

**ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF SPILL PREVENTION AND RESPONSE
CONTAMINATED SITES REMEDIATION PROGRAM**

Technical Memorandum

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Sediment Quality Guidelines (SQG)

The evaluation of the complex nature of sediment is an ongoing process. Contaminant chemistry, toxicity, benthic survey, bioavailability, and bioaccumulation, etc. are but a few areas pertaining to sediment quality or lack thereof. A number of different and sometimes divergent approaches have been taken in assessing sediment quality. In January 2001, the Alaska Department of Environmental Conservation (ADEC), through contractor support, conducted a comparative analysis of federal and other state information related to standards for marine, estuary, and freshwater sediments. The following is the Executive Summary of the report, *Sediment Quality Guideline Options for the State of Alaska*, dated May 2001. The completed report is located at http://www.state.ak.us/dec/spar/csp/guidance/sediment_quality_options.pdf. At present time, the state does not have a framework for screening, assessment and remediation of contaminated sediment. In the absence of such a framework and for consistency within the Contaminated Sites Program, project managers should consult with their supervisors on when and how to evaluate sediment and/or sediment contamination.

Sediment Quality Guideline Options for the State of Alaska, May 2001

Executive Summary

Alaska statute and regulations provide a clear expectation that parties responsible for contaminated sites must include consideration of contaminated sediment in the assessment and cleanup process. At present there is no state guidance that would provide a responsible party with direction in how to comply. This document provides background information on contaminated sediment and presents representative methods of sediment assessment for consideration as possible models for Alaska. DEC managers responsible for deciding how Alaska will proceed with sediment program development are the intended audience. In recognition that not all potential readers have dealt with contaminated sediment, this paper is geared toward those managers with limited knowledge of the issue as well as those with more experience.

This document begins with a brief description of the basic chemical, physical and biological concepts related to contaminated sediment in order to provide a building block toward better understanding of the science involved with deriving sediment criteria. Tools for evaluating sediment are discussed and the various recognized methods of developing sediment quality guidelines are then profiled, including theoretical and empirical methods. Although these two categories of methods take very different approaches, they share the common intent of deriving numerical standards protective of the benthic environment. The theoretical methods consist primarily of equilibrium partitioning (EqP) and acid volatile sulfide (AVS) methods, while the empirical methods are dominated by weight-of-evidence approaches that include criteria of similar narrative intent, but which are derived using different statistical approaches and/or data sets. The empirical approaches typically have lower level criteria, below which toxicity to benthic organisms is not expected to occur, and upper level criteria, above which toxicity is frequently expected to occur.

Seven representative states and two Canadian provinces are offered as examples of jurisdictions that have developed sediment quality guidelines for sediments based on one or more of the profiled methods. U.S. and Canadian federal government-derived criteria are also included, as well as the preferred methods of the international Organization of Economic Cooperation.

Finally, a comparison of approaches is offered along with a discussion regarding the sediment quality assessment methods and their practicality for use in Alaska. In essence, Alaska's choice of how to proceed with program development related to contaminated sediment must balance broad and varying geographic regions, limited existing regional data, and limited staff and fiscal resources.

Recommendations

As stated above, methods for determining sediment quality can be divided into two general categories, theoretical and empirical. Theoretical methods are based solely on sediment chemistry and may be limited to a specific contaminant group. For example, EqP is an approach for non-polar organics which assumes that pore water is in equilibrium with sediment. Pore water concentrations are calculated from the measured bulk sediment concentrations and compared to applicable water quality standards. Likewise, the AVS approach is based on equilibrium partitioning, however, specific to metal contamination.

Empirical or weight-of evidence methods are generally statistical approaches based on database information of sediment contamination levels and biological responses. Biological responses are for benthic organisms and may be field observations and/or laboratory derived. Several different databases and statistical approaches have been employed to develop “effects” levels, a lower level below which benthic effects are not expected to occur, and a higher level above which effects are frequently expected. These screening criteria have been statistically derived for a wide range of chemicals and generally, are better suited for evaluating sediments containing a mixture of contaminants.

Therefore, the department is recommending the use of the TEL and PEL Sediment Quality Guidelines (SQGs), as published in the NOAA Screening Quick Reference Tables (SQuiRTs). SQG TEL/PEL values are listed for both fresh and marine water. The reference tables and pertinent information are located at: <http://response.restoration.noaa.gov/cpr/sediment/squirt/squirt.html>.

