

APPENDIX C
SEDIMENT BIOACCUMULATION DATA QUALITY REVIEW AND
BIOACCUMULATION TESTING REPORT

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C.1 Introduction

Battelle Marine Sciences Laboratory (Battelle), of Sequim, Washington, was contracted to conduct the exposure portion of a 45-day, dual species bioaccumulation test on sediments collected from Anacortes, Washington, as part of a Dredged Material Management Program (DMMP) sediment characterization study for Hart Crowser, Inc., Seattle, Washington. Bioaccumulation testing was conducted by Battelle's Sequim Bay Marine Sciences Laboratory, a State of Washington-accredited laboratory (Lab accreditation number C043: Expiration November 23, 2000).

C.2 Sediment Bioassay Data Quality Review

Two test sediments were collected by Hart Crowser personnel and delivered to Battelle on January 21, 2000. Reference sediment was collected by Battelle personnel from Sequim Bay, sieved through a 1-mm mesh sieve, and stored in a cold room until needed.

Bioaccumulation testing was conducted using two species: *Macoma nasuta* and *Nephtys caecoides*. Test protocols included the co-testing of the two species in the same aquaria. Test duration was 45 days. *M. nasuta* were collected from Discovery Bay, Washington. The animals were supplied by Johnson and Gunstone of Port Townsend, Washington, and arrived on February 8, 2000. Sequim Bay reference sediments were used for the *M. nasuta* control sediments. *N. caecoides* and control sediments from Tomales Bay, California, were supplied by Brezina and Associates of Dillon Beach, California, and arrived on February 10, 2000.

The following criteria were evaluated as part of this data quality review:

- ▶ Bioaccumulation test conditions (water quality parameters);
- ▶ Bioaccumulation test performance in positive control tests; and
- ▶ The bioaccumulation testing procedures were based on the US Environmental Protection Agency methods (Lee et al., 1989) and the Puget Sound Dredge Disposal Analysis (PSDDA) guidelines (Corps, 1998a) for dredged material.

Additional protocols developed by Battelle for the recent East Duwamish Waterway project were also used.

C.2.1 Bioaccumulation Test Conditions

Battelle's acceptable water quality parameters (Table 1) are within the range of values PSEP (1995) and PSDDA (1994) used in evaluating water quality for bioassay testing.

Table 1 Battelle's acceptable water quality parameters for bioaccumulation tests.

Parameter	Acceptable Ranges
Temperature in °C	14 to 18
Salinity in ppt	28 to 32
Dissolved oxygen in mg/L	4 to 10
pH	7.3 to 8.3

There were no deviations from Battelle's water quality parameters for dissolved oxygen, or pH. Salinity was slightly elevated (>32.0 ppt) on 5 of the 45 days of the test as a result of elevated ambient seawater salinity. The highest measured salinity was 32.3 ppt, barely above the acceptable range on two days during the test. It is doubtful that these water quality deviations will have any significant effects on the results.

Temperature was below the minimal acceptable value of 14.0°C on day 42 of the test due to a power failure. Temperature dropped to 12.0°C. The other parameters were within the acceptable ranges. There did not appear to be any observed adverse effects from the single day of low temperatures.

C.2.2 Bioassay Performance—Positive Control

A concurrent reference toxicant test using copper was conducted on each species using a geometrically increasing concentration series. The concentration range had at least one concentration with mortality of greater than 50 percent and one with mortality of less than 50 percent. The calculated median lethal concentration (LC50) for *M. nasuta* was 1.23 mg/L copper. This value was within Battelle's control chart warning limits. The LC50 for *N. caecoides* was 0.13 mg/L copper, also within Battelle's control chart warning limits. Battelle's control charts were based on nine data points which is more than the five data points needed to develop an initial set of warning limits (Corps, 1998b). The health and sensitivity of the test animals to the reference toxicant is similar to the response of other groups of test organisms used in previous studies.

C.2.3 Bioaccumulation Test Performance—Survivorship

Mean survivorship of *M. nasuta* in the two test sediments was 90 and 95 percent. The *M. nasuta* survivorship was 96 percent in the reference/*M. nasuta* control sediment and 94 percent in the *N. caecoides* control sediment. Mean survivorship of *N. caecoides* in the two test sediments was 91 and 93 percent. The *N. caecoides* survivorship was 89 percent in the reference/*M. nasuta* control sediment and 98 percent in the *N. caecoides* control sediment. Survivorship values were above Battelle's survivorship target value of 80 percent.

C.3 Final QA Determination

Bioaccumulation testing protocols are still being revised and updated by the agencies. There are few agency standards for the 45-day bioaccumulation testing using two species. The results of this study were compared to Battelle's internal standards developed during other bioaccumulation studies. Battelle's water quality parameters are within the range of values found in the animals' natural habitats and are similar to test conditions required in other bioassays with similar animals. Survivorship in the 45-day test was above 89 percent in all treatments. Minor protocol deviations in regards to salinity and temperature are unlikely to affect the results of the test or the quality of the data. Based on the data available regarding the test conditions, including the water quality measurements, reference toxicant test performance, and survivorship, the bioaccumulation test performance is acceptable and the data are usable for PSDDA dredge disposal determinations.

C.4 References

Corps (US Army Corps of Engineers), 1998a. Dredged material evaluation and disposal procedures: a user's manual for the Puget Sound Dredged Disposal Analysis (PSDDA) program. US Army Corps of Engineers, Seattle, Washington.

Corps, 1998b. Evaluation of dredged material proposed for discharge in waters of the US—inland testing manual [online report]. Prepared by the US Army Corps of Engineers and US Environmental Protection Agency. US EPA website [May 6, 1998]. URL: <<http://www.epa.gov/OST/pubs/ITM/>>.

Lee, H., B.L. Boese, J. Pelletier, M. Winsor, D.T. Specht, and R.C. Randall, 1989. Guidance manual: bedded sediment bioaccumulation tests. US Environmental Protection Agency ERL-N, Pacific Branch Bioaccumulation Team, EPA/600/X-89/302, ERLN-N111, Newport, Oregon.

PSDDA (Puget Sound Dredged Disposal Analysis), 1994. Dredged analysis information system (DAIS), version 4.4. Electronic database from the US Army Corps of Engineers, Seattle District, Seattle, Washington.

PSEP (Puget Sound Estuary Program), 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments. Final report by PTI Environmental Services for US Environmental Protection Agency, Region X, Office of Puget Sound, Seattle, Washington.

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BATTELLE MARINE SCIENCES LABORATORY**