6.3.2 Dredging Techniques

Maintenance dredging in Poole Harbour has, to date, been carried out using the Commissioners' own grab dredger which is now used largely for works in quay and berth areas. Trailer suction dredgers have normally been used for contract maintenance work in the channels. The capital dredging of the Swash Channel was carried out using a trailer suction dredger. The original opening up of the Middle Ship Canal used a combination of trailer dredger and bucket dredger, and a similar combination is now being used for the enlargement of Middle Ship Channel. Some of the capital dredging within the harbour cannot be carried out easily with a trailer suction dredger, however, due to cohesiveness of the sediment.

6.3.3 Current Disposal Methods

At present, the majority of material dredged from Poole Harbour is disposed of at a licensed offshore disposal site at "Old Harry", off the Dorset Coast. Approximately 35,000 m^3, from the capital dredging now in progress in the Middle Ship Channel and at Hamworthy, will be used for beach nourishment at Sandbanks (see Figure 6.2.1). During the proposal stage of the Swash Channel Dredging scheme, in 1986 it was known that Bournemouth Borough Council (BBC) had problems with erosion of the beach at Bournemouth. An approach was made to BBC with a view to using the material arising from the Swash Channel improvement for a major beach nourishment scheme. The scheme was approved and, from the total of 1,182,000 m^3 of material dredged from the Swash Channel, 1,024,000 m^3 were pumped ashore, the remainder being coarse material which was dumped at sea. Following this operation, negotiations concluded that additional material could be used for further nourishment of the beach in the future. Had this beneficial use of the dredged material not been possible, the material would have been dumped at sea (Appleton, 1991).

6.4 Description of Holes Bay, Poole Harbour

6.4.1 Introduction

Holes Bay is the largest bay entering Poole Harbour. The bay has a narrow entrance which restricts tidal flow into and out of Holes Bay, therefore the flushing time is very slow. Due to the sheltered nature of Holes Bay the sediment which has settled is predominantly silty in nature.

Holes Bay was selected for this case study as a small area of the south-eastern section of the bay is owned by the Poole Harbour Commissioners who are interested in pursuing the potential beneficial uses of dredged material concept.

A detailed study of Holes Bay was carried out in 1983 (Dyrynda, 1983). Holes Bay was then considered to have an impoverished fauna and flora (Dyrynda, 1983: Doody and Dennis, 1984) due to the poor flushing characteristics of the bay, which inhibit the removal of detritus. This, in combination with the discharges entering the bay from sewage treatment works and industrial effluents, have rendered conditions eutrophic (enriched by nutrients), producing accelerated rates of plant growth, particularly of algae. This leads to high concentrations of interstitial hydrogen sulphide due to the bacterial decay of plant material and low oxygen tensions. These conditions often support a characteristic species distribution of low diversity. A species of regional importance, the bryozoan, Farella repens, was, however, found in the subtidal channels of Holes Bay (see Section 6.2.4).

The physical nature of the bay was assessed and samples were taken from the south-eastern area of the bay for chemical and biological analysis. The results of this study are detailed in the following sections.

6.4.2 Physical Status

The major physical properties of this shallow tidal bay are:-

- **Bed Sediment** — The only information on the bed sediment in Holes Bay has been obtained for the south eastern part of the bay within 500m of the RNLI. Bed samples were taken in 4 locations and for each the grading was found. The bed sediment in all cases comprises a sandy silt.

- **Dredged channels** — There are no major maintained dredged channels in Holes Bay. However, the entrance channel divides into three parts: Creekmore Lake, Upton Lake and a small channel leading to slipways at Cobbs Quay Marina. Their depths are 1.2, 1.5 and 1.4m below CD respectively.

- **Bathymetry** — Holes Bay is generally shallow, with most of its area being at a level of between 0.5m and 2m above chart datum (0.0m CD = -1.4m OD). Hence much of the area is dry at low tide. The tidal prism ratio for Holes Bay is about 40% greater than for Poole Harbour.

