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MEMORANDUM

To: Washington Department of Ecology

From: Tad Deshler and Kathy Godtfredsen

Subject: Alternative framework for evaluating bioaccumulative chemicals in sediment

Date: January 13, 2012

There has been much discussion during recent meetings on the Sediment Management Standards rule revisions about comparing chemical concentrations in sediments from contaminated sites and background areas. While such an approach may provide useful bounds on the magnitude and extent of sediment cleanup, it is one step removed from fish and shellfish concentrations, which are central to the most relevant exposure pathway for assessing human health risks in sediments.

We are providing an alternate sediment evaluation framework for your consideration. This framework is also based on a comparison to background concentrations, but it puts the comparison of tissue chemistry data ahead of sediment chemistry data. This reordering is appropriate because it provides for a careful background assessment early on in the process, which is conducive to a successful remedy.

Giving tissue chemistry data primacy over sediment chemistry, as shown in the flowchart below, is analogous to the existing Sediment Management Standards rule, where toxicity testing data can trump sediment chemistry data because toxicity data represent a more meaningful measurement of risk to benthic invertebrates than sediment data.

The flowchart presented in the figure below has numbered steps. Each step is briefly described below. There are many technical issues associated with each step. The intent here is to provide the broad framework; consequently, many of the technical details are left to a future discussion. We believe that this framework would provide more certainty that sediment cleanups would be achieving the important objective of protecting human health.

Step 1 – Evaluate tissue chemistry data

Tissue chemistry data are frequently collected as part of sediment quality investigations in order to conduct a human health risk assessment. Site-related tissue chemistry data should be compared to tissue chemistry from background areas. Chemical concentrations in fish/shellfish from background areas represent the potential exposure that fish/shellfish consumers may face from routine consumption practices outside contaminated areas, and thus this comparison represents an incremental risk assessment (i.e., site risk – background risk). An incremental risk assessment demonstrates whether risks posed by the site are above those in the regional setting. This information is important because if site-specific tissue concentrations are similar to regional concentrations, site-specific sediment cleanup is unlikely to result in a reduction of human health risk.

Step 2 – Evaluate risk

Incremental risk would be calculated, if appropriate, and compared to relevant risk thresholds. If the incremental risk estimate is below the risk threshold, then no additional analysis is necessary; otherwise Step 3 should be considered.

Step 3 – Assess bioaccumulation pathways

The inherent assumption in sediment remediation is that remediation will result in a reduction in chemical concentrations in fish/shellfish. For this to be true, the primary uptake pathways for this chemical must be related either directly or indirectly to chemical uptake from this particular location of sediment. Other factors, such as home range considerations as well as uptake from suspended or dissolved fractions, can also play important roles. This step requires a review of the target species evaluated in Step 1 and an evaluation of the likelihood that their chemical body burdens are derived primarily from site-specific sediment contamination. If water is the primary source or if the species has a large home range, it is less likely that sediment remediation will be effective at reducing chemical concentrations in fish/shellfish. If contaminated sediment in this area is the primary source, then additional analysis is warranted.

Step 4 – Evaluate sediment chemistry data

Step 4 provides another opportunity to compare site-related and background concentrations, this time in sediment. Ecology regulations already include provisions that state that cleanup levels in sediment should not be lower than background concentrations. Defining the appropriate background concentration (whether it is natural, regional, or area) has been a tricky proposition, particularly when considering the potential for recontamination from diffuse sources. It is this "anthropogenic" influence that is at the heart of EPA's definition of background. If site-related concentrations are greater than the background concentrations identified as relevant, then additional analysis is warranted. If site-related concentrations are not greater than background concentrations, additional evaluation and risk communication may be

