EXECUTIVE SUMMARY

Laboratory methods for measuring body burdens of low-level chemical contaminants in aquatic organisms traditionally have required sizeable amounts of tissue for analysis (i.e., 10 to 30 grams wet weight of tissue per sample). Predisposal testing of dredged material and postdisposal monitoring studies therefore have focused almost exclusively on examining bioaccumulation in large benthic macrofauna. There has long been interest, however, in evaluating bioaccumulation potential in the smaller, opportunistic benthic organisms that are typically the first to colonize new dredged material deposits in high numbers.

The specific concern is that rapid bioaccumulation by these abundant, fast-growing species might result in significant trophic transfer and biomagnification of low-level contaminants, ultimately leading to significant ecological or human health risks. In response to such concerns, DAMOS scientists conducted this desk-top study to review current methods for measuring low-level contaminants in very small, sediment-dwelling organisms and to offer suggestions about how future DAMOS assessments of bioaccumulation might benefit from recent advances in analytical techniques.

The following activities were undertaken as part of this desk-top study: 1) experts were interviewed about current analytical capabilities and costs, 2) published information on new developments in microscale analytical techniques was reviewed, 3) theoretical contaminant body burdens were calculated for representative small, opportunistic (i.e., Stage 1) benthic species from Long Island Sound (LIS) disposal sites and reference areas, which allowed estimates of required organism numbers for potential future studies, and 4) power analyses were employed to estimate the sample number required for a statistically valid comparison of tissue concentrations in Stage 1 organisms collected over DAMOS disposal mounds versus reference areas.

The interviews with experts and the accompanying literature reviews indicated that “microscale” or “microextraction” analytical techniques currently exist and have been used with success to measure both lipids and environmentally realistic concentrations of bioaccumulative organic contaminants (polynuclear aromatic hydrocarbons [PAHs] and polychlorinated biphenyls [PCBs]) in small masses of tissue. Researchers at the U.S. Army Engineer Research and Development Center (ERDC), University of South Carolina (USC), and the State University of New York at Stony Brook’s Marine Sciences Research Center (MSRC) have spearheaded the development and application of these microscale methods. The various research groups have reported measuring low levels of PAHs and PCBs in samples containing as few as 20 individual copepods, 3 to 15 amphipods, and 3 to 5 individuals of the small spionid polychaete *Streblospio benedicti*. The total amounts of tissue per sample required by the microscale methods ranged from

0.5 to 100 mg wet weight; these amounts are 3 to 5 orders of magnitude less than the 25,000 to 30,000 mg wet weight of tissue per sample required by the traditional methods.

The ERDC microscale approach achieved method detection limits (MDLs) adequate for measuring levels of organic contaminants likely to occur in Stage 1 polychaetes inhabiting DAMOS disposal mounds and reference areas in LIS. These detection limits were achieved through analysis of 100 mg of wet tissue per sample, and similar sample amounts would need to be collected in any future DAMOS studies if this particular set of methods were utilized. Smaller amounts of tissue per sample would be sufficient if the USC/MSRC microscale analytical methods were employed. These methods have proven useful for measuring selected PAH and PCB compounds in samples consisting of as little as 3 to 5 mg wet weight of tissue. This amount of tissue could be provided, for example, by only about 5 adult-sized individuals of the polychaete *S. benedicti*. This polychaete is a common Stage 1 colonizer of disposal mounds in LIS and a possible target species for use in any future DAMOS bioaccumulation studies.

A first-order power analysis using LIS sediment chemistry data indicates that from 5 to 20 individual tissue samples (each comprised of multiple individuals of whatever target species ultimately is chosen) would need to be collected and analyzed at both a disposal mound and reference area to reliably detect any significant differences that might exist between the two in the body burdens of various organic contaminants. The theoretical bioaccumulation calculations presented in this report, however, suggest there would be little actual difference in tissue concentrations measured at active DAMOS disposal mounds versus reference areas. In lieu of conducting field studies to test for small differences in bioaccumulation between disposal mound and reference areas, it might be more useful for DAMOS to direct limited resources toward the development of more advanced food chain and/or risk assessment models, with laboratory exposures and/or field collections targeted toward filling any identified data gaps.

Although microscale analytical methods are available, it does not necessarily mean that studies of bioaccumulation using field-collected organisms should become a routine part of DAMOS monitoring. In the future, DAMOS might consider employing these methods in one or more special investigative studies outside its routine monitoring efforts. Such studies could help determine, for example, whether the use of small, Stage 1 test organisms changes the outcome of field or laboratory investigations of bioaccumulation potential that have traditionally focused on larger taxa.