EXECUTIVE SUMMARY

Sediments from the Royal River in Maine, considered suitable for open-ocean disposal, were sequentially dredged and disposed at the Portland Disposal Site (PDS) as a proof-of-concept that dredged material could be placed, and capped, in a deep water open-ocean disposal site. Monitoring protocols developed through the Disposal Area Monitoring (DAMOS) Program were utilized, as well as a newly developed tracer technique to track different lithologies of dredged material on the seafloor. Overall, the Portland Disposal Site Capping Demonstration Project showed that dredged material can be effectively placed, capped, and monitored at a deep water disposal site. Recommendations for improvements to the dredging and disposal operations, as well as to the monitoring methods, are provided for future project considerations.

Disposal and capping of dredged material is a management technique for the containment of sediments considered unsuitable for open-ocean disposal (unacceptably contaminated dredged material, or UDM) that has proven successful in Long Island Sound, in relatively shallow water (approximately 20 m) and over a flat seafloor. Capping at deep water disposal sites (>40 m) was an unproven management method due to a variety of factors, including historical difficulties in disposal barge positioning, and shortage of evidence confirming the formation of distinct UDM and capping layers. Refinement of dredged material management techniques and the implementation of the differential Global Positioning System (DGPS) during disposal and capping operations contributed to our ability to form, and monitor, discrete mounds in deeper water. This tightly controlled, closely monitored deep-water capping project has provided evidence that the technique can be successful in deeper waters.

In order to avoid any potential adverse environmental impact from such a demonstration, material dredged from the Royal River, Yarmouth, ME, deemed suitable for unconfined open-water disposal, was used as both "pseudo-UDM" as well as capping dredged material (CDM). The capping demonstration was designed to identify reaches (sections) of the Royal River project that were sufficiently distinct to permit identification of source materials after disposal. Finer grained sediment removed from the upper reaches of the river were designated as pseudo-UDM and placed as a discrete mound at PDS. Material from the lower reaches of the river, characterized by coarser grained material, was designated as the project CDM and was placed over the initial pseudo-UDM deposit as a cap. The capped disposal mound was formed within a basin feature on the PDS seafloor at a depth of 64 m. After the completion of disposal and capping operations, the newly formed mound was surveyed and cored to confirm the existence of two distinct layers. This project design depended upon identifying characteristics of the reaches of the Royal River that could be analyzed in samples collected after disposal.

Based on the amount of dredged material disposed at the Royal River Project Area (39,500 m^3 pseudo-UDM and 22,200 m^3 CDM), the DAMOS Capping Model predicted the formation of a conical pseudo-UDM deposit approximately 1.2 m high with flanks extending up to 250 m from the central point of disposal, and a 20 cm cap. Although the volume of cap material was smaller than for normal projects (generally a minimum thickness of 50 cm), the areal distribution of both pseudo-UDM and CDM observed in the demonstration, was relatively consistent with the model predictions.

An important component of the Portland Disposal Site Capping Demonstration Project was the identification of tracers within the Royal River that could be used to identify the sediment on the seafloor at the PDS. Prior to the excavation of sediment, 30 vibracores from three reaches (upper, middle, and outer) of the Royal River were collected and analyzed for a variety of potential tracers. Although no single tracer was identified that was both unique to one reach of the river and commonly observed in all collected samples, a statistical method of combining several biological and mineralogical parameters was found to be suitable for classifying the material types. The sediment fine fraction (63-500 μm) was selected as providing the most statistically robust data.

Monitoring at the Royal River Project Area in the southeast corner of the PDS utilized standard DAMOS techniques, including single-beam bathymetry, side-scan sonar, REMOTS® sediment-profile images, as well as grab and core sampling. Results of the monitoring surveys showed that a discrete dredged material mound was detected on the seafloor within the Royal River Project Area. An accumulation of pseudo-UDM was 21
detected to the south and southeast of the disposal buoy position, located in the relatively flat-bottomed basin targeted for disposal. Accurately detecting dredged material deposition in the surrounding area of more complex topography by single-beam bathymetry alone was complicated by survey artifacts. In this case, sediment-profile images and core data were key to mapping the footprint of both UDM and CDM on the seafloor.

The grab and core samples collected from the disposed dredged material were analyzed for the environmental tracers selected after analysis of Royal River Cores. The statistical tracer data were able to show a discernible difference between the CDM, pseudo-UDM, and ambient material. The presence of historical dredged material at the project area complicated the analyses, as historical material shares biological characteristics with both native, ambient sediment (recolonization by benthic species, settling of planktonic species), and with recent dredged material (presence of freshwater species).

Statistical analyses showed that tracers successfully identified disposed dredged material layers collected from different regions of the estuary, but material from the middle reach had many overlapping characteristics that complicated the interpretation. The biological indicators were found to be more statistically robust than the mineralogical indicators. Differences in species composition of the microorganism populations corresponded to the contrasts among the brackish habitats of the three reaches of the Royal River. The statistical overlap of the pseudo-UDM and CDM samples collected in cores and grabs from the disposal mound was consistent with the sequence of disposal operations.

The results of the demonstration project provided recommendations for future cap monitoring projects in deep water disposal sites, including suggestions for modifications to both the monitoring protocols and to dredging and disposal operations. For areas of complex bottom topography, a higher resolution single-beam bathymetric survey grid (5 to 10-m lane spacing) or multibeam bathymetry is required to provide more precise depth information over a wider area of seafloor. For the demonstration project, the low volumes of dredged material, and the complications in the dredging and disposal schedule, contributed to uncertainty in the data interpretation. Operational complications that may occur with a larger project will have less of an impact, because larger volumes reduce the overall monitoring error.

Finally, the tracer technique that was selected demonstrated promising results in tracking dredged material at a subaqueous disposal site. Several recommendations were made to improve the method, including selecting tracers with the narrowest range in the dredging area, and sampling and analyzing the baseline (ambient and historical dredged) material prior to disposal of project material.

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