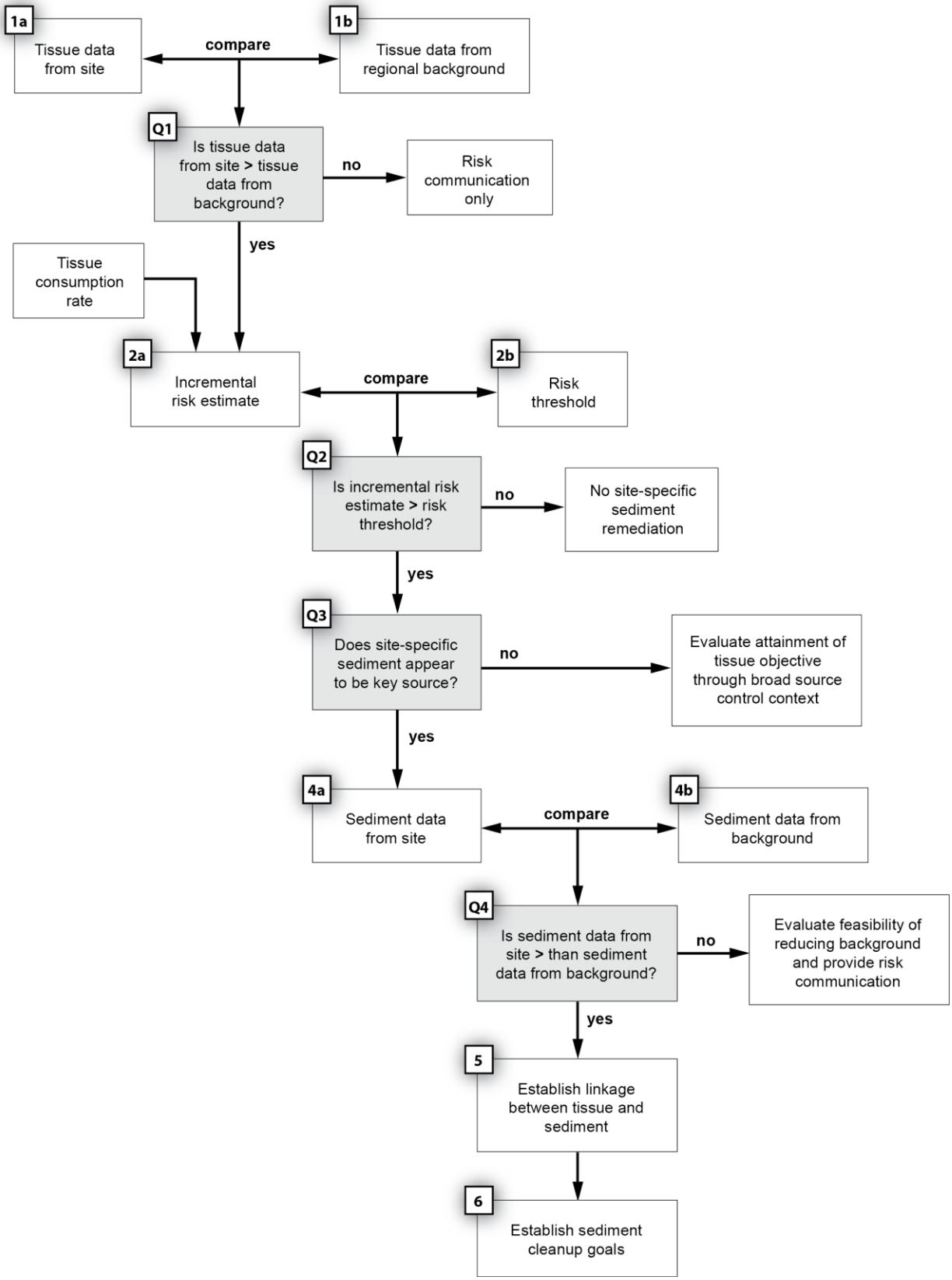
warranted on the topic of reducing background concentrations, but no immediate remedial action is warranted at the contaminated site.

Step 5 – Establish linkage between sediment and tissue

If sediment remediation is warranted based on the above steps, a linkage should be established between sediment and tissue concentrations so that the extent of remediation can be determined. There are various models for establishing linkages between sediment and tissue, ranging greatly in complexity, depending on the risk driver chemical and the species being consumed.

Step 6 – Establish sediment cleanup goals

Models developed in Step 5 can be used to develop the appropriate cleanup goals, taking background tissue concentrations and other key factors into account.


1a
Tissue data from site
compare
1b
Tissue data from regional background
Q1
Is tissue data from site > tissue data from background?
no
Risk communication only
yes
Tissue consumption rate
2a
Incremental risk estimate
compare
2b
Risk threshold
Q2
Is incremental risk estimate > risk threshold?
no
No site-specific sediment remediation
yes
Q3
Does site-specific sediment appear to be key source?
no
Evaluate attainment of tissue objective through broad source control context
yes
4a
Sediment data from site
compare
4b
Sediment data from background
Q4
Is sediment data from site > than sediment data from background?
no
Evaluate feasibility of reducing background and provide risk communication
yes
5
Establish linkage between tissue and sediment
6
Establish sediment cleanup goals