whose cumulative probabilities are closest to 0.05 in order to calculate an estimate of the concentration of the pollutant corresponding to a cumulative probability of 0.05, which is called the Final Acute Value. If the SMAV of a commercially or recreationally important species is lower than the calculated Final Acute Value and that SMAV is based on results of a flow-through test in which the concentrations of the test material were measured, then that SMAV becomes the Final Acute Value in order to provide protection for that important species. The Final Acute Value is then divided by 2 to derive the acute criterion concentration that corresponds to a percent mortality in the range of 0 to 10% for a hypothetical species whose SMAV equals the FAV, based on empirical data and analyses which indicate that dividing the LC_{50} for a test by two generally lowers the value to a lethality level which is nearly indistinguishable from the level of mortality observed in the control samples using clean water.

The commenter also states that Oregon's new and revised aquatic life criteria do not protect against sublethal effects. This is incorrect because the chronic criteria are derived from data on the sublethal endpoints, such as growth and reproduction, as defined in the Guidelines:

Chronic criterion concentrations are calculated in the same manner as acute criterion concentrations when acceptable chronic tests are available for species in eight specified families. However, instead of LC_{50}s and EC_{50}s derived from acute tests, the calculations use no observed effect concentration (NOEC) and the lowest observed effect concentration (LOEC), which are based on chronic toxicity tests which, by nature, are measured affects on growth, reproduction, and long-term survival. The NOEC is the highest tested concentration in which survival, growth, and reproduction are not statistically significantly different from the control treatment, whereas the LOEC is the lowest tested concentration in which survival, growth, and/or reproduction is statistically significantly different from the control treatment. The geometric mean of these two values is called the Maximum Acceptable Toxicant Concentration (MATC). Another acceptable endpoints is the EC_{20}, or concentration that effects 20 percent of a test population.

EPA uses results of three types of chronic toxicity tests to derive the CCC.

a. Life-cycle toxicity tests take into account adverse effects on survival and growth of adults and young, maturation of males and females, eggs spawned per female, embryo viability, and hatchability.
b. Partial life-cycle chronic toxicity tests are used for fish species that require more than a year to reach sexual maturity, and the effects taken into account are the same as full life-cycle toxicity tests.
c. For fish, early life-stage toxicity test take into account survival and growth during 28 to 90-day exposures, depending on the species, that begin shortly after fertilization and go through embryonic, larval, and early juvenile development of the fish species. For fish, results of early life-stage toxicity tests are used because they have been shown to be useful predictors of the results of life-cycle tests.

If sufficient acceptable chronic data are not available to derive a CCC directly, an alternative method exists that uses fewer chronic data to estimate the CCC from the FAV using an acute-chronic ratio (ACR) to extrapolate from acute to chronic effects based on measured relationships between the two types of effects. This approach can be used if ACRs are available for species from at least three different families provided that one is a fish, one is an invertebrate, and one is an acutely sensitive freshwater or saltwater species. For each chronic value for which at least one corresponding acceptable acute value is available, an ACR is calculated by dividing the acute value by the chronic value. For each species, the Species Mean Acute-Chronic Ratio is calculated as the geometric mean of all acute-chronic ratios available for that species.

If the Species Mean Chronic Value of a commercially or recreationally important species is lower than the calculated Final Chronic Value, then that Species Mean Chronic Value replaces the calculated Final Chronic Value in order to provide protection for that important species as was the case with tributyltin.

The acute and chronic criterion concentrations that are derived as described are then implemented with duration and frequency limits that prevent the unacceptable effects to species from exceedances of the criterion concentration by ensuring compensating periods of time during which the concentration is below the criterion concentration. For most pollutants the four-day average concentration of the pollutant must not exceed the CCC more than once every three years on average and the one-hour average concentration must not exceed the acute criterion concentration more than once every three years on average.

The CCC sets an upper limit below which concentrations must remain a high percentage of the time in order for the water body to attain standards. The attainment goal for the chronic criteria set forth by Oregon is a 4-day average exceedance once in 3 years. Interpreted as remaining below the criterion more than 99.5 percent of the time, this indicates that concentrations in attaining waters would seldom rise to the level of the criterion. Given typical time variability of real-world ambient waters, for example, a log standard deviation of 0.5, waters that remain below the criterion 99.5 percent of the time would have a median and geometric mean concentration nearly six-fold lower than the criterion (as determined for a lognormal distribution by log geometric mean = log criterion - z sigma, where z, the normal deviate (i.e., Excel's NORMSINV) corresponding to 0.995 is 2.58 and sigma is 0.5). If the median concentration were higher than this, the frequency of exceeding the criterion concentration would higher than that specified for attainment.

For such a time-variable situation the aggregate level of effect for a species having an EC_{20} (or MATC) equal to the criterion can be calculated as the summation of the each possible level of effect (from 0% to 100% of individuals affected) multiplied the probability (over time) of that level of effect occurring, as illustrated in Appendix D of Delos (2008). For the above situation where (a) the concentration remains below the criterion 99.5 percent of the time, and where (b) the concentration-response curve has a has a typical log-probit shape (which assumes a lognormal distribution of sensitivity among individuals in the species) with a typical slope such that the EC_{20}/EC_{50} is 0.625, the aggregate effect on the sensitive species would be less than one percent, meaning that on average less than one percent of individuals would be affected. Such a low level of effect is indistinguishable from zero and is far below the threshold for detecting effects in the field or even in the lab. The criteria thus provide a much higher level of protection than implied by a naive assertion that the criteria allow 20 percent effect[27].

The commenter states that Oregon's new and revised criteria are not protective because Oregon has

[27] Delos, C.G. 2008. Modeling Framework Applied to Establishing the Aquatic Life Criteria Attainment Frequency, June 2008 Draft. Office of Water, U.S. Environmental Protection Agency, Washington, DC. 160 p.

not shown a percentage of "a population" protected. EPA does not agree that these criteria are not protective. The derivation of national ambient water quality criteria for the protection of aquatic life, and thereby the protection of the aquatic life designated use as adopted in Oregon, aims to protect the biological integrity of the waters of the United States. Calculating the percentages of a population that may be affected by criterion concentrations is not performed as there is no robust and vetted method to do so, however, as discussed in the Guidelines, the criteria are set at concentrations that protect 95 percent of all genera (and by extension, species) based on existing toxicity data.

The general protectiveness of water quality criteria has been summarized in EPA's *Technical Support Document for Water Quality-based Toxics Control* (page 2) as indicated in 40 CFR 131.11.

See General Response 4 concerning ESA listed species.

Comment G: Oregon's Proposed Criteria Do Not Adequately Protect Designated Uses Because They Are Based On Studies Performed On An Unrepresentative Population Of Surrogate Species.

Oregon's proposed criteria suffer from a primary flaw underlying EPA's development of recommended toxics criteria: they are established through testing toxicity on a narrow and unrepresentative population of surrogate species. Rather than test a toxic chemical's impacts on species found in a particular water body, EPA uses surrogate species to estimate the effects of toxic pollutants on other untested species. The data derived from surrogate species tests, however, are not precise enough to protect species found in natural waterways. While EPA must set criteria based on available data, and while the use of surrogate species is generally appropriate, EPA's failure to adjust the criteria to account for the lowered sensitivity of surrogate species results in criteria that do not protect species found in Oregon's waters.

Surrogate species are often less sensitive to toxic pollutants than species for which the surrogates are used. For example, EPA uses toxicity data that it developed for fish to assess the impacts of toxics on amphibians, even though some amphibians are up to three orders of magnitude more sensitive than the test fish. The chart below, from the EPA pesticide ecotoxicity database, demonstrates the great differences in sensitivity to pesticides even between members of the same genus.

Pesticide	Organism	LC_{50}(µg/L)
Diuron	Red-legged frog (Ranc aurora)	22,200
Diuron	Carp, (Carrassius)	63,000
Diazinon	Climbing Perch (Anabas scandens)	37,750
Diazinon	Green frog (Rana clamitans)	21
Diazinon	Bog frog (Rana limncharis)	7,977
Carbaryl	Walking catfish (Clarias batrachus)	71,350
Carbaryl	Western mosquitofish (Gambusla affinis)	20,377
Carbaryl	Toad (Bufo hufojaponicus)	7,200
Carbaryl	Gray tree frog (Hyla versieolor)	2,470
Carbaryl	Green frog (Rana clamitans)	20,372
Endosulfan	Snake-head catfish (Channa punctata)	4,586

Endosulfan	Zebra danio (Danio rerio)	750
Endosulfan	Toad (Bufo vulgaris formosus)	2,075
Endosulfan	Bog frog (Rana limnocharis)	12
Endosulfan	Tiger frog (Rana tigrina)	2

As one example, the green frog (Rana clamitans) is two orders of magnitude more sensitive to diazinon than the bog frog (Rana linrnockaris). The criteria do not account for these differences.

Similarly, studies show that toxic pollutants have different effects on different salmonid stocks. For example, sockeye salmon are five times more sensitive to copper than Chinook salmon. In addition, an organism's sensitivity to toxic pollutants varies according to the species' life stage. For example, salmon eggs, juvenile fish, and juvenile mussels are much more sensitive than adults to certain pollutants. EPA does not, however, lower its recommended criteria to protect the most sensitive species or most sensitive life stages or to account for different tolerances to toxic pollutants among surrogate species. Nor does Oregon account for these differences in its proposed criteria. The criteria do not, as a result, adequately protect designated uses in these circumstances.

EPA's Response to Comment G:

EPA disagrees with the comment that Oregon's new and revised aquatic life criteria fail to protect Oregon's Fish & Aquatic Life designated use, due to their use of toxicity data from tests performed using surrogate species. The comment does not include any specific information supporting the contention that the toxicity data underlying Oregon's aquatic life criteria are insufficiently representative of the species present in Oregon waters.

On the contrary, the data provided in the comment supported the protectiveness of those criteria magnitudes. For diazinon, the commenter presents 21 µg/L as the most sensitive frog LC_{50}. However, the submitted acute criterion is 0.17 µg/L, more than 100-fold lower. For endosulfan, the comment presents 2 µg/L as the most sensitive frog LC_{50}, whereas the submitted criterion is 0.22 µg/L, almost 10-fold lower.[28] EPA recognizes that there is variation among species in their sensitivity to various pollutants, as illustrated by the data presented in the comment, and uses this information in its procedures. But the data supplied here actually support EPA's risk assessment conclusion that the nationally recommended criteria are protective of sensitive species in Oregon.

While there are toxicity data for some of the species in Oregon waters, for most species those data are not available and EPA must use toxicity for surrogate species to determine potential effects on aquatic species from the criteria values. EPA criteria development relies on a variety of surrogate species to ensure that the criteria are protective of the wide variety of aquatic species that may occur in an ecosystem.