- **Tidal Currents** — Extensive studies have been carried out by others of the tidal currents in Holes Bay. The maximum tidal currents near the entrance to the bay are in the order of 0.6m per second. However, the maximum current gradually falls within the bay, in relation to the distance from the bay entrance.

- **Wind Conditions** — The wind conditions for Holes Bay are the same as for Poole Harbour as a whole.

- **Wave Climate** — Waves in Holes Bay are locally generated. As the fetch distance is small, wave heights are small and are less than those experienced in Poole Harbour itself.

- **Tides** — As for Poole Harbour as a whole, Holes Bay has a relatively small tidal range of 1.7 and 0.5m at spring and neap tides respectively. The tidal curve is complex.

6.4.3 Chemical Status

Consultation with both the NRA and Poole Harbour Commissioners have revealed that, over the years, a number of land users surrounding Holes Bay have been contributing to the Bay's sediment contaminant load, either through accidents or through routine discharging. According to NRA, almost all discharges in the Bay are concentrated, some more recent than others. Figure 6.4.3 shows the present land uses along Holes Bay frontage.

Discussions with the National Rivers Authority (NRA) Wessex Region concerning the chemical status of the Holes Bay sediments revealed that the only data of which they are aware, is a 1992 survey by NRA on "the effects of effluent from Poole Sewage Treatment Works upon the Intertidal Macrofauna of Holes Bay, Poole Harbour". The purpose of the survey was to investigate the effects of the Poole sewage treatment works upon the intertidal macrofauna of Holes Bay. The sampling was performed throughout Holes Bay but was concentrated in the vicinity of the north side where the major inputs occur. The basis of the survey was one core sample per site. Only the top 15cm of sediment was sampled because NRA were interested in recent deposits. The sediment samples were analysed for macrofauna, particle size, heavy metals, total organic carbon and organics (including the UK's Black List substances namely DDT, PCP, Drins, TCB, HCB). To date, however, the survey's results are in the form of an internal document and the analytical data has not yet been confirmed by NRA.

The Ministry of Agriculture, Fisheries and Food (MAFF) Fisheries Laboratory in Burnham-on-Crouch were also consulted for data on sediment quality for Holes Bay. Sediment samples from Cobbs Quay Marina in the south west corner of Holes Bay were analysed by MAFF for dumping licence purposes in 1991. According to MAFF the sediment quality justified the granting of a dumping licence.

- Point and Diffuse Sources of Contaminants

Several land uses along Holes Bay coastline contribute to the sediment's contaminant load through their effluent discharges. The main outfall from Poole Sewage Treatment Works emerges in the north corner of Holes Bay, together with extensive surface water drainage from the Fleetbridge Industrial Estate. The surface drainage from the various industrial estates at the top end of the Bay is unconsented. According to NRA these are light industry premises and their surface drainage is not, therefore, expected to represent a substantial pollutant load entering Holes Bay. The effluent discharges from these light industry premises join the sewerage network and end up at Poole Sewage Treatment Works. To the east of Holes Bay and behind Holes Bay Road there is Sterte Industrial Estate with a number of electroplating works discharging into the Bay. Their discharges have been consented recently. On the south corner of Holes Bay frontage there is Merck Ltd., chemical manufacturers. Their effluent was consented in mid January 1991 and contains various metals and organics. In 1985, their discharge effluent facilities were upgraded. According to NRA a dispersal analysis test carried out approximately 5 years ago, indicated that the Merck effluent oscillated either side of the discharge point on the tide. A 24 hour analysis for the effluent's concentrations levels showed a progressive dilution of the effluent.