Following are the TEL/PEL definitions:

TEL – Threshold Effects Level; represents the concentration below which adverse effects are expected to occur only rarely.

PEL – Probable Effects Level; represents the concentration above which adverse effects are frequently expected.

Explanation of the calculation of the statistically derived TEL/PEL values can be found in the Oasis report and as part of the NOAA SQiRT tables (page 12). As noted, the TEL tends to be the most conservative screening value. Determination as to which value to utilize in sediment evaluation (TEL/PEL) should be made by the department’s project manager and based upon site specific information, requirements and acceptable risk level.

In applying the NOAA SQiRT values, the following must be considered for assessment.

- 1) The values are Sediment Quality Guidelines (SQGs) and as such, should be used for screening purposes only. They are not meant to be, nor should they be, viewed or utilized as sediment cleanup levels.
- 2) The values are based upon effects reported for benthic organisms; organisms that inhabit the bottom of an aquatic environment. They do not address or apply to bioaccumulation, adverse effects in higher trophic level organisms (biomagnification), and/or human health. As such, compounds that are known (or suspected) to bioaccumulate and biomagnify may warrant further investigation.
- 3) If TEL/PEL values are not listed for a COC, alternative, published screening levels may be proposed and reviewed by the department on a site specific basis.
- 4) Background concentrations should be evaluated when metal(s) are the contaminants of concern (COC).

SQGs should be utilized as a first tier screening for sediment evaluation at contaminated sites. This first tier, therefore, will generally be to compare site specific sediment concentrations to the recommended TEL/PEL values. If the SQGs are exceeded and it is determined, based on site specific information, that additional sediment evaluation is warranted, a second tier investigation may include sediment toxicity testing, benthic community surveys, bioaccumulation evaluations and/or tissue sampling, and fate and transport modeling to further delineate site specific conditions. Site specific sediment determinations may then be developed based upon all available data. In summary, a weight of evidence approach is recommended for final, site specific decisions in regards to sediment contamination.

Additional Information

Additional sediment information can be located through the following web links.

NOAA : Office of Response & Restoration

Links to Toxic Chemicals in Coastal Environments and Sediment Guidelines

<http://response.restoration.noaa.gov/index.html>

EPA Office of Water: Contaminated Sediments links page

<http://www.epa.gov/OST/cs/>

<http://www.epa.gov/waterscience/cs/guidelines.htm>

EPA Great Lakes Nat'l Program Office (GLNPO)

Case Studies:

<http://www.epa.gov/glnpo/sediments.html>

Regional Dredging Framework:

<http://www.epa.gov/glnpo/sediment/gltem/index.html>

State of Minnesota: List of Contaminated Sediment WEB references, including Sediment Screening Levels and Sediment Assessment Methods.

<http://www.pca.state.mn.us/water/sediments/links-assessment.html>

State of Florida: 1994 Florida SQGs, including Sediment Screening Levels and Sediment Assessment Methods.

<http://www.dep.state.fl.us/water/monitoring/seds.htm>

State of Washington

Sediment Management Home Page: Starting Point for all things sediment in WA.

<http://www.ecy.wa.gov/programs/tcp/smu/sediment.html>

Sediment Management Standards: Current Set of Regulations.

http://www.ecy.wa.gov/programs/tcp/smu/sed_chem.htm

Puget Sound Dredged Disposal Analysis (PSDDA)

<http://www.psat.wa.gov/>

Sediment Management Working Group

Technical advisory group. Among other technical documents, present a framework for evaluation of sediment.

<http://www.smwg.org/index.htm>

Dredging

EPA/USACE (Joint): Dredged Material Management

EPA's Oceans and Coastal Protection Division: Includes links to Dredging Framework, Inland Testing Manual, and Ocean Disposal guidance documents.

<http://www.epa.gov/owow/oceans/ndt/>

<http://www.epa.gov/waterscience/itm/>

Lower Columbia River Dredged Material Evaluation Framework. This framework is strongly supported by Region 10.

<http://www.nwp.usace.army.mil/ec/h/hr/Final/>

<http://www.nwp.usace.army.mil/ec/h/hr/>

US Army Corps of Engineers: Dredging Operations Technical Support

Homepage for USACE technical dredging issues.

<http://chl.wes.army.mil/research/dredging/>

<http://www.wes.army.mil/el/dots/guidance.html>

<http://www.wes.army.mil/el/dots/>