Criteria are derived using a data set that is sufficiently broad to encompass most ecosystems within the State. They do in fact take into account all available relevant data regardless of the distribution of sensitivities (see response to comment F). The 1985 Guidelines were applied to Oregon's derivation of individual chemical criteria and require acceptable test results for a broad range of species in order to ensure aquatic life criteria protect almost all aquatic ecosystems. EPA's minimum data requirements for deriving a criterion for freshwater aquatic animals require results of

[28] The comment also presents a sensitive frog LC_{50} of 22,500 µg/L for diuron. However, as diuron is not included in the Oregon standards package being reviewed, this information is not directly relevant to the current action.

acceptable acute tests with at least one species of freshwater animal in at least eight specified families.[29] These families are:

1. the family Salmonidae in the class Osteichthyes
2. a second family in the class Osteichthyes, preferably a commercially or recreationally important warmwater species (e.g., bluegill, channel catfish, etc.)
3. a third family in the phylum Chordata (may be in the class Osteichthyes or may be an amphibian, etc.)
4. a planktonic crustacean (e.g., cladoceran, copepod, etc.)
5. a benthic crustacean (e.g., ostracod, isopod, amphipod, crayfish, etc.)
6. an insect (e.g., mayfly, dragonfly, damselfly, stonefly, caddisfly, mosquito, midge, etc.)
7. a family in a phylum other than Arthropoda or Chordata (e.g., Rotifera, Annelida, Mollusca, etc.)
8. a family in any order of insect or any phylum not already represented.[30]

Similarly, the Guidelines require results of acceptable acute tests with at least one species of saltwater animal in at least eight different families.[33] These families are:

1. two families in the phylum Chordata
2. a family in a phylum other than Arthropoda or Chordata
3. either the Mysidae or Penaeidae family
4. three other families not in the phylum Chordata (may include Mysidae or Penaeidae, whichever was not used above)
5. any other family.[31]

A method to derive Final Chronic Values using chronic data from at least 3 families (in combination with acute data from at least 8 families) is presented in the 1985 Guidelines because chronic toxicity test data are significantly less available. The minimum taxonomic data requirements (MDRs) outlined in the 1985 Guidelines ensure that resulting criteria are reliable estimates that protect the majority of species in the majority of aquatic ecosystems. Results of acute and chronic toxicity tests with representative species of aquatic animals are necessary so that the data available for tested species can be considered a useful indication of the sensitivities of untested species. To ensure that national aquatic life criteria are appropriately protective, the required data purposely include some species that are sensitive to many pollutants, specifically daphnids and salmonids. The required breadth of families in criterion calculations serve as useful surrogate species and are representative in these assessments. Additional data are desirable and uncertainty in a criterion decreases as the amount of available quality data increases.

In development of the criterion, the toxicological data are rank ordered from least sensitive to most sensitive. The calculation of the final acute value, and if sufficient data is available, the final chronic value, are determined by using the fifth percentile value based on the four most sensitive genus mean values. Therefore, criteria development is specifically designed to protect the most sensitive species for which toxicological data that meet data quality objectives are available. The final acute value is further divided by 2 as identified above to be below a calculable level of effect for that fifth percentile genus.

It has not been demonstrated that surrogate species are less sensitive as the commenter claims.

[29] *Ibid*. Reference 1. PB85-227049. Section III, Required Data.
[30] *Ibid*.
[31] *Ibid*.

Rather, the available data demonstrate that the sensitivities of surrogate species are similar, on the average, to the sensitivities of other species. For example, Dwyer et al. (2005) tested early life stages of 17 species and found that the rainbow trout was equal to or more sensitive than listed species 81% of the time and, therefore, criteria that protect rainbow trout would, in most cases, protect listed fish species. In addition, previous studies comparing the sensitivities of ESA listed species with the sensitivities of standard test species demonstrated that listed species generally are not more sensitive and the use of surrogate species is appropriate for endangered species risk assessment.[32] Indeed, many scientists concur that, although no one species is consistently the most sensitive, rainbow trout and other salmonids are generally more sensitive than other species and are adequate surrogates for listed species.[33,34,35]

The commenter can readily find instances of substantial differences between species within the same genus. The methods described above in response to comment F account for apparent divergent sensitivities based on test acceptability (where the data may not be of sufficient quality to be used in criteria development) and by using all available data in the calculation of species and genus mean averages. If studies yield quality data, the results are used in the calculation of the aquatic life criterion. In fact, per the Guidelines, EPA uses Genus Mean Acute Values (GMAVs) that include all species within a genus for which acceptable data exist. Further, the commenter has not demonstrated that, when there are differences between species, EPA uses data for the more resistant species. In fact, this is contradictory to the 1985 Guidelines approach; the calculation of the criteria uses the four most sensitive genera (including most sensitive life stages tested) based on all available data.

It is incorrect that EPA uses data solely from fish studies to assess impacts on amphibians. When data are available for amphibians, they are used. When data are not available for amphibians, all of the other species for which data are available become surrogates for that missing family per the Guidelines protocol listed above for the protection of the ecosystem.

Additionally and importantly, most of the toxicological data upon which EPA bases the water quality criteria use the most sensitive life stages (i.e., juvenile fish, etc) when performing these tests. Therefore, these more sensitive life stages are protected in the calculation of Oregon's water quality criteria.

Comment H: Oregon's Proposed Criteria Do Not Protect Designated Uses, Because They Are Based Primarily OnToxicity Studies Performed In Static Water.

Oregon's proposed criteria do not protect designated uses because the criteria are derived primarily from toxicity studies performed in static water. Scientists have demonstrated that static studies greatly underestimate the toxicity of a pollutant. Test organisms are most sensitive to a pollutant in

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[32] Raimondo, S, Vivian, DN, Delos, C, Barron, MG. 2008. Protectiveness of Species Sensitivity Distribution Hazard Concentrations for Acute Toxicity Used in Endangered Species Risk Assessment. Environ. Toxicol. Chem. 27:12 2599-2607.
[33] Mayer FL, and Ellersieck MR. 1986. Manual of acute toxicity: Interpretation and database for 410 chemicals and 66 species of freshwater animals. Resource Publication 160. U.S. Fish and Wildlife Service, Washington
[34] Dwyer FJ, Mayer FL, Sappington LC, Buckler DR, Bridges CM, Greer IE, Hardesty DK, Henke CE, Ingersoll CG, Kunz JL, Whites DW, Augspurger T, Mount DR, Hattala K, and Neuderfer GN. 2005. Assessing contaminant sensitivity of endangered and threatened aquatic species: I. Acute toxicity of five chemicals. Arch. Environ. Contam. Toxicol. 48:143–154
[35] Sappington LC, Mayer FL, Dwyer FJ, Buckler DR, Jones JR, and Ellersieck MR. 2001. Contaminant sensitivity of threatened and endangered fishes compared to standard surrogate species. Environ. Toxicol. Chem. 20:2869–2876

a tank that allows polluted water to flow continuously, rather than in a tank of static water. For example, a study comparing the toxicity of silver on fathead minnows showed that toxicity rates were two times higher in flow-through tanks than in the static tanks. Another study found that static test results were twenty times less protective than flow-through tests for DDT. These data indicate that tests performed in static water underestimate the toxicity of pollutants. It should go without saying that flow-through tests more closely resemble the natural conditions of species exposure to toxic pollutants in most Oregon waterways, which consist primarily of rivers, streams, and other moving waterways. Oregon's proposed criteria, however, are based on tests performed in static water unless such information is unavailable. The criteria thus fail to adequately assess the risks to, and thus protect, Oregon's designated and existing uses.

EPA's Response to Comment H:

While EPA prefers the results of flow-through acute tests, then static-renewal tests, over results of static acute tests (as stated in EPA's response to Comment F), EPA disagrees with the overall premise of the comment—that Oregon's new and revised aquatic life criteria all fail to protect Oregon's Fish & Aquatic Life designated use, due to reliance on data from static acute tests.

When flow-through or static-renewal acute test data are available, EPA does not use results of static acute tests. Data for static tests is used only when no other relevant data is available and when there are no concerns regarding volatility or other interference in the test, except in certain cases as identified in ASTM or EPA toxicity testing standards. This is done to maximize the amount of acute data for species used in the derivation of the FAV and to ensure protection of all species tested by using the fullest quality data set available. EPA decided that it was better to use acute values for more species rather than reject results of all static acute toxicity tests. Further, flow-through tests do not necessarily yield lower, more protective values; chemicals that are stable in water may not exhibit increased toxicity in flow-through tests.

More importantly, EPA does not use results of static chronic tests; acceptable chronic tests must be flow-through or renewal tests in order to guarantee constant concentrations and water quality during the timeframe in which the test is performed. The chronic criterion concentration of high BCF chemicals is of much more regulatory significance than the acute criterion concentration due to their bioaccumulative nature.

The commenter cited a study which found that static test results were twenty times less protective than flow-through tests for DDT. As a practical matter, the acute tests for DDT have no regulatory or environmental relevance, whether they are static or flow-through tests, because the chronic criterion concentration for DDT was derived independently of the acute tests (see Appendix I) with more robust direct chronic data. Consequently, it is not clear why this issue is raised for DDT. If the commenter is implying that results of static acute toxicity tests are typically 20-fold higher than the results of flow-through acute toxicity tests for other pollutants, such a conclusion is unfounded. Organic pollutants with large bioconcentration factors (BCFs) are likely to show larger differences between static and flow-through acute toxicity tests than other pollutants, but such pollutants are also ones for which the CCC (based solely on non-static test data) is much more important than the acute criterion concentration as discussed above.

Comment I: Oregon's Proposed Criteria Fail To Adequately Consider Impacts Of Water Hardness And pH On Toxicity And Thus Fail To Protect Designated And Existing Uses.

Oregon's proposed criteria use a hardness-dependant formula for metals that does not consider other variables that affect the toxicity of a pollutant and, as a result, does not protect designated and existing uses. In general, the toxicity of certain metals decreases as the hardness of the ambient water increases. EPA measures hardness as a ratio of calcium to magnesium. The hardness-based formula, however, is not protective of designated uses.

The hardness-based formula established by EPA does not consider other environmental variables, such as dissolved organic carbon (DOC) and pH which affect the degree to which hardness influences toxicity. Scientists have demonstrated repeatedly that hardness is just one of the influences on toxicity. One study determined that pH values had a greater impact on toxicity than hardness. As pH increased from 7.17 to 8.58, the level of toxicity necessary to cause death to half the test population decreased nearly three-fold. The same results occurred as the alkalinity was adjusted from 20 to 600 mg/L CaCO3. Similar results occurred as the water hardness was adjusted. Another test showed that the addition of small quantities of sodium chloride (common salt) increased toxicity. In addition, researchers have demonstrated that both alterations in pH and DOC affect copper toxicity to daphnia. Researchers have also found that DOC is important in controlling toxicity of copper in fathead minnows. These studies provide convincing evidence that natural variables, in addition to hardness, significantly affect the toxicity of contaminants. Despite this, however, only hardness is considered in establishing criteria.

In the case of silver, scientists discovered that hardness is not the most important variable influencing its toxicity. The Services noted that "recent science challenges the EPA concept of hardness as having a large ameliorating effect on aquatic toxicity of silver." Researchers have found that calcium, by itself, is not the most protective constituent for silver. Their work concluded that DOC is more important than hardness for predicting the toxicity of ionic silver in natural waters to rainbow trout, fathead minnows, and daphnia.

Scientists have also recently developed complex gill surface interaction models to account for waters of different chemical compositions. A new model tests the additive or synergistic relationship of various metals on gill toxicity and reports that a number of factors in addition to calcium influence toxicity.

Research thus demonstrates that Oregon's hardness formula oversimplifies the interactions of multiple chemicals, resulting in metals criteria that are underprotective of aquatic uses. The Services interpreted this research by stating, "the use of hardness alone as a universal surrogate for all water quality parameters that may modify toxicity, while perhaps convenient, will clearly leave gaps in protection when hardness does not correlate with other water quality parameters such as DOC, pH, Cl- or alkalinity." Five years after the Services made this observation, EPA continues to rely on outdated hardness data alone. Similarly, Oregon's failure to use more accurate science and its reliance on an oversimplified and scientifically unsound model renders the proposed criteria unprotective of designated and existing uses.

EPA's Response to Comment I:

EPA disagrees with the comment that Oregon's new and revised aquatic life criteria for metals fail to protect Oregon's Fish & Aquatic Life beneficial use because they fail to adequately consider impacts of hardness and pH on toxicity. The commenter provides some discussion of hardness-based criteria and the biological opinion concerning the CTR, but the commenter presents no specific data demonstrating that Oregon's criteria fail to protect Oregon's designated use.

