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MEMO

November 28, 2011

To: Sediment Cleanup Advisory Group Members
From: Dave Bradley, Toxics Cleanup Program
RE: Sediment Management Standards (SMS) Rule Revisions - Freshwater Sediment Standards

One of Ecology's rulemaking goals is to adopt chemical and biological criteria for freshwater sediments. Over the last five years, Ecology has been working with other agencies, organizations and individuals to resolve a wide range of technical and policy issues associated with freshwater sediment criteria.

We plan to discuss this issue at the December 9th meeting. This discussion will focus on the draft SMS rule revisions that include chemical and biological criteria. Under the draft revisions, the criteria would initially be used to establish sediment cleanup standards that are protective of the benthic community.

Purpose of the December 9th discussion and supporting materials

This will be the first topic discussed at the December 9th meeting. We are particularly interested in your feedback on the following questions:

- Do you agree with Ecology's decision to promulgate freshwater sediment standards that are consistent with the current SMS framework, specifically:
 - Adopting both chemical and biological criteria.
 - Allowing the biological criteria to override chemical criteria.
 - Allowing for development of site specific chemical criteria by the use of bioassays.
 - Promulgating chemical and biological criteria that are protective of the benthic community but not necessarily protective of bioaccumulative effects to higher trophic levels.
 - Adopting two tiers of criteria at the sediment quality standard and cleanup screening level.
- Is the suite of chemicals in section -573 comprehensive enough for the freshwater sites with which you are familiar?

The following discussion materials are attached:

- Background information. We have prepared a short background paper that summarizes the key issues associated with the draft chemical and biological criteria. It is attached to this document.
- Draft rule language. We have prepared a new section (WAC 173-204-573) that includes chemical and biological criteria for the freshwater sediment standards rule language.
- Technical report. The technical report describes the information and methods used to develop the draft chemical criteria.

Next steps after the December 9th meeting

We recognize that we will probably not have enough time on December 9th to fully discuss all of your issues and concerns. Consequently, we encourage you to provide written comments on the freshwater provisions. We would like to receive those comments by January 13, 2012.

We will consider the feedback from the December 9th meeting and written comments in deciding how to proceed with this issue during the SMS rule revision process.

We look forward to meeting with you on December 9th. If you have questions on the attached materials prior to the meeting, please contact Chance Asher at (360) 407-6914 or e-mail chance.asher@ecy.wa.gov.

Summary of Technical and Policy Issues Associated With Chemical and Biological Criteria for Freshwater Sediments

Background:

Currently the SMS rule outlines specific standards and decision-making processes to protect biological resources and clean up contaminated sediment. The SMS rule includes adopted marine chemical and biological standards for protection of the benthic community but lacks adopted freshwater chemical or biological standards. Instead, the SMS has only a narrative standard for freshwater sediment.

There are many contaminated freshwater sediment sites in the state under Ecology or EPA oversight. Because of the lack of adopted freshwater sediment standards, the narrative standard requires a site-specific evaluation to determine cleanup standards. This site-specific process can create inconsistency on how freshwater sediment sites are cleaned up. In addition, the lack of adopted freshwater sediment standards limits how the EPA uses the SMS at federal sediment cleanup sites in Washington.

How have the SMS been revised to add freshwater sediment standards?

Ecology reviewed a number of options before making a decision on adopting freshwater sediment standards including:

- Develop and adopt only biological criteria for evaluating freshwater sediments.
- Develop and adopt only numeric chemical criteria for evaluating freshwater sediments.
- Develop and adopt both numeric and biological criteria for evaluating freshwater sediments.

After careful consideration, and substantial input from the Sediment Workgroup and MTCA/SMS Advisory Group from 2009 – 2010, Ecology decided to move forward with adoption of both chemical and biological sediment criteria. This decision was based on the need to be consistent with the current SMS framework and to support the most consistent and efficient process for assessing and cleaning up freshwater sediments. Implementing the SMS with only biological or chemical standards for freshwater sediments would result in higher analytical costs for sediment evaluations and inconsistent evaluations and cleanup decisions.

What sections of the SMS rule will be revised to incorporate freshwater standards?

Part V – Sediment Cleanup Standards has been revised to include the freshwater sediment standards for cleanup. WAC 173-204-500 through 590 establishes a cleanup decision process and policies, hazard assessment and site identification, and cleanup standards. Biological tests and endpoints that establish both sediment quality standards (SQS) and cleanup screening levels (CSL) have been added to Part V, in a new section -573.

In addition, the marine SQS in Part III section -315 and -320 have been added to Part V, as a new section -572. This addition does not change the marine chemical or biological SQS or CSL numeric criteria. Instead, it allows the reader to reference Part V for both marine and freshwater SQS and CSL chemical and biological criteria.

Do the freshwater sediment standards include bioaccumulative chemicals?