6.4.4 Biological Status

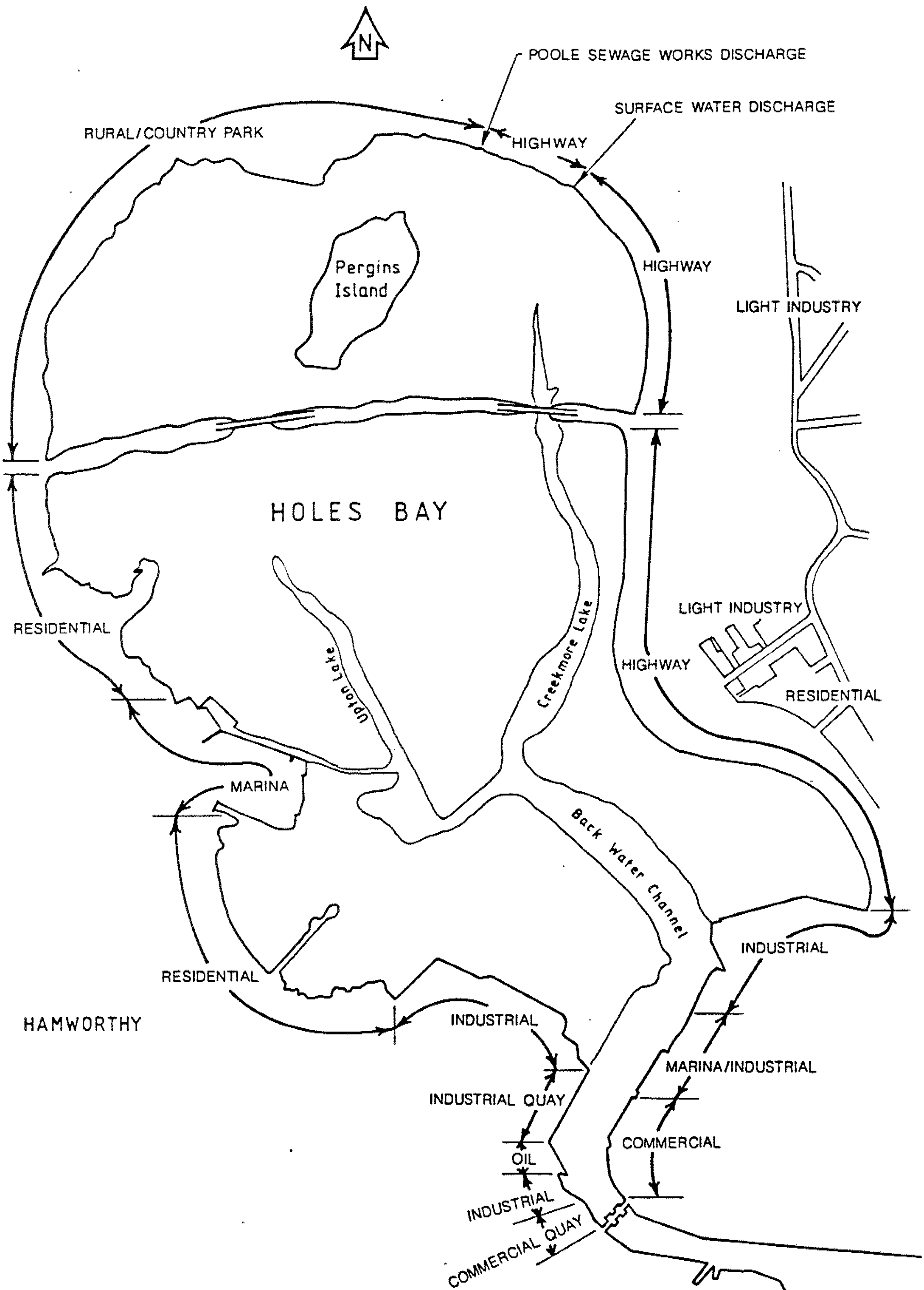
For the purpose of determining whether there were any species of importance or species sensitive to disturbance, benthic samples were taken for faunal analysis. The results of the benthic invertebrate sampling analysis are shown in Appendix F.