Additive and synergistic interactions have been addressed in EPA's response to Comment A.

Hardness is a variable that has been demonstrated to correlate with change in the toxicity of many metals. For some metals the effect might be, wholly or partially, due to variables such as alkalinity and pH that are usually correlated with hardness. In the derivation of criteria EPA does examine the effects of pH, temperature, and other tested water chemistry variables on toxicity, where there are sufficient data to determine such relationships (e.g., ammonia criteria).

The presence of dissolved organic carbon (DOC) decreases the toxicity of most metals. EPA intentionally uses results of acute toxicity tests performed in dilution waters that have low concentrations of DOC. Therefore, not taking DOC into account in the derivation of an aquatic life criterion generally has the effect of preserving the protectiveness of criteria, not rendering the criteria less protective. Very few surface waters would have DOC concentrations even lower than the dilution waters used in acceptable laboratory toxicity tests contain. Thus, the metal and other water quality criteria determined using tests waters with low DOC yield values that are generally expected to be more protective, not less, than would be determined in natural waters.

Although it is true that speciation and site-water chemistry can affect toxicity and that the criteria do not account for some of these factors, EPA does not agree that the criteria are underprotective of designated and existing uses. There are inadequate data on enough species and conditions to adjust for all important factors in the criteria, although current work is addressing these issues with increasing specificity. However, this uncertainty is insufficient reason to refuse to adopt and implement criteria based on the best science presently available; criteria are sufficiently protective of most receiving waters without modification, and can be appropriately adjusted for other waters through the development of site-specific criteria.

Comment J: Oregon's Proposed Criteria Do Not Protect Species From Sublethal Effects Of Toxic Pollutants And Therefore Do Not Adequately Protect Designated And Existing Uses.

Oregon's proposed criteria do not protect designated and existing uses because the criteria do not defend against sublethal effects, such as species' decreased ability to obtain food, escape predators, or produce successful offspring due to functional impairment. Functional impairment includes developmental, endocrinal, reproductive, neurological, or immuniologic impairment. Oregon's proposed criteria neglect toxic pollutants' contribution to functional impairment in designated uses, even though the CWA mandates the protection of the most sensitive designated uses and the restoration of the physical, chemical, and biological integrity of the nation's waters. By not considering the sublethal effects of toxic pollutants, Oregon has failed to protect the most designated uses in the manner required by the CWA.

Studies demonstrate that Oregon's proposed criteria are not protective of designated uses, including threatened and endangered species, because sublethal effects result from pollutant concentrations that fall well below Oregon's proposed criteria. As an example, one study showed that very low concentrations of endosulfan cause sublethal effects in salamanders. The study demonstrated that 0.5 µg/L of endosulfan disrupted the pheromonal communication system of female red-spotted newts. Pheromone disruption resulted in decreased mate selection and mating success for the exposed newts. The sublethal effects manifested themselves, even though there were no outward signs of toxicosis. In contrast to the low levels of endosulfan that caused these results, Oregon's proposed criteria do not protect aquatic life from endosulfan whatsoever, and the human health criterion is 62 µg/L, well above the concentration of endosulfan that caused sublethal effects in newts. Oregon's proposed criteria simply do not protect designated uses because they fail to protect species against sublethal effects, such as the ones demonstrated in the endosulfan tests.

Similarly, Oregon's proposed criteria do not consider, and thus do not protect against, immunosuppression and lower disease resistance that result from exposure to toxic pollutants. A study comparing the disease resistance of Chinook salmon in Oregon's polluted estuaries versus the disease resistance of Chinook salmon in Oregon's less polluted waters demonstrated that "juvenile fall chinook salmon from polluted estuaries are immunosuppressed and are more susceptible to disease than those from less polluted waters." This field study corroborates a recent laboratory experiment in which scientists administered sublethal doses of polycyclic aromatic hydrocarbons (PAHs) and PCBs to juvenile chinook. The exposed fish exhibited suppression of their primary and secondary plague-fighting cells' response to an antigen, as well as an increase in disease susceptibility. The scientists concluded that, while disease is a natural occurrence, pollution "may significantly shift the balance between salmon survival and mortality due to disease." Another study compared fish responses to two stressors, a natural parasite and a PCB mixture. The results showed that, in combination, the natural and anthropogenic stressors have a greater adverse effect on salmon health than either stressor alone. Since natural waterways contain several natural parasites, diseases, and other stressors, it must be concluded that the addition of anthropogenic pollutants will lower species' natural resistance to these natural stressors. Oregon's proposed criteria, however, were established through tests conducted in purified laboratory water and do not consider the potential for pollutants to affect species' immunosuppression, disease resistance, or ability to fend of parasites. As such, Oregon's proposed criteria fail to protect against demonstrated risks to designated uses and thus fail to meet the requirements of the CWA.

Reduced physical performance is another sublethal effect that Oregon does not incorporate into its proposed criteria. One study showed that low doses of ammonia affected the swimming performance of coho salmon. At 0.04 mg/L of ammonia in water, the swimming velocity of coho noticeably decreased. At 0.08 mg/L, there was a marked decrease in swimming efficiency. Very low doses of ammonia, therefore, can induce the sublethal effects of reduced swimming performance which, in turn, affects the species' survival. These concentrations of ammonia are two orders of magnitude less than EPA's recommended criteria and Oregon's proposed criteria of 24 mg/L for salmonids. In failing to account for these sublethal effects, Oregon's proposed criteria clearly do not protect designated uses, particularly threatened and endangered salmonids.

EPA's Response to Comment J:

EPA disagrees with the comment that Oregon's new and revised aquatic life criteria all fail to protect Oregon's Fish & Aquatic Life beneficial use because they do not protect species from sublethal effects of toxic pollutants. EPA's methodology for deriving aquatic life criteria considers available data concerning "cumulative and delayed toxicity, flavor impairment, reduction in survival, growth, or reproduction, or any other adverse effect that has been shown to be biologically important."[36] Such data can be used to lower the CCC if sublethal effects indicate that a lower value should be used. Furthermore, chronic tests inherently include measures of sublethal effect such as effects on growth and reproduction.

[36] Reference 1. PB85-227049. Section X Other Data and Section XI Criterion.

While it is possible that some sublethal effects may not be identified in standard toxicity tests, many sublethal effects will have no bearing on the survival of organisms or maintenance of a population due to the lack of a biological link to disruption of natural homeostatic function. The National Academy of Sciences report "Toxicity Testing in the 21st Century" (NAS/NRC, 2007, p.6) notes that ". . . at low doses, many biological systems may function normally within their homeostatic limits."

Regarding the Park *et al* (2001) study of salamander reproductive disruption claimed by the commenter to be relevant to this action regarding reproductive success: The commenter is incorrect in stating that Oregon's "proposed criteria do not protect aquatic life from endosulfan whatsoever." In fact, the magnitude of Oregon's chronic criterion for endosulfan (0.056 µg/L) is almost an order of magnitude lower than the 0.5 µg/L referenced above.

The commenter alludes to data regarding the impacts of polluted waters on the immune system of chinook salmon, but no specific chemical criteria are discussed in relation to the data presented, other than for PAHs and PCBs. Oregon did not propose new or revised aquatic life criteria for PAHs or PCBs. Because there are no revised aquatic life criteria for EPA to review for PAHs or PCBs in this action, these comments are not pertinent to EPA's action.

The cited study by Wicks et al. (2002) is, in fact, included in EPA's analysis of the submitted ammonia criteria. Also, the comment mentions information on the effect of ammonia on swimming performance of coho salmon, but does not include sufficient information for EPA to use the referenced information. From the magnitude of the effect concentrations, it is clear that the comment refers to un-ionized ammonia concentrations, which are a small fraction of total ammonia, and cannot be translated to the total ammonia nitrogen (the units of the criterion) without knowing the pH and temperature of the study, for which the comment provides no reference information. EPA has thus considered the comment but finds the information to be too incomplete to be used scientifically. Please see the comment and response concerning ammonia in the Specific Pollutant Concerns section at the end of this document. Consequently, EPA disagrees with the commenter's comment that EPA is failing to consider sublethal effects of toxic pollutants.

See General Response 4 concerning ESA listed species and Response to Comment F regarding chronic criteria.

Comment K: Oregon's Proposed Criteria Do Not Account For Hundreds Of Dioxins, Furans, And PCBs, And Thus Fail To Protect Designated And Existing Uses.

EPA's Response to Comment K:

EPA responded to Comment K in its June 1, 2010 *Supplemental Response to Comment Submitted by Northwest Environmental Advocates [NWEA} as They Pertain to Oregon's New and Revised Human Health Water Quality Criteria for Toxics Submitted on July 8, 2004.* For the full comment and EPA's response, please see pages 15-17 of the referenced document.

Comment L: Oregon's Proposed Criteria Do Not Include Protections Against Endocrine Disrupting Chemicals And Thus Fail To Protect Designated And Existing Uses.

Oregon's proposed criteria do not protect designated uses because the criteria fail to defend against endocrine disrupting chemicals (EDC) that adversely affect organisms at concentrations well below Oregon's criteria. The scientific community, including EPA, recognizes that many pollutants can disrupt the hormonal balance controlled by the endocrine system. EDCs disrupt thyroid hormones, androgens, estrogens, and other endocrine processes. Endocrine disruption may have profound effects, including feminization of males, decreased offspring survival, alteration of the immune system, and behavioral changes. Despite the known presence of EDCs in Oregon's waters and the significant harm that EDCs cause, Oregon has failed to include in its water quality standards protections against these chemicals. As a result, Oregon's proposed criteria do not protect designated uses.

Federal agencies have long been aware of endocrine disruption. In its proposed statement of policy for the long-term Endocrine Screening Program, EPA stated, "[t]aken collectively, the body of scientific research on human epidemiology laboratory animals, and fish and wildlife provides a plausible scientific hypothesis that environmental contaminants can disrupt the endocrine system leading to adverse-health consequences." The National Toxicology Program, which consists of a panel of academic, government, and industry scientists, similarly determined that there is "credible evidence" that some hormone-like chemicals can affect test animals' bodily functions well below the "no effect" levels determined by traditional testing and used as a basis for Oregon's new criteria. The report stated, "[l]ow-dose effects, as defined for this review, were demonstrated in laboratory animals exposed to certain endocrine active agents." Low dose effects were clearly demonstrated for estradiol and several other estrogenic compounds, methozychlor (an insecticide), and nonylphenol (an industrial compound identified in drinking water supplies).

Recent studies have shown disturbing effects of EDCs at very low concentrations. For example, Professor Hayes at the University of California found that extremely low concentrations of atrazine (0.1 ppb or µg/L) cause hermaphradotism in male leopard frogs in the laboratory. Hayes also conducted broad field studies across the Great Plains that corroborated the lab results. Hermaphradotism in leopard frogs was widespread, but only in locations where atrazine was present. Twenty-nine percent of the frogs exposed to 0.1 ppb of atrazine showed some degree of sex reversal, whereas none of the frogs in the control group (in which no atrazine present in the water) showed any sex reversal. Hayes' results show that extremely low concentrations of a pesticide can disrupt hormonal processes of aquatic life.

Many of the pesticides contained in Oregon's water quality standards are EDCs. Oregon's criteria, however, were developed using traditional toxicological parameters, omitting any inclusion of the pollutants' effects on the endocrine system. For example, Oregon's water quality standards do not address atrazine at all, even though it is one of the most widely used herbicides. For those pollutants for which Oregon has proposed water quality criteria, Oregon has utterly ignored their endocrine disrupting effects. Because Oregon's proposed criteria do not consider EDCs, they do not protect designated uses and EPA should disapprove the standards.