The proposed numeric chemical and biological criteria have been developed to be protective of toxicity to the benthic community. The proposed criteria include some bioaccumulative chemicals but were not developed to be protective of higher trophic levels or human health from bioaccumulative effects. This is consistent with the current SMS framework for marine criteria. However, the revised rule does include proposals for addressing bioaccumulative impacts to human health and the environment. These revisions are focused in new sections -571 (human health protection) and section -574 (aquatic life protection).

What are the main policy choices Ecology made to develop the freshwater standards?

- Consistency with the SMS framework. Ecology decided to develop freshwater standards consistent with the SMS framework, specifically related to:
 - Minor adverse effects. Protection of the benthic community rather than individual aquatic animals or species. This results in allowance of some adverse effects to aquatic animals but overall protectiveness of the benthic community.
 - Two tier criteria: Development of two levels of criteria (SQS and CSL) so a cleanup standard can be established within a range of effects from no adverse effects to minor adverse effects.
 - Applicability to sites: Ecology recognized that freshwater environments are very diverse and that a single set of criteria could not be applied universally at all sites. Ecology decided to develop chemical criteria that were applicable and representative of the majority of sites in the state.
- Biological criteria – use of new sediment toxicity tests. The draft SMS rule revisions include seven sediment toxicity test endpoints to implement the biological criteria. The rule currently provides flexibility for Ecology to approve the use of newer methods as they are validated and Ecology has approved the use of newer marine bioassays on a programmatic level through the annual review meetings which has been incorporated into guidance and on a site specific basis. Ecology clarified rule language and has begun outlining supporting guidance to better identify the site manager's discretion in selecting and implementing new bioassay methods.
 - Biological criteria – choice of minimum detectable difference. The draft biological criteria consider both statistical significance and a biological threshold of effects (such as a 10% difference between the test results and the control sediments). There are concerns about the use of biological thresholds greater than 10%. The 2011 SQV report has been revised to provide more detail on this issue. Based on discussions with experts from national labs, it was determined that the initial performance standard for control and interpretive criteria were within the statistical noise for some tests. ASTM round robin tests revealed higher minimum detectable differences that were reflected in setting performance standards and interpretive criteria.
 - Chemical criteria – applicability to metals-only sites. The chemical criteria were developed using paired chemical and biological results from a majority of sampling stations that have both metals and organic contaminants. It has long been recognized that the data used to develop the chemical criteria is not representative of metals-only sites that often have low levels of organic contaminants. While the rule has flexibility to develop site specific criteria and the biological override when the chemical criteria may not be representative, there are

concerns the language is not clear enough to implement as an ARAR or to set site specific criteria. Rule language was added to provide clarity and specifically identifies metals only sites as an example of when the criteria may not be representative.

- Chemical criteria - protectiveness. There are some concerns about whether the chemical criteria are protective enough. Some of these concerns are related to the policy choice of the use of a 20% false negative rate. The 20% false negative rate for a single test can be interpreted as less conservative. We considered that the 20% false negative rate for a single test does not correspond to the same false negative rate for the combined SQV set or for a single station. The SQS (lower effects level) for each chemical is established by the most sensitive bioassay for that chemical. When combined, the full set of criteria will be lower and result in fewer false negatives than those from individual tests from which they were developed. We also considered that the rule requires multiple bioassays for each station and at least three independent stations to exceed criteria to identify a cleanup site. It was determined that the false negative rate for a single test was more conservatively balanced by these requirements currently built into the rule. These requirements will remain to retain a higher level of conservatism.

What review did Ecology undertake in the development of freshwater standards?

Ecology has conducted extensive scientific peer review during and after development of the freshwater sediment standards. The most recent peer review process included the Sediment Workgroup, MTCA/SMS Science Panel, and an external scientific peer review. Ecology considered this input and revised the SQV report in 2011, which is attached.

Scientific Peer Review. Ecology asked four national sediment experts to review the 2010 draft SQV report and accompanying documentation. The four experts were Drs. Allen Burton (University of Michigan), Jay Fields (NOAA), Chris Ingersoll (USGS) and David Mount (EPA). Some of the main conclusions and/or observations include the following:

- Biological criteria – general.
 - Comment. Overall, we heard that sediment bioassays are a good tool for predicting sediment toxicity and the biological criteria are technically sound and consistent with approaches being used by other agencies. They are not perfect, but as one peer reviewer stated “it’s the best you can do at present”.
 - Response. Ecology has proposed rule language that includes freshwater bioassays and retains the biological criteria override of chemical criteria that exists for marine criteria.
- Biological criteria – new tests and endpoints.
 - Comment. Reviewers urged Ecology to provide the flexibility to use new bioassays as they become available (freshwater mussels and mayfly tests were specifically mentioned). Three of the four reviewers suggested that Ecology consider using biomass as an endpoint for the *Hyalella* 10-day test (which takes into account both survival and growth).
 - Response. Ecology clarified existing language in the SMS rule to emphasize the flexibility to add and modify bioassays as science progresses. We are evaluating the biomass endpoint and will be collecting the data needed to compare with growth and mortality endpoints.