All of the species found are typical estuarine species which would be expected in this environment. None of them are particularly indicative of any excessive conditions. Although the diversity of species is low, the abundance of certain species is high. This implies that the species found are opportunistic in that they can exploit the conditions in which they live to their own advantage. The species found are relatively short-lived and therefore not highly sensitive to disturbance, as within their short life-cycle they produce large numbers of offspring, for future colonisation.

6.5 Site Survey Analysis

6.5.1 Sampling

For the purpose of identifying possible beneficial use options for the sediment from Holes Bay, core samples (top 15cm) of the south eastern most corner of the bay were taken and analysed for a number of representative heavy metals, pH, organics, organic content, carbonate content and redox potential. The latter was read in situ as soon as the core sampler was brought inside the boat. The results of the survey are shown in Appendix F.



Title

LAND USES ON HOLES BAY FRONTAGE

CONSULTING ENGINEERS
POSFORD DUVIVIER

DATE FEB. 92	SCALE 1:12,500
DRAWN J.R.	CHKD
Figure 6.4.3	

As an indicative survey for case study purposes, the number of samples were limited to four and the sampling was carried out on the basis of one sample per sampling location. A more extensive programme (in terms of increased sample depth, number of samples per location and number of locations) would be applicable to any future study of Holes Bay sediment quality. The four sampling locations were evenly spread in the south east corner of Holes Bay (Figure 6.5.1).

6.5.2 Chemical Testing

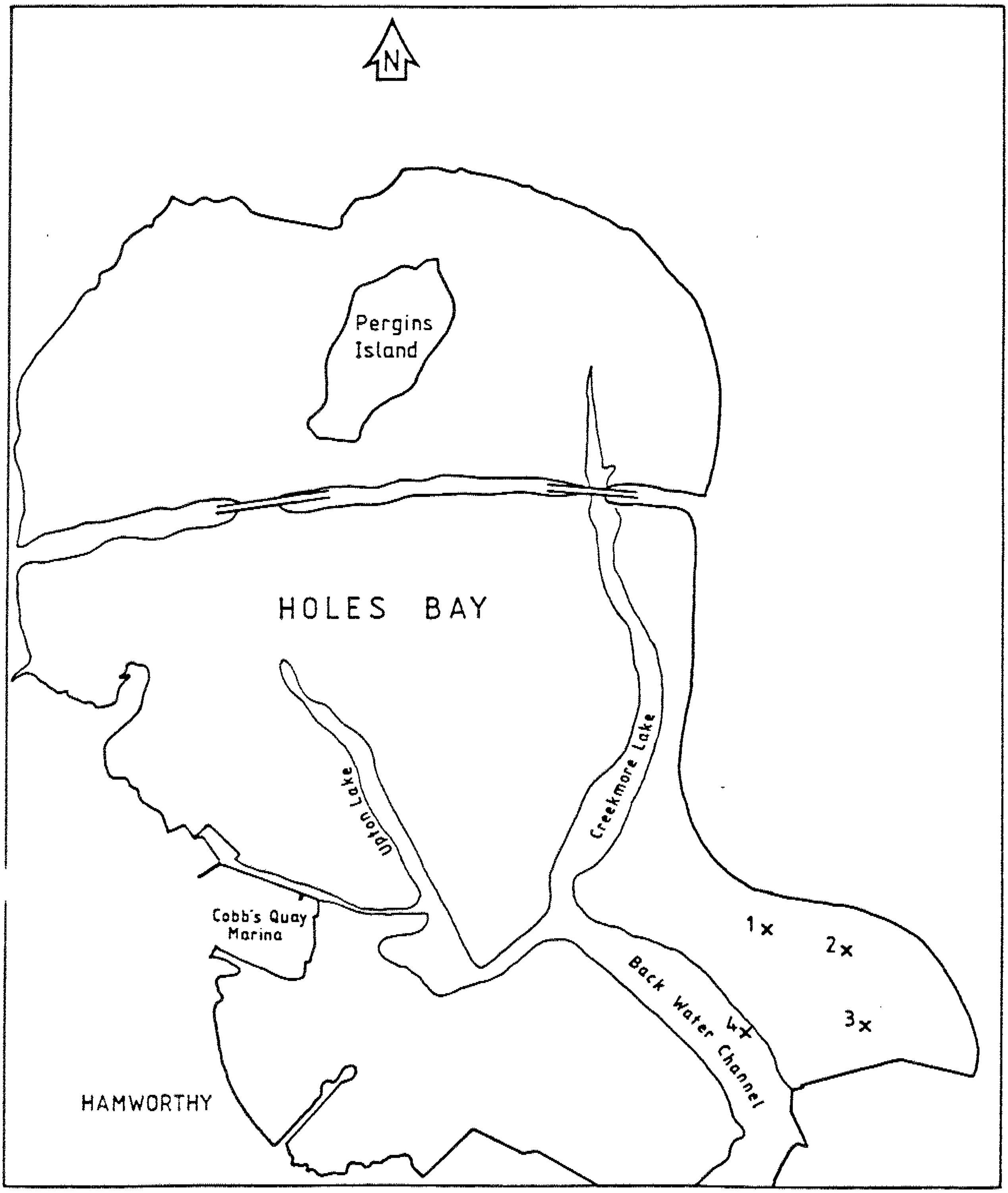
A small number of critical parameters were selected for analysis. Their selection was based on potential toxicity to plant and animal life and on possible changes in the sediment's contaminant load following different types of disposal, as discussed in Sections 4.2 to 4.4.