EPA's Response to Comment L:

EPA disagrees with the comment that Oregon's new and revised aquatic life criteria all fail to protect Oregon's Fish & Aquatic Life beneficial use because certain other criteria, relating to endocrine disrupting chemicals (EDCs), were not included in the submission upon which EPA is acting. Specifically, Oregon did not submit new or revised aquatic life criteria for estradiol, methoxychlor, nonylphenol, or atrazine. These substances are therefore not being reviewed in this action. The commenter's contention that Oregon needs to adopt additional criteria (chosen based on those additional pollutants' effects on the endocrine system) simply does not bear on the question currently before EPA: whether or not to approve the particular new and revised criteria that Oregon *actually did* adopt and submit to EPA's review.

In general, EDCs pose a challenge because of their complex nature and their potential effects on aquatic life, humans, and wildlife. A major issue that must be addressed for endocrine disruption is the need to define what constitutes an "adverse effect," especially considering that effects might be observed from the molecular level to the community level. According to EPA's interim position, the Agency does not consider endocrine disruption to be an adverse effect *per se*, but rather a mode of action potentially related to other outcomes, such as carcinogenic, reproductive, or developmental effects, that are routinely used in making regulatory decisions.[37]

In 2004, Oregon adopted new aquatic life criteria for tributyltin (TBT) which, in part, acts as an EDC. TBT is a highly toxic biocide that has been used extensively in anti-fouling paint to protect the hulls of large ocean-going ships. It is deemed a problem in the aquatic environment because it is extremely toxic to non-target organisms and has been linked to imposex (i.e., the superimposition of male anatomical characteristics on females) and to immuno-supression in snails and bivalves (U.S. EPA 2003) in valid scientific studies. The low effect concentrations established for female gastropods in the laboratory were subsequently corroborated in field studies. The saltwater CCC was lowered based on the professional judgment that these effects were relevant for the risks of TBT to gastropod reproduction.

Comment M: Oregon's Proposed Criteria Do Not Provide Adequate Protections For Endangered And Threatened Species.

Studies demonstrate that Oregon's proposed criteria jeopardize several threatened and endangered species. The Services found that the CTR criteria, which are very similar to Oregon's proposed criteria, jeopardize several threatened and endangered species that occur in Oregon, including bald eagle, California brown pelican, California least tern, marbled murrelet, western snowy plover, and several salmonid species. The Services concluded, based on an extensive review of the literature, that the criteria do not protect physiological needs of the species, mostly due to bioaccumulation. As with the CTR criteria, Oregon's proposed criteria fail to protect imperiled species.

The criteria do not protect threatened or endangered populations that are inherently stressed due to low numbers, decreased genetic diversity, reduced geographic range, or health and reproductive problems. In adopting the EPA recommended criteria, Oregon noted that EPA's criteria arc intended to protect "at least 95% of the species" because "aquatic ecosystems are tolerant of some stress". This statement, however, does not begin to address the requirements of threatened and endangered species. Oregon's threatened and endangered species cannot tolerate any additional stress. The environmental baseline for these species is, by definition, bordering on extinction. For example, the stresses on threatened or endangered salmon include habitat loss, dams, competition

[37] EPA, 1997. Special Report on Environmental Endocrine Disruption: An Effects Assessment And Analysis. EPA/630/R-96/012. http://oaspub.epa.gov/eims/eimscomm.getfile?p_download_id=36841

and disease from hatchery fish, elevated temperature, and decreased dissolved oxygen. Even if the proposed toxic criteria were accurate and protected species with a healthy population (Oregon's criteria do not), the assumption that all species can tolerate additional stress is faulty and will result in adverse effects on threatened and endangered species that are already overstressed.

In addition, criteria designed to protect ninety-five percent of the species present must, by definition, sacrifice five percent. The ESA proscribes any unauthorized "take" of any listed species. Therefore, the policy to protect ninety-five percent of the species is contrary to the ESA unless the agency can demonstrate that the sacrificed five percent does not contain any listed species. This is unlikely, however, because many threatened and endangered species, such as salmonids and the California tern, are more likely than other species to be adversely affected by bioaccumulative toxic pollutants because they eat at high trophic levels.

Listed species that use aquatic habitats or prey are in peril because the regulatory system is not working to protect them. For example, chemicals such as atrazine are not regulated to protect against detrimental impacts from their effects on aquatic and wildlife species, including threatened and endangered species. It is unrealistic to design water quality standards to sacrifice five percent of species, and then assume that none of the five percent sacrificed are threatened or endangered. Oregon's criteria will cause further harm to already imperiled species and thus do not protect designated uses that are also listed as threatened and endangered species.

EPA's Response to Comment M:

See General Response 4 concerning ESA listed species and General Response 5 concerning wildlife. Specifics covering the percentile protections are addressed directly in the response to Comment F.

Comment N: Oregon's Proposed Criteria Do Not Contain Wildlife Criteria And Thus Do Not Protect All Designated Uses.

EPA rules require states to protect wildlife as a designated use. When classifying designated uses, a state must consider "protection and propagation of fish, shellfish and *wildlife*." EPA's Water Quality Standards Handbook provides, "[s]tates must provide water quality for the *protection and propagation of fish, shellfish, and wildlife, and provide for recreation in and on the water* where attainable." The Handbook further provides, "[w]ildlife protection should include waterfowl, shore birds, and other water emigrated wildlife." As required by federal rule, wildlife is a designated use in Oregon. Oregon's proposed water quality criteria, therefore, must protect the designated use of wildlife.

Oregon's proposed criteria do not, however, protect wildlife. Oregon proposes to adopt EPA's recommended criteria, which scientists have condemned as not protective of wildlife. (*See, e.g., infra*, for criticism of selenium, mercury, PCP, and cadmium criteria.) Oregon's proposed standards contain criteria to protect only aquatic life and human health. The standards do not contemplate aquatic-dependent wildlife, such as shorebirds, bald eagles, mink, and otter. Rather than establish wildlife criteria, Oregon relies on chronic aquatic life criteria to serve as a proxy for wildlife-specific criteria. However, aquatic criteria do not serve as an adequate proxy for wildlife-specific criteria, as the chart below shows. This chart compares Oregon's proposed chronic aquatic life criteria with the criteria developed by EPA to protect wildlife for in the Great Lakes Initiative

(GLI). It makes clear that the GLI criteria are at least an order of magnitude more protective than Oregon's proposed criteria.

Pollutant	*GLI*	*Oregon Chronic Aquatic Life*
DDT	0.000011 µg/L	0.001 µg/L
Mercury	0.0013 µg/L	0.012 µg/L
PCBs	0.00012 µg/L	0.014 µg/L
2,3,7,8 TCDD	0.0000000031 µg/L	None

Similarly, New Jersey's water quality standards for toxic pollutants demonstrate not only that states and EPA are able to develop criteria for wildlife but that EPA has, in other states, made a commitment to do so because toxic criteria for the protection of human health and aquatic life are not sufficient to protect designated uses. In 2001, New Jersey completed an analysis on which to base its criteria for the protection of wildlife for DDT and its metabolites, mercury, and PCBs. The state and federal agencies involved used the same test doses, uncertainty factors, water and food consumption rates, animal weights, and equation for deriving wildlife values as the Great Lakes Water Quality Initiative. Proposed in 2002, values derived for Peregrine falcon were used to establish the regulatory criteria because, of the species evaluated, falcon's consumption of piscivorous birds, rather than fish, placed it at the highest risk. The proposed values were as follows: 0.000004 for DDT and its metabolites; 0.00053 for mercury; and 0.000072 for PCBs µg/L (ppb). In addition, New Jersey prohibited mixing zones for new discharges of bioaccumulative chemicals of concern with a bioaccumulation factor of greater than 1000 L/kg based on the need to protect beneficial uses from bioaccumulative pollutants.

Moreover, the Services, in the CTR BiOp, have already concluded the 0.3 ug/g human health tissue residue concentration (TRC) criterion for mercury does not protect several threatened or endangered species present in Oregon. These examples demonstrate that Oregon's aquatic life criteria do not protect wildlife. EPA must disapprove any criteria that do not protect wildlife and either direct Oregon to establish protective criteria or use its own authority to establish criteria protective of wildlife.

EPA's Response to Comment N:

See General Response 4 concerning ESA listed species and General Response 5 concerning wildlife.

Comment O: EPA Must Review And Disapprove Any Unidentified, Substantive Revisions That Oregon Made To Its Toxic Narrative Criteria

Oregon submitted new water quality standards to EPA on December 10, 2003. Most of the changes regarded temperature, but there were also changes to the toxic narrative standards. EPA approved these changes on March 2, 2004 without review. CWA section 303(c)(3) requires that the EPA determine whether the revised or new standard submitted by the state meets the requirements of the chapter. EPA overlooked the substantive changes to the revised standards, and, as a result, failed to determine if the standards met the requirements of the chapter pursuant to section 303(c)(3). In addition, EPA's approval of Oregon's standard is arbitrary and capricious under section 706 of the Administrative Procedure Act because EPA approved Oregon's standards without considering these substantive changes.

EPA's Support Document states that the changes to Oregon's toxic standards are "non-substantive editorial changes or corrections that do not alter the substance of the water quality standards that EPA has previously approved." This statement is incorrect. DEQ substantively changed its rules regarding toxic pollutants. DEQ changed the substantive requirements of its toxic standards by replacing imperative terms, such as "shall," with permissive terms, such as "may." DEQ's previous standards on toxic pollutants are ordained in OAR 340-041-0205(A), which provides, "[t]oxic substances shall not be introduced above natural background levels . . ." The new rule, OAR 340-041-0033(1), changes "shall not" to "may not." In addition, OAR 340-041-0033(2) also, changes "shall not" to "may not." These are substantive changes because "shall" indicates a mandatory term whereas "may" is generally permissive. While "may not" could be seen as a prescriptive term, it also could convey an element of discretion that did not exist in the previous rules. Since Oregon did not identify the reason for these changes and did not indicate the meaning that it intends for "may not" to now have, EPA must assume that the changes from "shall not" to "may not" were deliberate and substantive changes. Therefore, the old narrative criteria prohibited toxic substances above background levels whereas the new narrative criteria do not. No antidegradation review was conducted on this change.

Another rule changes "shall" to "will." "Shall" provides a mandatory duty, whereas "will" may indicate a future intent that is not a legally binding commitment enforceable under the APA. The old rule provides, "[i]f toxicity occurs, the Department *shall* evaluate and implement necessary measures to reduce toxicity on a case-by-case basis." The new rule provides, "[i]f toxicity occurs, the Department *will* evaluate and implement necessary measures to reduce toxicity on a case-by-case basis". By changing the language of the rules, particularly without providing any explanation for the changes, DEQ must be assumed to have substantively altered the meaning of the rules. EPA must therefore review the revised toxic standards pursuant to 33 U.S.C. § 1313(c)(3).

DEQ also revised OAR 340-041-0205(D), an important provision that requires the Department to conduct bioassessment studies once the Department deems the studies necessary. The old rule provided:

> Bioassessment studies such as laboratory bioassays or instream measurements of indigenous biological communities, shall be conducted, as the Department deems necessary, to monitor the toxicity of complex effluents, other suspected discharges or chemical substances without numeric criteria, to aquatic life. These studies, properly conducted in accordance with standard testing procedures, may be considered scientifically valid data for, the purposes of paragraph (c) of this subsection. If toxicity occurs, the Department shall evaluate and implement measures necessary to reduce toxicity on a case-by-case basis.

The old rule required that a bioassessment be conducted if the Department deems it necessary. The old rule, therefore, provides both a discretionary duty and a nondiscretionary duty. It gives the Department the discretion to deem a study necessary. Once the Department deems, that a study is necessary, the performance of the study is nondiscretionary (the "study shall be conducted").