- Biological criteria – statistical and biological significance.
 - Comment. The proposed SMS biological criteria consider both statistical significance and a biological threshold of effects (such as a 10% difference between the test results and the control sediments). There are concerns about the use of biological thresholds greater than 10%. Reviewers agreed that interpretation criteria should consider both statistical significance and a biological threshold of effects, such as a 10% difference between the test results and the control sediments.
 - Response. Ecology revised the 2011 SQV report to include a new section that discusses minimum detectable differences, which was one of the factors considered in selection of the biological criteria. Based on discussions with experts from national labs, it was determined that the initial performance standard for control and interpretive criteria were within the statistical noise for some tests.

- Chemical criteria – general.
 - Comment. Reviewers agreed that multivariate statistical models provide a credible basis for developing chemical criteria. However, most of the reviewers cautioned that these models represent associations (not cause-effect relationships) between sediment concentrations and biological effects. Reviewers also thought that the data quality requirements were scientifically sound.
 - Response. Ecology ensured the revised 2011 SQV report did not have language that inferred a cause and effect relationship.

- Chemical criteria – Database.
 - Comment. Ecology asked reviewers if they thought the database provided sufficient data to develop statewide chemical criteria. There were a number of questions on the geographic distribution of the sediment results and the large percentage of results for certain bioassays from Portland Harbor. However, at least one reviewer said he did not expect different concentration-response relationships in different geographic areas.
 - Response. Information was added to the 2011 SQV report to show the geographical distribution and hits and no-hits data distribution. While Portland Harbor area did dominate some of the bioassay datasets (up to 75% of the data for *Hyalella* 28-day growth), the new map shows reasonable geographical distribution across Washington for samples and hits.
 - Comment. About 20% of the bioassay results represent “hits” (failed the bioassay). Three of the reviewers raised questions about the low percentage of hits and the implications for criteria development. Two reviewers suggested that Ecology examine this issue by recalculating the criteria by using the stations with hits + an equal number of stations with no toxic responses. We could then check the reliability of the resulting chemical criteria using the remaining no-hit stations.
 - Response. The floating percentile method used to develop the chemical criteria is not adversely impacted by hit/no-hit ratios. However, reliability evaluations are impacted by the lack of hits in the dataset. Several options were considered on how to deal with this issue, and Ecology adopted suggestions from Burt Shepard of EPA. Multivariate models reflect correlations between variables (in this case, the correlation between sediment toxicity and chemical concentrations). The validity of these types of models is judged by their ability to accurately predict toxicity. EPA suggested that we use three additional reliability measures (Bias, Odds Ratio, and Hanssen-Kuipers Discriminant). The analyses using these

reliability measures indicate the floating percentile method is protective and reliably predicts sediment toxicity. This new analyses of reliability was added to the 2011 SQV report which evaluates reliability in a manner unbiased by the hit/no-hit ratio.

- Chemical criteria - Protectiveness.
 - Comment. Several reviewers recommended that Ecology carefully consider whether the chemical criteria were protective enough. Some of these concerns related to the choice of a 20% false negative rate. Other concerns seemed to stem from the way the floating percentile method works and the potential for some chemical values to become artificially high due to co-occurrence of several chemicals.
 - Response. A case study analysis was conducted using alternatives that included use of other SQVs such as TELs and TECs which are lower and have a very low false negative rate. These alternatives were analyzed regarding how they would perform under the proposed rule, which allows a bioassay over-ride of chemical criteria. Results showed the proposed standards and TEC/TELs resulted in similar areas requiring cleanup, indicating that the proposed standards are as protective as the TEL/TEC approach when a bioassay over-ride is allowed. This is due to the high false positive rate of the TEL/TEC, which is directly associated with the lower false negative rate.

MTCA/SMS Science Panel Review. Ecology asked the MTCA/SMS Science Panel to review the draft 2010 SQV report and accompanying documentation. The panel includes five members: Drs. Bruce Duncan (EPA); Elaine Faustman (University of Washington); Teri Floyd (Floyd/Snider); Michael Riley (Anchor QEA); and Rosalind Schoof (Environ). The main conclusions include:

- Science Panel members concluded that the biological tests and endpoints are consistent with the best available science. Like the national peer reviewers, they emphasized the importance of having the flexibility to use newer toxicity tests that are validated in the future.
- Science Panel members agreed that the multivariate statistical approach was a common technique and consistent with best available science. They provided similar cautions on the interpretation of results (associations vs. cause-effect) discussed by the national peer reviewers.
- Science Panel members expressed general support for the approach and analysis. However, they raised some of the same questions/issues about the underlying database identified by the national peer reviewers.
- Science Panel members concluded that Ecology's proposal represents a robust approach and its scientific defensibility is linked to the judgment and flexibility associated with the overall SMS implementation framework (combination of chemical and biological criteria, use of new scientific information, bioassay override of chemical criteria, etc.).