The majority of the metals chosen for analysis are known for their phytotoxic (plant killing) properties. Others, mercury in particular, were selected for their photosynthetic inhibitive activity. Organic pollutants such as Polychlorinated Biphenyls (PCBs), the insecticide DDT, phenols, pesticides (Drins) and the polyaromatic hydrocarbons were chosen because their chemical stability in the environment, their lipid solubility and fear of water (hydrophobic) facilitate food chain amplification. DDT's half life is 10 years minimum and it is believed that DDT and PCBs act synergistically (Duffus, 1989). Organotins were tested because of their effects on shellfish reproductive activity.

Sulphides were selected because of their ability to oxidise to sulphates in oxygen-rich conditions and potentially release heavy metal, while at the same time the formation of sulphuric acid reduces the pH. These properties were discussed in more detail in Section 4.0. The redox potential of the sediment samples was selected in order to identify the sediment's oxidation potential once it becomes exposed to oxygen-rich conditions.

Carbonate content and pH were selected in order to identify the sediment's buffering capacity should the pH drop, and hence to determine whether or not mitigating measures against pH decrease would be necessary.

A high percentage of organic matter in a sediment appears to reduce the biological availability of PCBs and other organic chemicals in sediments (US ACE 1990). The sediment samples from Holes Bay were, therefore, tested for their organic matter content.



Title	CONSULTING ENGINEERS		
SEDIMENT SAMPLING LOCATIONS IN HOLES BAY	POSFORD DUVIVIER	DATE FEB. 92	SCALE 1:12,500
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		Figure 6.5.1	

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6.5.3 Use of Guidelines

The survey results were compared with a number of guidelines, in order to identify their suitability for various end uses. The results were compared against the Dutch guidelines on dredged sediment quality (Section 4.2.3) should the preferred end use be an intertidal or subtidal habitat. The UK DoE's Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) Guidelines were chosen in terms of the phytotoxic levels of the metals boron, copper and nickel. The U.S. recommended maximum limits for metal content in digested sewage sludge disposal to agricultural land are currently in use for dredged material disposal until appropriate Federal standard are set for sediments. The survey results were also compared against these standards (U.S. ACE, 1990), should the end use be a terrestrial habitat.