In contrast, the new rule provides:

> If the Department determines that it is necessary to monitor the toxicity of complex effluents, other suspected discharges or chemical substances without numeric criteria to aquatic life, then bio-assessment studies may be conducted. Laboratory bioassays or in-stream measurements of indigenous biological communities, properly conducted in accordance with standards testing procedures, may be considered as scientifically valid data for the purposes of section (3) of this rule. If toxicity occurs, the Department will evaluate and implement necessary measures to

reduce or eliminate the toxicity on a case-by-case basis.

The new rule states even if the Department satisfies the prerequisite and deems a study necessary, the Department retains discretion to forego the study ("may be conducted").

The new rule substantively differs from the old rule. First, the new rule requires the Department to deem a study necessary for one of the three listed purposes, whereas the old rule grants the Department discretion to conduct a study "as [it] deems necessary." The new rule, therefore, limits the Department's discretion to conduct important bioassessment studies and may require the Department to make an affirmative finding of necessity for each study it wishes to conduct. Second, the statement in the new rule that "bioassessment studies may be conducted" gives the Department full discretion to refuse to conduct a bioassessment even if the study is deemed necessary. The old rule ("shall be conducted") provides a nondiscretionary duty to conduct a study when the Department deemed a study necessary. The new rule removes this duty.

EPA failed to identify any of DEQ's substantive changes discussed above as requiring EPA review. NWEA informed EPA that DEQ substantively changed its rules without notifying the public or EPA. NWEA specifically pointed out changes of "shall" to "may" in a letter to EPA and comments forwarded to EPA. Inexplicably, however, in the EPA support document for approval of the rule, EPA stated, "[a]ll underlined text indicates the actual change or revision to the rule unless otherwise noted." The only underlined text in this section is the editorial change from "paragraph" to "section" and "subsection" to "rule." DEQ underlined these same two changes in its submission to EPA. Apparently, EPA relied on DEQ's misrepresentation that the changes it made to the narrative criterion for toxics were simply editorial. However, as explained above, DEQ altered much more than either DEQ or EPA identified. Because the new rule is subject to a different interpretation from the old rule, EPA must consider the effects that these revisions will have on Oregon's water quality standards.

DEQ's revisions of OAR 340-041-0033(1) and (4) weaken the narrative criteria. The narrative criteria in OAR 340-041-033(1) and (4) are meant to fill the gaps left by inadequate numeric standards. Subsection (1) provides the general narrative statement that "[t]oxic substances may not be introduced above background levels… in amounts, concentrations, or combinations that may be harmful…" Subsection 4 authorizes DEQ to conduct bioassessment studies to evaluate whether the standards are protecting aquatic life and to implement protective measures if toxicity occurs. EPA and DEQ recognize the importance of bioassessments for protection of aquatic life. This importance is undermined by these unidentified changes.

Oregon's narrative criteria assume added importance because the state's numeric criteria are less stringent than EPA requirements (which themselves are not adequately protective) for some toxic pollutants. EPA is well aware of the essential gap-filling nature of the narrative criteria. Indeed, in reviewing the CTR, EPA noted that it could justify the proposed numeric criteria only because the narrative criteria would be heavily used to fill in the gaps left by the inadequate numeric criteria. Due to the vital role of Oregon's narrative criteria, EPA must scrutinize any changes made to the criteria.

EPA's failure to review Oregon's revised water quality standards for toxic pollutants is a violation of CWA section 303(c)(3).

EPA's Response to Comment O:

EPA provided its response to each of the issues raised in Comment O in its February 8, 2005 letter to Holly Schroeder, Oregon Department of Environmental Quality (Re: Provisions in Oregon's water quality standards submission that EPA did not act on.)

Comment P: Oregon's Proposed Criteria Do Not Protect Designated Uses Because Oregon's Water Quality Standards Lack A Narrative Implementation Methodology.

EPA's Response to Comment P:

EPA responded to Comment P in its June 1, 2010 *Supplemental Response to Comment Submitted by Northwest Environmental Advocates [NWEA} as They Pertain to Oregon's New and Revised Human Health Water Quality Criteria for Toxics Submitted on July 8, 2004.* For the full comment and EPA's response, please see pages 19 - 21 of the referenced document.

SECTION V. SPECIFIC POLLUTANT CONCERNS

A. Selenium

1. *Oregon's proposed selenium criterion does not protect designated uses.*

There is widespread scientific agreement that Oregon's proposed freshwater chronic criterion for selenium, 5 µg/L, does not protect designated uses because selenium is strongly bioaccumulative. The Services stated, "nearly every major review of experimental and field data conducted over the past decade has concluded that a chronic criterion of 5 µg/L is not fully protective of fish and wildlife resources." EPA's public notice of this recommended criterion stated that the chronic criterion of 5 µg/L, for selenium continues to be scientifically valid and protective of aquatic life. This is not so. As the Services stated, "In the aggregate, the weight of scientific evidence supporting a chronic criterion for selenium of <2 µg/L is now overwhelming."

In addition, Oregon's proposed freshwater aquatic life *acute* criterion for selenium does not protect designated uses because selenium bioaccumulates quickly and affects designated uses at concentrations below the proposed criterion. Oregon adopted the EPA recommended criterion, which is a speciation-weighted criterion based on the relative concentrations of selenite, selenate, and all other forms of selenium found in a water body. Based on the formula, the range of potential criteria is 12.8 (if one hundred percent selenate) to 185.9 (if one hundred percent selenite). The Services determined that "the promulgation of the proposed speciation weighted acute criterion for selenium in the CTR would not afford adequate protection to listed species." Selenium bioaccumulates rapidly in aquatic organisms and a single pulse of selenium (>10 µg/L) into aquatic ecosystems could have lasting effects, including elevated selenium concentrations in aquatic food webs. In addition, Oregon's speciation-weighted criterion assumes that selenate is more toxic than selenite, an assumption that runs opposite of the findings of most studies.

The Services stated that the EPA recommended acute criterion "may fail to adequately protect aquatic dependent fish and wildlife." because of the pulse-effect hypothesis. This was demonstrated by a study that evaluated a pulse of 23 µg/L selenium discharged into a wetland that usually had a selenium concentration of 2 to 3 µg/L. Three months after the pulse, and without any additional selenium pulses, twelve percent of avian eggs sampled at the site contained greater than 6 µg/L selenium, a level that exceeds the exbryotoxic risk threshold. The pulse of 23 µg/L selenium, which was well within the EPA recommended acute criterion, created an unacceptable level of risk. The rapid uptake of this selenium pulse and the resultant toxic effects demonstrate the need for a much lower acute criterion.

2. *The proposed selenium criterion does not account for bioaccumulation and harm caused by other stressors.*

The proposed selenium criterion does not protect aquatic life and wildlife because selenium bioaccumulates in aquatic organisms. Bioaccumulation results in a marked elevation of residues in food-chain organisms as compared to waterborne concentrations. Therefore, relatively low concentrations of selenium in the water can result in dangerous concentrations of selenium in organisms. For example, laboratory studies show that organoselenium compounds can be bioconcentrated over 200,000 times by zooplankton when water concentrations are 0.5 to 0.8 µg/L, which is well under the Oregon proposed criteria of 5 µg/L. The selenium concentrations in the zooplankton of these were 100 µg/g, much higher than the dietary toxicity threshold for fish (0.3 µg/g).These results demonstrate that water concentrations of selenium that are permissible under Oregon's proposed criteria result in extremely high tissue concentrations in aquatic life.

Field studies similarly demonstrate selenium bioaccumulation factors of 500 to 35,000 in contaminated aquatic habitats where the water concentration of selenium ranged from 2 to 16 µg/L. Based on waters containing 1-5 µg/L of total selenium, composite bioaccumulation factors for aquatic food-chain items are typically between 1,000 and 10,000. Oregon's proposed chronic criterion of 5 µg/L, therefore, permits bioaccumulation factors of 1,000-10,000.

Because selenium is highly bioaccumulative, the majority of scientists recommend a chronic aquatic life criterion much lower than Oregon's proposed 5 µg/L criterion. Lemly stated, "based on risk from bioaccumulative dietary toxicity, a generic aquatic life criterion in the range 0.2 to 2 would be justified." Lillebo concluded that a chronic criterion of 0.9 µg/L for total selenium is required to protect fish. Person and Nebeker stated that 1 µg/L for wildlife is warranted. Each of these recommendations is significantly lower than the 5 µg/L chronic criterion proposed by Oregon. In addition, Lemly synthesized the scientific literature on selenium and concluded that a chronic criterion greater than 2 µg/L will cause food chain bioaccumulation and reproductive failure in fish and piscivorous birds. In sum, Oregon's new criterion of 5 µg/L is much less protective than the recommendations from USFWS and academia. It is abundantly clear that Oregon's proposed 5 µg/L criterion, therefore, does not protect beneficial uses.

In addition, Oregon's proposed criterion does not protect aquatic life because natural stressors reduce an organism's ability to survive toxic contamination. The purified laboratory tests, upon which EPA and Oregon based the criterion, do not account for stressors. Any metabolic stressor - including winter stress syndrome, migration, smoltification, and pathogen challenges - may lower the toxicity threshold. Albers et al. concluded that the dietary toxicity threshold in the presence of winter stress was only half the threshold level for selenium as a solitary stressor. Accordingly, criteria based on single stressor data should be reduced by at least a factor of two.

Furthermore, the Services provide additional reasons why Oregon's proposed selenium chronic criterion of 5 µg/L does not protect designated uses. First, EPA's criterion of 5 µg/L is based, in part, on inaccurate or misinterpreted field data from Belews Lake, North Carolina. EPA claimed that aquatic life in the lake was unaffected at 5 µg/L. Dr. Lemly reexamined the lake and found multiple lines of evidence that indicated adverse effects of selenium on fish in the lake at concentrations of 0.2 - 4 µg/L. Second, wildlife exposed to elevated levels of selenium are more susceptible to pathogens. Third, Oregon's criterion does not address the effects of chemical synergism. Other contaminants act as stressors that make wildlife vulnerable to lower levels of selenium. The Services cite a study of ninety-eight Swedish lakes that concluded that 1-2 µg/L was the maximum safe criterion. Another study upon which the Services depended in the CTR BiOp cites very strong synergistic effects between dietary organo-selenium and organo-mercury with regard to reproductive impairment of mallards.

In 2000, the Services issued a draft jeopardy opinion for the CTR because the 5 µg/L selenium criterion would jeopardize fifteen ESA-listed species. Four years later Oregon has submitted the same unprotective criterion to EPA. In those four years, scientists have further demonstrated that 5 µg/L is not protective of fish and birds due to selenium's highly bioaccumulative properties. Therefore, EPA must disapprove Oregon's selenium criterion. In fact, this criterion should be based on a tissue residue criterion that is protective of threatened or endangered salmonids and aquatic-dependent wildlife. The Services took this position in the CTR BiOp:

> There is a strong need for developing a method to link criteria directly to food chain contamination. In the absence of site-specific and species-specific data regarding the sensitivity of particular species and for threatened and endangered species of fish and wildlife, a general criterion of at least 2 µg/L is required to assure adequate protection of threatened and endangered fish and wildlife. This is especially warranted considering the well-demonstrated potential for selenium facilitated pathogen susceptibility that can rapidly extirpate entire populations of fish and wildlife via epizootic events.

3. *Field data from Belews Lake show that Oregon's proposed selenium criterion will not protect designated uses.*

The Belews Lake, North Carolina selenium poisoning serves as an important case study to demonstrate the hazards of selenium bioaccumulation. During ten years of heavy contamination, the average selenium concentration in Belews Lake was 10 µg/L. At this concentration, selenium accumulated 514 to nearly 4000 times in the biota. As a result, nineteen of the twenty fish species were rendered sterile and extirpated. It is interesting to note that one of the worst selenium poisonings in the history of the United States occurred at 10 µg/L, a level that is only twice Oregon's proposed criterion.

