MARINE AGGREGATE MINING

BENTHIC & SURFACE PLUME STUDY

FINAL REPORT

To:

UNITED STATES DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE
&
PLUME RESEARCH GROUP
(ARC Marine Ltd)
(South Coast Shipping Company Ltd)
(United Marine Dredging Ltd)
(HR Wallingford Ltd)

MMS OCS STUDY NUMBER 99-0029

PREPARED BY:

COASTLINE SURVEYS LIMITED
BRIDGEND FARMHOUSE, DOWNTON ROAD
BRIDGEND, GLOUCESTERSHIRE, GL10 2AX

TEL: +44 (0) 1453 826772 FAX: +44 (0) 1453 826762

ABSTRACT

A comprehensive and authoritative study of sediment plumes generated by marine aggregate mining operations in the UK has been completed. A thorough literature review has identified, with some notable exceptions, a paucity of conclusive information applicable to the marine aggregate mining industry in general, and in particular to the UK situation. Information is more widespread for other forms of dredging activities but is shown to be largely inappropriate for general application to most marine aggregate mining scenarios.

Extensive sampling campaigns have determined the sediment source terms of benthic and surface plumes. These support earlier (unpublished) results and are corroborated by other contemporary studies world-wide. Marine aggregate mining vessels currently working in the UK are shown to return, as overspill and unwanted screened material, between 0.2 and 5 times the cargo load. Further, the importance of detailed prospecting and reserve evaluation data is reinforced for predicting the likely magnitude and variation of such overboard returns.

Baseline measurements of the range of increased turbidity that may be generated have been obtained. A total of 162 Continuous Backscatter Profiling (CBP) transects across plumes have been recorded and post-processed using in-house programs. CBP transects show the bulk of the plume settling out of the water column (or, more strictly, settling to within 1.5m of the seabed) within 300m (sands) to 500m (silts) downstream. This corresponds to a time period of 10-15 minutes since release. Coarse sands (> 2mm) and gravels settle out virtually instantaneously. We propose that the far field visible 'plume' extending beyond the boundaries of measured suspended sediment load discernible above background conditions is an organic admixture of fats, lipids and carbohydrates agitated by the dredging process and with little sediment content.

We recommend as Best Practice that assessments of plumes from dredging operations are founded on pertinent, well designed sampling and testing programmes. We have shown there are significant productivity gains through the competent use of Continuous Backscatter Profiling (CBP) techniques with precise navigational control to effectively track and delimit the plume boundaries. This significantly improves confidence in the interpretation of results as representative of the maxima and minima conditions.

The development of a benthic plume by the hydrodynamic and physical interactions of the draghead on the seabed has been firmly established by the present work. We have shown however, using underwater imaging, suspensate sampling from around the draghead and CBP techniques, that the magnitude of the draghead plume is minor in comparison with the surface plume. Contribution of the overboard returns to the suspended load is 4-5 orders of magnitude greater than from the draghead. It is considered that the impact of the draghead plume may be deemed negligible in comparison to any surface plume effects.

Hopper overflow and the screening process is thus of dominant importance in the establishment of dispersive plumes from marine aggregate mining. Plume excursion is dependent on (among other factors) the total quantity of sediment rejected, the particle size of the sediments and tidal current velocity. Further, the rate and manner of overboard return is important in defining the initial stages of plume descent as a density current (Dynamic Phase) which subsequently controls the location and quantity of material available for conventional advection and dispersion (Passive Phase). Our work confirms that, as a general principle, the rate of deposition of material from the dispersing plume is much faster than would be assumed from conventional Gaussian diffusion models and that sedimentation is largely confined to distances of a few hundred metres from the point of discharge.

Importantly this suggests that the impact of dredging on benthic biological resources may be confined to the immediate vicinity of the dredged area. Little is known of the impact within Licence areas worked commercially, in the surrounding deposits, nor of the rate of recovery following cessation of dredging. Of particular interest is the possible impact of organic material released into the water column which may play an important role in the (well-documented) enhancement of secondary production in deposits surrounding dredged areas. This requires further investigation both as part of our understanding of plumes associated with marine aggregate mining and with establishing the impact on biological food webs leading to commercially exploitable fish stocks.

STATEMENT

"This Study was funded jointly by the Minerals Management Service, U.S. Department of the Interior, Washington, D.C. under Contract Number 14-35-0001-30763 and the following U.K. Marine Aggregate Mining Companies: ARC Marine Ltd; South Coast Shipping Company Ltd; United Marine Dredging Ltd; and the Consultancy HR Wallingford. Herein collectively known as the **Plume Research Group**".

Compiled By:

D R Hitchcock B.Sc., Ph.D. A.R.I.C.S.
(Coastline Surveys Ltd)

with specialist contributions by:

R C Newell B.Sc., Ph.D., D.Sc.(Lond)
L J Seiderer B.Sc., Ph.D.
(Marine Ecological Surveys Ltd)

"This Final Report has been reviewed by the **Minerals Management Service** and **the Plume Research Group** Members and has been approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Service or the Group, nor does mention of trade names or commercial products constitute endorsement or recommendation for use."

The correct citation for this report is;
Hitchcock, D.R., Newell, R.C. & Seiderer, L.J. "Investigation of Benthic and Surface Plumes associated with Marine Aggregate Mining in the United Kingdom – Final Report".
Contract Report for the U.S. Department of the Interior, Minerals Management Service.
Contract Number 14-35-0001-30763. **Coastline Surveys Ltd Ref. 98-555-03 (Final)**

Not to be cited without the permission of the Minerals Management Service or Coastline Surveys Ltd

Full Acknowledgement to be Accredited

ABSTRACT

STATEMENT

CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

CONTENTS

FIGURES

TABLES

PLATES