6.5.4 Results of Analysis

All determinants from the four Holes Bay samples were found in concentrations equal to or lower than the recommended guidelines for disposal on land and open water disposal (Appendix E). Some determinants were found in higher concentrations in one sample than in another . With the exception of polyaromatic hydrocarbons (PAH), the difference in the contaminants concentrations levels was found to be inconsistent for samples 1 to 3 (see Appendix F). Sample 4 had higher concentrations of polyaromatic hydrocarbons as well as higher redox potential readings than any other sample. Although sampling location 4 (Figure 6.5.1) is nearer to potential industrial sources of pollutants than the other sampling locations, it is also in the Back Water Channel, a mid channel in Holes Bay. It is, therefore, possible that the recorded pollutant load has been carried downstream through Creekmore Lake which joins the Back Water Channel in the north end of Holes Bay and until 18 months ago, used to receive effluent from Poole sewage treatment works. Alternatively, it is possible that over the years various pollutant loads were carried upstream during flood tide.

The low contaminants levels in the sediment samples, and in particular the almost non detectable sulphide levels, have favourable implications for the future beneficial use of the sediment for nature conservation as discussed in the following section.

The moderately high carbonate content in the sediment samples indicate high buffering capacity of the sediment to mitigate against possible pH decreases. The latter, however, is not anticipated given the very low levels of sulphides in the sediments. The relatively clean sediment samples indicate that disposal of the top layer (approximately 15cm) of Holes Bay sediment is not expected to create contamination problems wherever it is disposed. It must, however, be noted that these results and their implications refer only to the top 15cm of the sediments. It would be necessary to base any firm recommendations for the beneficial uses of Holes Bay sediment on samples taken deeper than 15cm.

6.6 Possible Beneficial Uses of Material from Holes Bay

6.6.1 The decision tree shown in Section 5.1 demonstrates that the first stage in determining any potential uses of dredged material would need to establish whether the dredged material was clean or contaminated to any degree. The case study has shown that on first examination, the surface sediment is apparently clean enough for beneficial use and that there are no existing species found which might preclude the material from being dredged or preclude its use in any beneficial use scheme. The sediment found in Holes Bay is a sandy silt. Potential beneficial uses are therefore discussed below in terms of the physical, chemical and biological status of the sampled top layer of Holes Bay sediment.

6.6.2 Physical Status

Potential beneficial uses of the material in Holes Bay are discussed below in respect of three main options:-

i) **Beach Nourishment**

The sediment material that could be taken from Holes Bay is not considered suitable for beach nourishment firstly because its silty nature would spoil a pleasure beach, and secondly its small particle size means it would quickly be lost offshore from any beach with even a moderate marine climate (waves and currents).

ii) **Mudflats**

The sediment from Holes Bay could be used for mudflat creation if a suitable site is available, provided that the site is sufficiently close to Holes Bay that transport costs do not become excessive.

The U.S. Army Corps of Engineers have created mudflats by underwater placing of dredged material. Their experience has confirmed that erosion will be a problem if the mudflat is exposed to high wave energy or littoral drift.

Wave attack can be reduced by protecting the mudflat with breakwaters situated on the seaward site of the mudflat. Such breakwaters could however, be expensive with their absolute costs dependent on nature, location, ease of access, depth of water and the severity of the wave attack.

Any site suitable for use of the material won from Holes Bay will need to have a wave climate similar to or milder than that in Holes Bay. Studies in France (Cellule de Suivi du Littoral Haut Normand 1989) have suggested that for successful mudflat creation currents should be in the range 0.5 - 0.7m/second to avoid excessive erosion whilst being sufficiently large to prevent accretion which in time could allow colonisation by pioneer settlement plants. The maximum current in Holes Bay is 0.6m/s.

iii) **Saltmarshes**

The material won from Holes Bay could be used for saltmarsh creation if a suitable site is available sufficiently close to Holes Bay. If not transport costs could negate any chance of the project being viable.

Knutson et al (1981) have put forward a system of scoring possible sites to enable the possible vegetative stabilization of salt marshes to be compared. According to this, the sediment size in Holes Bay (sandy silt) is good for vegetative stabilisation and scores highly.