Prior to extirpation, fish in Belews Lake had damaged gills, blood, liver, kidneys, heart ovaries, and eyes. The most insidious aspect of selenium poisoning occurred in the eggs, which received selenium from their mother's diet and stored the toxin until hatching. This poisoning was invisible because adult fish can survive and appear healthy despite the fact that massive reproductive failure is occurring. A wealth of studies show that these insidious effects occur at selenium water concentration levels below the 5 µg/L criterion proposed by Oregon.

The extreme, yet invisible, nature of selenium poisoning requires Oregon to exercise caution in order to protect designated uses. Lemly stated, "once selenium contamination begins, a cascade of events is set into motion that can result in major ecosystem disruption. Early detection and action is key. Environmentally sound hazard assessment and water quality goals, coupled with prudent risk management, can prevent significant biological impacts." Contrary to this warning, Oregon's chronic criterion, which is significantly higher than what scientists consider safe, will result in major ecosystem disruption.

4. *The proposed selenium criterion fails to protect threatened and endangered species.*

Oregon's selenium criterion does not protect threatened or endangered species, as demonstrated by the examples presented below.

Bald Eagle:

Oregon's proposed selenium chronic criterion of 5 µg/L does not protect the bald eagle. Lillebo et al. demonstrated that l.4 µg/L is necessary to protect piscivorous birds. This is greater than three times more protective than Oregon's proposed standards. Likewise, Peterson and Nebeker calculated a chronic criterion specific to bald eagles at 1.9 µg/L. The Services concluded that "widespread expansion of aquatic habitats containing >1.9 µg/L selenium, as could occur with a criterion of 5 µg/L, could put substantial numbers of California's bald eagles at risk of toxic effects of selenium. The Services' concerns regarding eagles apply equally in Oregon. Therefore, Oregon's proposed criterion jeopardizes the threatened bald eagle.

Brown Pelican:

Oregon's proposed selenium chronic criterion does not protect the brown pelican. The Services concluded that a criterion on the order of 1.4 µg/L is needed to protect the brown pelican from selenium poisoning. The Services suggest that a very unusual and large case of botulism that killed more than 1400 brown pelicans may have resulted from elevated selenium level in fish tissue, which left the fish immune-impaired and hypersensitive to the bacterial attacks that facilitated the botulism outbreak. The Services recommendation of 1.4 µg/L applies equally to Oregon's brown pelicans.

California Least Tern:

Oregon's proposed selenium chronic criterion does not protect the California least tern. Terns, like bald eagles and pelicans, are piscivorous. Since there are no data specific to the California least tern, the Services determined that the studies related to piscivorous birds applied to the tern. Oregon's 5 µg/L criterion, therefore, is up to three times less protective than necessary to support this piscivorus bird. In addition, results from interior least tern studies suggest that California least tern eggs would "substantially exceed the 6 ug/g threshold for embryotoxicity established for black necked stilts if selenium concentrations were permitted to rise to 5 µg/L water concentration. In combination with elevated mercury concentrations already noted for eggs of California least terns, significant reproductive impairment would be the expected outcome."

Marbled Murrelet:

Oregon's proposed chronic selenium criterion does not protect marbled murrelets. Marbled murrelets feed in Oregon's bays and estuaries on small fish and shrimp. As a piscivorous bird, the 1.4 to 1.9 µg/L threshold also applies to murrelets. The Services concluded, "5 µg/L must be viewed as unprotective of marbled murrelets foraging in enclosed bays and estuaries in the State of California." This statement applies to Oregon's murrelets because they have the same physiological needs as murrelets in California.

Salmonids:

Oregon's proposed selenium chronic criterion does not protect salmonids. The agencies concluded that the most dangerous exposure pathway for salmonids is to obtain selenium via dietary bioaccumulation. After citing numerous studies that refute the alleged protectiveness of the 5 µg/L criterion, the Services concluded that "currently available data for salmonids do not support the CTR proposed selenium criterion of 5 µg/L as adequately protective of salmonids." The agencies were referring to salmonid species present in Oregon as well as California, including the Southern Oregon/Northern California Coast ESU, Chinook salmon, steelhead, and Lahontan cutthroat trout. The Services concluded that "a criterion of 2 µg/L or less would be necessary for protection of these species, that the proposed speciation based acute criterion should not be promulgated and that a selenium criteria revision that considered the bioaccumulative nature and long term persistence of selenium in aquatic sediments and food chains was necessary…"

In sum, the Services concluded that the selenium criterion in the CTR BiOp does not protect each of the endangered species above. This is directly relevant to Oregon because Oregon's proposed criterion is identical to the CTR criterion roundly criticized by the Services and scientists. Moreover, many of the species identified in the CTR BiOp are also found in Oregon. EPA must reject Oregon's attempt to use this discredited criterion.

EPA's response to specific pollutant concerns regarding selenium

While EPA does not necessarily agree with all of the commenter's intermediate contentions regarding the appropriate evaluation these criteria, the Agency agrees with the commenter's ultimate conclusion: that the submitted criteria for selenium are not protective of Oregon's designated aquatic life use. EPA has detailed its reasons for reaching this conclusion in the Technical Support Document associated with this action.

B. Mercury

Oregon's proposed criterion for mercury is similarly flawed. Oregon has proposed to adopt an acute criterion that exceeds EPA's recommended criterion, in direct contravention of the CWA. The proposed criterion will not protect designated uses and must be disapproved.

1. Oregon failed to adopt a criterion at least as stringent as EPA's recommended criterion.

Oregon's proposed acute criterion for mercury of 2.4 µg/L violates section 303(c)(2)(B) of the CWA because Oregon's criterion is higher than the EPA recommended criterion of 1.4 µg/L. Section 303(c)(2)(B) provides that a state shall adopt the EPA recommended criteria for toxic pollutants during each triennial review. EPA must disapprove Oregon's acute mercury criterion because Oregon did not adopt the EPA recommended value.

Oregon's rationale for not following the requirements of the Clean CWA is not a legitimate justification for allowing Oregon to avoid the requirements of federal law. In attempting to justify its failure to adopt EPA's recommended criterion, Oregon stated:

DEQ believes that maintaining the current Oregon aquatic life criteria for mercury [2.4

> µg/L] is prudent because of concerns existing in Oregon over mercury and the protection of threatened and endangered salmonids. These criteria were "reserved" (i.e. withdrawn) from the CTR because of the Services' objections to suspected adverse impact of the proposed EPA criteria on Threatened and Endangered salmonids. Since Oregon has the same species as those identified in the BO to the California Toxics Rule, DEQ believes this is the most prudent action until such time that the mercury criteria can he reviewed in depth.

This justification, however, is nonsensical. The Services criticized EPA's proposed criterion because of concerns that the 1.4 µg/L criterion would not provide adequate protection for designated uses. No rational decision maker would conclude that Oregon's proposed criterion, which is 1 µg/L higher – and thus less protective – than the disputed EPA criterion, would satisfy the state's obligation to adopt criteria that are protective of designated uses. Oregon's failure to adopt EPA's recommended criterion, at a minimum, or a more stringent criterion, plainly violates the requirements of section 303(c)(2)(B).

2. Oregon's proposed criterion for mercury does not protect designated uses.

Oregon's proposed acute criterion of 2.4 µg/L also violates 40 C.F.R. § 131.11 because it does not protect designated uses. Mercury is highly toxic, it bioaccumulates, and it biomagnifies. Oregon failed to consider any of these facts when it proposed a criterion that is less protective than the 1.4 µg/L acute criterion rejected by the Services.

In their review of EPA's proposed criteria for mercury, the Services stated:

> the aquatic life mercury criteria of [.770 (chronic) and 1.4 (acute)] are so high as to effectively be without value for controlling mercury in even the most severely mercury-impaired California water bodies. Concentrations above the CCC in the dissolved form are virtually unmeasured in the California environment, even though those environments contain numerous water bodies with direct mercury discharges.

The Services thus rejected EPA's proposed criterion of 1.4 µg/L, because it would have no beneficial effect. It necessarily follows that Oregon's proposed acute criterion of 2.4 µg/L certainly does not protect designated uses.

In addition, Oregon's proposed acute criterion of 2.4 µg/L is significantly higher than the mercury criterion recommended by the Mercury Report to Congress as necessary to protect wildlife. In that report, EPA recommended a 0.05µg/L methylmercury criterion and a 0.641µg/L "total dissolved" mercury criterion. Both of these recommendations clearly fall below Oregon's outrageous 2.4 µg/L proposal.

3. Oregon's tissue residue concentration of 0.3 mg/kg does not protect wildlife.

Oregon has also proposed a tissue residue concentration (TRC) criterion of 0.3 mg/kg for mercury. However, this criterion will not protect wildlife and must therefore be rejected. Water quality criteria must protect the most sensitive designated use, including wildlife. Oregon's proposed TRC criterion was meant to protect human health, and was never established to protect more sensitive wildlife uses.

During the consultation process for the CTR, EPA requested that USFWS determine if the TRC of 0.3 mg/kg would affect federally listed species in California. The Services created a risk assessment methodology to assess the protectiveness of the criterion for threatened and endangered wildlife using two different methodologies to create a more protective Highest Trophic Level (HTL) and a less protective Average Trophic Level (ATL) approach. The USFWS found that applying the TRC criterion with the estimated trophic level methylmercury concentrations under the less protective ATL approach may be sufficiently protective for only two of the seven species considered: the southern sea otter and Western snowy plover. It concluded that the five other species examined (California least tern; bald eagle; California, light-footed, and Yuma clapper rails) would likely have dietary exposures under this approach that would place them at risk for adverse effects from methylmercury toxicity. Applying the TRC under the more protective HTL approach yielded sufficient protection for four of the seven species considered: the southern sea otter, California clapper rail, Western snowy plover, and bald eagle. Two remaining species examined (California least tern and Yuma clapper rail) would likely have dietary exposures under this approach that would place them at risk for adverse effects from methylmercury toxicity.

Thus, the USFWS found that not all designated uses of wildlife are protected by the 0.3 mg/kg TRC criterion even using the more protective approach. The California least tern, which is found in Oregon and is listed as endangered under both the federal and state ESAs, would likely have adverse effects from methylmercury toxicity under the TRC of 0.3 mg/kg. This evaluation demonstrates that Oregon's proposed TRC of 0.3 mg/kg is not protective of wildlife in violation of EPA regulations.

Further support that Oregon's 0.3 mg/kg TRC criterion for mercury does not protect wildlife comes from the Services' comments on the Clear Lake TMDL in California. The Services concluded that the proposed methylmercury concentrations of 0.13 and 0.30 mg/kg of wet weight fish tissue for trophic levels three and four, respectively, are not sufficient to protect wildlife resources at Clear Lake. The Services instead recommended criteria of 0.09 mg/kg and 0.19 mg/kg to protect wildlife. The Services' recommendation indicates that Oregon's proposed criterion for mercury does not protect wildlife.

There is no support for Oregon's 0.3mg/kg TRC criterion. EPA must therefore disapprove Oregon's recommended criterion and replace it with a criterion that will at long last protect beneficial uses.

EPA's response to specific pollutant concerns regarding mercury

While the commenter characterizes Oregon's aquatic life criteria for mercury as "proposed," (apparently on the grounds that Oregon stated reasons for *not* revising those criteria),[38] a statement of reasons for not altering a previously-adopted regulatory provision cannot be reasonably equated with a proposal to adopt that provision in the first place. Oregon made clear that it was "<u>not</u> proposing to change aquatic life criteria for mercury."[39]

EPA only reviews new or revised water quality standards under CWA § 303(c)(3). The aquatic life criteria for mercury that are being commented upon here are neither new nor revised. Because there are

[38] DEQ Issue Paper at H-65 (2004).
[39] Summary of Public Comments and Agency Responses at B-17 (Attachment B to Agenda Item at the May 20-21, 2004 meeting of the Oregon Environmental Quality Commission).

no new or revised aquatic life criteria for mercury for EPA to review in this action, these comments are not pertinent to EPA's CWA § 303(c)(3) action.

Oregon's revised human health criteria for mercury have already been separately addressed.[40]

C. Ammonia

Oregon's proposed criterion for ammonia does not protect designated uses because the criterion was developed with tests on fish resting in stagnant water. Tests in moving water indicate that exercising fish are much more sensitive to ammonia. Fish excrete ammonia while exercising to regulate the ammonia in their system. Ammonia concentrations that are above a waterbody's natural level adversely affect the ammonia regulatory system of fish. Oregon's criterion is not protective of fish because the criterion was developed using tests in static water, thus ignoring the importance of exercise sensitivity.

Wicks et al. demonstrated that the Oregon proposed criterion does not protect salmonids because even small doses of ammonia (0.04 mg/L) decrease coho swimming velocity. Comparing, the results of these studies with the EPA recommended criteria for ammonia, Wicks concluded, "the levels set forth by the US EPA will not protect swimming fish and may endanger annual migrations of anadromous fishes."

Oregon's proposed criterion mirrors EPA's inadequate recommended criterion for ammonia. The criterion will not protect beneficial uses, and EPA must disapprove it.

EPA's response to specific pollutant concerns regarding ammonia

EPA agrees that Oregon's 2004 submitted aquatic life criteria for ammonia do not protect Oregon's Fish & Aquatic Life designated use based on currently available information. While EPA does not necessarily agree with all of the commenter's intermediate contentions regarding the appropriate evaluation these criteria, the Agency agrees with the commenter's ultimate conclusion: that the submitted criteria for ammonia are not protective of Oregon's designated aquatic life uses. EPA has detailed its reasons for reaching this conclusion in the Technical Support Document associated with this action.

EPA published a draft criteria update in December 2009 and is poised to release final recommended aquatic life criteria for ammonia that take into account new data since the 1999 criteria update. Specifically, the new ammonia criterion includes acute data for sensitive species of freshwater mussels, resulting in an adjustment to the 304(a) criteria.

D. Cadmium

Research indicates that Oregon's proposed cadmium criteria do not protect designated uses. EPA's recommended criteria for cadmium are based on a hardness-dependent formula. At a hardness of 100 mg/L, the freshwater acute criterion is 2 µg/L and the freshwater chronic criterion is 0.25 µg/L. Oregon's proposed standards adopt the EPA recommended criteria. The proposed criteria are

[40] See EPA's letter to Neil Mullane, Oregon Department of Environmental Quality from Michael Bussell, EPA; October 17,2011; Re: Approval of New and Revised Human Health Water Quality Criteria for Toxics and Implementation Provisions in Oregon's Water Quality Standards Submitted on July 12 and 21, 2011.

significantly higher than the values recommended by the Services for the protection of threatened and endangered species. The Services stated, “it appears that a [chronic] criterion for cadmium that would be protective of salmonids and stickleback is somewhere between 0.096 and 0.180 µg/L, but probably would still not protect cladocerans.” Oregon’s proposed concentration of 0.25 µg/L is considerably less protective than even the high end of this recommendation.

Oregon’s proposed cadmium criteria also do not protect rainbow trout (and more sensitive species) because cadmium bioaccumulates in aquatic organisms at concentrations below Oregon’s proposed criteria. McGeer et al. demonstrated that bioaccumulation of cadmium occurs in rainbow trout continuously because cadmium is not regulated by the trout. In addition, some aquatic invertebrates are sensitive to an increased concentration of particulate cadmium in the water column. Canfield et al. showed that some aquatic invertebrate communities change to more pollution tolerant species at higher levels of cadmium. This reduces the biomass, which likely limits food availability for predators, thereby affecting their survival.

These examples demonstrate demonstrates that Oregon’s criteria do not protect the most sensitive use in violation of 40 C.F.R. § 131.11 and that Oregon’s proposed criterion would not satisfy the ‘no jeopardy’ requirement of consultation under section 7 of the ESA. Therefore, EPA cannot approve Oregon’s proposed criteria for cadmium.

EPA’s response to specific pollutant concerns regarding cadmium

EPA notes that the August 14, 2012 Biological Opinion of the National Marine Fisheries Service (NMFS) and the July 30, 2012 Biological Opinion of the U.S. Fish and Wildlife Service (FWS) supersede the commenter’s reliance on the California Toxics Rule Biological Opinion (apparently as a surrogate for the Services’ views on this action).
Significantly, neither NMFS nor FWS were of the opinion that Oregon’s revised chronic criterion for cadmium would jeopardize any listed species in Oregon’s waters.

With respect to Oregon’s revised acute criterion for cadmium (2 ug/L), EPA acknowledges that NMFS is of the opinion that certain ESA-listed species may be jeopardized by acute exposure to cadmium at the revised criterion concentration. For the reasons described in decision document for this action, EPA is disapproving the revised acute aquatic life criterion for cadmium. However, EPA does not thereby assume the validity of the commenter’s general contentions with respect to the acute aquatic life criteria for cadmium.

In regards to the specific references brought forward by the commenter, EPA would like to address specific scientific concerns. First, although McGreer et al. (2000) demonstrated uptake of cadmium by rainbow trout, uptake by itself is not an adverse effect; it is necessary to demonstrate that unacceptable adverse effects are caused by exposure (see response to comment H). The last sentence in the abstract of McGreer et al. (2000) says “While the initial patterns of accumulation for each metal were generally consistent with the damage, repair and accumulation pattern from concurrent physiological measurements it was clear that tissue metal accumulation was not a good indicator of either exposure [or] physiological impact.” The EPA cannot ascribe specific physiologic effects with any specific compound of concern from this study.

Canfield et al. (1994) found that metal-contaminated sediment affected benthic invertebrate community structure. However, the sediment was contaminated by arsenic, cadmium, copper, lead, manganese, and zinc and therefore this study does not provide information regarding cadmium as a contributor to water column based toxicity.

See General Response 4 concerning ESA listed species.

E. Pentachlorophenol

Oregon's proposed acute and chronic criteria for pentachlorophenol (PCP) also do not protect salmonids. Oregon's PCP criterion is pH-dependent. At a pH of 7.8, the acute and chronic criteria are 19 µg/L and 15 µg/L, respectively. The Services evaluated the protectiveness of these criteria on threatened and endangered species in the CTR BiOp. The Services concluded that "the proposed acute and chronic water quality criteria for PCP arc not protective of endangered and threatened fish. Current literature indicates adverse effects of ... PCP on reproduction, early life stage growth, or behavior of salmonid species at concentrations at or below the proposed criteria."

Research demonstrates that Oregon's acute criterion for PCP is not protective of the most sensitive stages of salmon life. Studies by VanLeeuwen et al. and Dominguez and Chapmen derived different 96-hour LC_{50} values for early life stage salmonids (18 µg/L and 66 µg/L, respectively). The Services acknowledged that different study methods led to different results, but concluded that "the essential point is that both studies indicate that PCP can cause significant lethality in early life stage salmonids after exposures as short as 4 days…. Since the LC_{50} is the concentration at which half the organisms die, both these studies suggest it is likely that some mortality would occur at PCP concentrations at or below the proposed chronic criterion." Because the mortality of young salmonids will likely occur at or below Oregon's proposed acute criterion, the standards do not protect the designated uses of aquatic life and fish propagation.

Fish do not fare any better under the chronic criteria. One study by Dominguez and Chapman exposed rainbow trout to EPA's recommended chronic criterion of purified PCP from the embryo state through 72 days of development. The authors reported a 34 percent mortality after 72 days. They also found a 32 percent reduction in weight, fin erosion, mild malformations, and lethargy compared to controls. This demonstrates that Oregon's chronic criterion does not protect salmonids. EPA must therefore disapprove the acute and chronic criteria for PCP.

EPA's response to specific pollutant concerns regarding pentachlorophenol

EPA disagrees with the comment that Oregon's aquatic life criteria for pentachlorophenol (PCP) does not protect salmonids.

EPA notes that the August 14, 2012 Biological Opinion of the National Marine Fisheries Service (NMFS) and the July 30, 2012 Biological Opinion of the U.S. Fish and Wildlife Service (FWS) supersede the commenter's reliance on the California Toxics Rule Biological Opinion (apparently as a surrogate for the Services' views on this action).
Significantly, neither NMFS nor FWS were of the opinion that Oregon's revised chronic criterion for pentachlorophenol would jeopardize any listed species in Oregon's waters.

More recently, the EPA evaluated existing toxicity data for PCP. Only the exotic fish, *Cyprinus carpio*, is sensitive at the current freshwater criteria. No tested species are sensitive at the saltwater criteria. The PCP criteria, both acute and chronic, are protective of all tested salmonids. The 1988 study by Dominguez and Chapman mentioned by the comment is in the data table and was considered with a value of 20ug/L which is above the criterion. The VanLeeuwan study was rejected due to quality failure (see Appendix K of the TSD).

See General Response 4 regarding ESA listed species.

APPENDIX 1: TEST RESULT QUALITY REVIEW PROCEDURES

Sections II.B - F, IV.B - E, IV.H, and VI.B - E of the Guidelines give reasons why the results of some toxicity tests should not be used, should be rejected, or should not be used in calculations, whereas sections II.G, X, XI.C, XII.A.14, and XII.B allow the use of "questionable data" and "other data" in some situations. In other words, sections II.B - F, IV.B - E, IV.H, VI.B - E give reasons why the results of some toxicity tests using aquatic animals should not be directly used in the derivation of a Final Acute Value (FAV) or a Final Chronic Value (FCV), whereas sections II.G, X, XI.C, XII.A.14, and XII.B describe other possible uses of test results with aquatic animals that should not be directly used in the derivation of a FAV or a FCV.

The *Guidelines* say the following concerning the use of results of toxicity tests using aquatic animals:

1. General guidance:
    a. All data should be available in typed, dated, and signed hard copy (publication, manuscript, letter, memorandum, etc.) with enough supporting information to indicate that acceptable test procedures were used and that the results are probably reliable. (section II.B)
    b. Information that is confidential or privileged or otherwise not available for distribution should not be used. (section II.B)
    c. Questionable data, whether published or unpublished, should not be used. For example, a test result should usually be rejected if it is from:
        i. a test that did not contain a control treatment.
        ii. a test in which too many organisms in the control treatment died or showed signs of stress or disease.
        iii. a test in which distilled or deionized water was used as the dilution water without addition of appropriate salts.

        (section II.C)
    d. A result of a test on technical-grade material may be used if appropriate, but a result of a test on a formulated mixture or an emulsifiable concentrate of the test material should not be used. (section II.D)
    e. For some highly volatile, hydrolyzable, or degradable materials it is probably appropriate to use only results of flow-through tests in which the concentrations of test material in the test solutions were measured often enough using acceptable analytical methods. (section II.E)
    f. Data should be rejected if they were obtained using:
        i. Brine shrimp.
        ii. A species that does not have a reproducing wild population in North America.
        iii. Organisms that were previously exposed to substantial concentrations of the test material or other contaminants. (section II.F)

2. Guidance specifically regarding results of acute tests:
    g. Acute toxicity tests should have been conducted using acceptable procedures. (section IV.B) The following two American Society for Testing and Materials (ASTM) Standards are referenced as examples of acceptable procedures:
        i. ASTM Standard E 729, Practice for Conducting Acute Toxicity Tests with Fishes, Macroinvertebrates, and Amphibians. (The title was later changed to "Standard Guide for Conducting Acute Toxicity Tests on Test Materials with Fishes, Macroinvertebrates, and Amphibians".)