The fetch length (lengths of open water over which wind blows to form waves) is important in assessing the suitability of a site, as is the shape of the coastline. In general the smaller the fetch, the smaller the waves will be that attack the saltmarsh and the less the erosion. Boorman (1987) has suggested that in the U.K. fetch length should be restricted to less than 2km for colonisation of the saltmarsh. Similarly a sheltered cover is more likely to be successful in encouraging vegetative growth than a headland. The fetch in Holes Bay is substantially less than 2km.

However, as for mud flats, wave attack can be reduced, at a cost, by construction of breakwaters that take the energy out of attacking waves and reduce their height.

6.6.3 Chemical Status

As stated in Section 6.5.4 the sediment samples from the top 15cm of Holes Bay contained some heavy metals and organic pollutants, but in concentrations below the recommended threshold values for aquatic and/or terrestrial disposal. Consequently the top layer (approximately 15cm) of Holes Bay sediment could be used for habitat creation in the subtidal, intertidal and terrestrial environments.

The limited depth of core samples, however, precludes any recommendations on the beneficial uses of Holes Bay sediments deeper than the top 15cm.

In the case of a terrestrial disposal any acidity changes, as discussed in Section 4.3, are expected to be buffered by the sediment's considerable carbonate content. However, it is recommended that the dredged sediment is mixed with lime, prior to disposal, as a precautionary measure should the acidity increase. The volume of lime should be very carefully determined to prevent an unacceptable increase in alkalinity should the sediment's carbonate content prove to be of an adequate buffering capacity.

6.6.4 Biological Status

In terms of the biological status of the dredged material, and from the results of the samples taken show that none of the species were of particular importance with regard to their rarity or distribution patterns (e.g. not recorded in areas where they have not previously been found). Therefore, based on the information from this survey, there should not be a problem in biological terms of using the material for beneficial uses. Should the material in Holes Bay be used for mudflat creation, and depending on the type of dredger used, it is likely that some of the species would survive and be available to recolonise a newly created mudflat.

6.6.5 Conclusions

The results of this case study indicate that the material, at least at the surface, in the south eastern corner of Holes Bay is likely to be suitable for saltmarsh or mudflat creation assuming that the physical requirements (e.g. wave energy) can be met, and that transport costs are not prohibitive.

The next stage in the decision making process would have to involve finding potential locations for habitat development. The physical criteria of the chosen location would then need to be assessed in detail before conclusions can be drawn on the possible uses of the dredged material. Other criteria which would then require further detailed assessment are engineering considerations, notably cost of transport, and environmental and socio-political impacts.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

7.1.1 Beneficial Use Opportunities

Capital and maintenance dredging are currently essential to the commercial viability of many of the U.K.'s ports and harbours. This situation is likely to persist into the foreseeable future as ports need to be able to accommodate deeper drafted vessels to maintain their competitiveness.

Increasing restrictions on disposal opportunities, imposed both by legal controls and limitations on available land based disposal sites, confirm the pertinence of investigations into alternative disposal options based on the concept of dredged material as a resource.

Beneficial uses of dredged material for coastal habitat creation, as proven by experience in the United States, may offer a significant opportunity to redress, to some extent, historic losses of such habitats due to development and land claim, and anticipated future losses due to climate change and sea level rise.

7.1.2 Impacts of Dredging

The dredging process can have potentially adverse environmental impacts including destroying benthic habitats, increasing turbidity, resuspension of contaminants and knock on effects for coastal processes including erosion and bed-form changes.

Openwater (subtidal) disposal may have environmental consequences including turbidity, smothering of benthos, changing bathymetry and, if present, introducing contaminants into the water column.

Onland (terrestrial) or intertidal disposal may lead to changes in the physical and chemical conditions of the sediment, potentially rendering it toxic, and may have detrimental impacts on the flora and fauna previously present at the disposal site.

Several recent developments have, however, enabled both dredging and disposal to take place with reduced adverse impacts.