        Some of the most important items in Standard E 729 include:

        (1) "The test material should be reagent-grade or better, unless a test on a formulation, commercial product, or technical-grade or use-grade material is specifically needed."

("Reagent-grade" is referenced to the American Chemical Society specifications.) (section 9.1)

(2) "If an organic solvent is used, it should be reagent-grade or better and its concentration in any test solution must not exceed 0.5 mL/L. A surfactant must not be used in the preparation of a stock solution because it might affect the form and toxicity of the test material in the test solutions." (section 9.2.3)

(3) "For static tests the concentration of dissolved oxygen in each test chamber must be from 60 to 100 % of saturation during the first 48 h of the test and must be between 40 and 100 % of saturation after 48 h. For renewal and flow-through tests the concentration of dissolved oxygen in each test chamber must be between 60 and 100 % of saturation at all times during the test." (section 11.2.1)

ii. ASTM Standard E 724, Practice for Conducting Static Acute Toxicity Tests with Larvae of Four Species of Bivalve Molluscs. (The title was later changed to "Standard Guide for Conducting Static Acute Toxicity Tests Starting with Embryos of Four Species of Saltwater Bivalve Molluscs".)

When water quality criteria for aquatic life are derived, EPA does not automatically accept all toxicity tests that are performed according to an ASTM Standard or according to "Standard Methods". EPA reviews results of all aquatic toxicity tests for acceptability using best professional judgment. Although written methodologies are very useful, no such methodology can appropriately address all aspects of toxicity tests, especially all organism-specific and all chemical-specific aspects. In addition, written methodologies often do not keep up with the newest information that is available.

h. Except for tests using saltwater annelids and mysids, results of acute tests during which the test organisms were fed should not be used, unless data indicate that the food did not affect the toxicity of the test material. (section II.C)

i. Results of acute tests conducted in unusual dilution water, e.g., dilution water in which total organic carbon or particulate matter exceeded 5 mg/L, should not be used, unless a relationship is developed between acute toxicity and organic carbon or particulate matter or unless data show that organic carbon, particulate matter, etc., do not affect toxicity. (section IV.D)

j. Acute values should be based on endpoints which reflect the total severe acute adverse impact of the test material on the organisms used in the test. Therefore, only the following kinds of data on acute toxicity to aquatic animals should be used:

(1) Tests with daphnids and other cladocerans should be started with organisms less than 24 hours old and tests with midges should be started with second- or third-instar larvae. The result should be the 48-hr EC_{50} based on the percentage of organisms immobilized plus percentage of organisms killed. If such an EC_{50} is not available from a test, the 48-hr LC_{50} should be used in place of the desired 48-hr EC_{50}. An EC_{50} or LC_{50} of longer than 48 hr can be used as long as the animals were not fed and the control animals were acceptable at the end of the test.

(2) The result of a test with embryos and larvae of barnacles, bivalve molluscs (clams, mussels, oysters, and scallops), sea urchins, lobsters, crabs, shrimp, and abalones should be the 96-hr EC_{50} based on the percentage of organisms with incompletely developed shells plus the percentage of organisms killed. If such an EC_{50} is not available from a test, the lower of the 96-hr EC_{50} based on the percentage of organisms with incompletely developed shells and the 96-hr LC_{50} should be used in place of the desired 96-hr EC_{50}. If the duration of the test was between 48 and 96-hr, the EC_{50} or LC_{50} at the end of the test should be used.

(3) The acute values from tests with all other freshwater and saltwater animal species and

older life stages of barnacles, bivalve molluscs, sea urchins, lobsters, crabs, shrimps, and abalones should be the 96-hr EC_{50} based on the percentage of organisms exhibiting loss of equilibrium plus the percentage of organisms immobilized plus the percentage of organisms killed. If such an EC_{50} is not available from a test, the 96-hr LC_{50} should be used in place of the desired 96-hr EC_{50}.

(4) Tests with single-celled organisms are not considered acute tests, even if the duration was 96 hours or less.

(5) If the tests were conducted properly, acute values reported as "greater than" values and those which are above the solubility of the test material should be used, because rejection of such acute values would unnecessarily lower the FAV by eliminating acute values for resistant species.

(section IV.E)

k. The agreement of the data within and between species should be considered. Acute values that appear to be questionable in comparison with other acute and chronic data for the same species and for other species in the same genus probably should not be used in the calculation of a Species Mean Acute Value (SMAV). For example, if the acute values available for a species or genus differ by more than a factor of 10, some or all of the values probably should not be used in calculations. (section IV.H)

3. Guidance specifically regarding results of chronic tests:

l. Chronic values should be based on results of flow-through (except renewal is acceptable for daphnids) chronic tests in which the concentrations of test material in the test solutions were properly measured at appropriate times during the test. (section VI.B)

m. Results of chronic tests in which survival, growth, or reproduction in the control treatment was unacceptably low should not be used. The limits of acceptability will depend on the species. (section VI.C)

n. Results of chronic tests conducted in unusual dilution water, e.g., dilution water in which total organic carbon or particulate matter exceeded 5 mg/L, should not be used, unless a relationship is developed between chronic toxicity and organic carbon or particulate matter or unless data show that organic carbon, particulate matter, etc., do not affect toxicity. (section VI.D)

o. Chronic values should be based on endpoints and lengths of exposure appropriate to the species. Therefore, only data on chronic toxicity to aquatic animals that satisfy the species-specific requirements given in sections VI.E.1, VI.E.2, and VI.E.3 should be used.

4. Guidance regarding other possible uses of results of toxicity tests using aquatic animals:

p. Questionable data, data on formulated mixtures and emulsifiable concentrates, and data obtained with non-resident species or previously exposed organisms may be used to provide auxiliary information but should not be used in the derivation of criteria. (section II.F)

q. Pertinent information that could not be used in earlier sections might be available concerning adverse effects on aquatic organisms and their uses. The most important of these are data on cumulative and delayed toxicity, flavor impairment, reduction in survival, growth, or reproduction, or any other adverse effect that has been shown to be biologically important. Especially important are data for species for which no other data are available. Data from behavioral, biochemical, physiological, microcosm, and field studies might also be available. Data might be available from tests conducted in unusual dilution water, from chronic tests in which the concentrations were not measured, from tests with previously exposed organisms, and from tests on formulated mixtures or emulsifiable concentrates. Such data might affect a criterion if the data were obtained with an important species, the test concentrations were measured, and the endpoint was biologically important. (section X)

r. The Criterion Continuous Concentration (CCC) is equal to the lowest of the Final Chronic Value (FCV), Final Plant Value (FPV), and Final Residue Value (FRV), unless other data show that a lower value should be used. (section XI.C)

s. Are any of the other data important? (section XII.A.14)

t. On the basis of all available pertinent laboratory and field information, determine if the criterion is consistent with sound scientific information. If it is not, another criterion, either higher or lower, should be derived using appropriate modifications of these *Guidelines*. (section XII.B)

In addition, the following aquatic life criteria documents published by U.S. EPA in 1985, 1986, 1987, and 1988 gave a variety of reasons for classifying specific test results as "unused":

U.S. EPA. 1985. Ambient Water Quality Criteria for Cadmium - 1984. EPA 440/5-84-032. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1985. Ambient Water Quality Criteria for Chlorine - 1984. EPA 440/5-84-030. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1985. Ambient Water Quality Criteria for Copper - 1984. EPA 440/5-84-031. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1985. Ambient Water Quality Criteria for Lead - 1984. EPA 440/5-84-027. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1985. Ambient Water Quality Criteria for Mercury - 1984. EPA 440/5-84-026. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1986. Ambient Water Quality Criteria for Chlorpyrifos - 1986. EPA 440/5-86-005. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1986. Ambient Water Quality Criteria for Parathion - 1986. EPA 440/5-86-007. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1986. Ambient Water Quality Criteria for Pentachlorophenol - 1986. EPA 440/5-86-009. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1986. Ambient Water Quality Criteria for Toxaphene - 1986. EPA 440/5-86-006. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1987. Ambient Water Quality Criteria for Selenium - 1987. EPA 440/5-87-006. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1987. Ambient Water Quality Criteria for Zinc - 1987. EPA 440/5-87-003. U.S. Environmental Protection Agency, Washington, DC.

U.S. EPA. 1988. Ambient Water Quality Criteria for Chloride - 1988. EPA 440/5-88-001. U.S. Environmental Protection Agency, Washington, DC.

The following is a list of common reasons why the results of some toxicity tests should not be used. Most of these reasons can be considered to be based on items "a" through "o" listed above.

1. The document is a secondary publication of the test result.
2. The test procedures, test material, dilution water, and/or results were not adequately described.

3. The test species is not resident in North America.
4. The test species was not obtained in North America and was not identified well enough to determine whether it is resident in North America.
5. The test organisms were not identified specifically, for example, “crayfish” or “minnows.”
6. There is reason to believe that the test organisms were possibly stressed by disease or parasites.
7. The test organisms were exposed to elevated concentrations of the test material before the test and/or the control organisms contained high concentrations of the test material.
8. The test organisms were obtained from a sewage oxidation pond.
9. By the end of the test, the test organisms had not been fed for too long a period of time.
10. The water quality varied too much during the test.
11. The test was conducted with brine shrimp, which are from a unique saltwater environment.
12. The exposed biological material was an enzyme, excised or homogenized tissue, tissue extract, plasma, or cell culture.
13. The test organisms were not acclimated to the dilution water for a sufficiently long time period.
14. The test organisms were exposed to the test material via gavage, injection, or food.
15. There is reason to believe that the test organisms were probably crowded during the test.
16. The test organisms reproduced during an acute test, and the new individuals could not be distinguished from the original test individuals at the end of the test.
17. The test material was a component of a mixture, effluent, fly ash, sediment, drilling mud, sludge, or formulation.
18. In a test on zinc, the dilution water contained a phosphate buffer.
19. The test material was chlorine and it was not measured acceptably during the test.
20. The test chamber contained sediment.
21. The test was conducted in plastic test chambers without measurement of the test material.
22. The test was a field study and the concentration of test material was not measured adequately.
23. A known volume of stock solution was placed on a wall of the test chamber and evaporated and then dilution water was placed in the test chamber; the investigators assumed that all of the test material dissolved in the dilution water, but the concentrations of the test material in the test solutions were not measured.
24. The test only studied metabolism of the test material.
25. The only effects studied were biochemical, histological, and/or physiological.
26. The data concerned the selection, adaptation, or acclimation of organisms for increased resistance to the test material.
27. The percent survival in the control treatment was too low.
28. The concentration of solvent in some or all of the test solutions was too high.
29. The study was a microcosm study.
30. The concentration of test material fluctuated too much during the exposure.
31. Too few test organisms were used in the test.
32. The dilution factor was ten.
33. There was no control treatment.
34. The pH was below 6.5.
35. The dilution water was chlorinated or “tap” water.
36. The dilution water contained an excessive amount of a chelating agent such as EDTA or other organic matter.
37. The acceptability of the dilution water was questionable because of its origin or content.
38. The dilution water was distilled or deionized water without the addition of appropriate salts.
39. The measured test temperature fluctuated too much.
40. Neither raw data nor a clearly defined endpoint was reported.
41. The results were not adequately presented or could not be interpreted.

42. The results were only presented graphically.
43. The test was a chronic test and the concentration of test material was not measured.