7.1.3 Legislative and Economic Considerations

Legislation governing dredged material disposal in the U.K. comprises the food and Environment Protection Act (1985) (dumping at sea) and the Town and Country Planning and Environmental Protection Acts, both 1990 (dumping on land or intertidal areas).

Environmental constraints focus primarily on existing protection for the dredging or disposal site (e.g. Site of Special Scientific Interest) and on the possible requirement for an Environmental Assessment prior to disposal.

Guidelines governing options for and controls on the materials are very limited. Adequate guidance is urgently required.

Existing disposal costs are variable depending on the distance of transportation of material and the type of material dredged (see Section 3.2.6). Costs of disposal could be reduced by disposing of material closer to the dredging site, where an area is available for habitat development.

The cost of habitat creation initiatives can vary considerably depending on the requirements of the proposed habitat. In particular, transport costs and the cost of protective structures such as breakwaters could potentially be prohibitive. A sheltered site, as close as possible to the dredging area is therefore desirable for such initiatives.

7.1.4 Physical, Chemical and Biological Controls on Beneficial Uses

There are several parameters which control the development of habitats whether in a natural or anthropogenic situation. The complex interaction of the processes operating determines the likely success of habitat development initiatives. Planning for beneficial uses of dredged material should therefore consider the following critical factors with respect to the physical, chemical and biological characteristics of the dredged sediment.

The primary physical parameters controlling habitat development are:-

- Sediment type, size, chemical composition and cohesion.
- Tidal currents which determine sediment transport rates and directions.
- Elevation relative to water levels.
- Slope which, in turn, controls drainage.
- Site size: large sites offer a greater chance of stability and ecological diversity.

Chemical considerations apply particularly when using potentially contaminated dredged material. The key chemical controls are:-

- Amount and type of contaminants in the sediment, including heavy metals, sulphides, fertilizers, pesticides, petroleum products and other organics.
- Maximum acceptable levels for pollutants in water, soils, plants and animals as set out by a competent authority.
- Any impact of changes in chemical reactions, on the disposal site itself, on surrounding habitats and on surface and groundwater quality.
- The ability of the plant and animal species that will be planted and placed on the site, their abilities to regulate uptake of pollutants, and their tolerance levels before any changes in life efficiency or reproduction ability occur.
- Biomagnification via the food chain from plants and invertebrates.

Finally, biological controls include the natural availability of seeds, invertebrates, etc. from adjacent sites; the development of the sediment infauna; and the need to ensure that species introduced through planting do not detrimentally affect nearby habitats.

7.1.5 Habitat Creation Options

Possible beneficial habitat creation options using clean or treated dredged material include subtidal, intertidal and terrestrial uses. Examples of subtidal features include reefs, berms, gravel bars and shellfish flats. Intertidal opportunities centre around marsh and mudflat creation, using dredged material to raise the elevation or to provide a suitable substrate for the growth of saltmarsh vegetation or for colonisation. Relatively little is known, however, about the specific process requirements of some coastal habitats, notably mudflats, and research is necessary to establish in detail the processes currently operating at existing sites. Islands might also be created, notably islands for birds using coarser grained sediments. Many terrestrial use options also exist.

Dredged material can also be used beneficially for aquaculture, beach nourishment and land claim projects, among others.

Much of the experience in this type of habitat creation initiative, however, emanates from the United States, notably the U.S. Army Corps of Engineers Beneficial Uses of Dredged Materials Programme. The U.K. has very little experience in habitat creation using dredged material and experimental pilot studies are therefore urgently required.

7.1.6 Contaminated Dredged Material

The sediments dredged from some of the U.K.'s port and harbour waterways are contaminated with heavy metals, nutrients, organic pollutants and other substances, reflecting past and present land uses around the estuary.

Contaminated sediments require either treatment or disposal in a confined site. Case studies demonstrate, however, that potential for the beneficial use of some contaminated sediments does exist (e.g. the creation of sub-tidal habitats, capped with clean materials which provides a substrate for colonisation). The primary environmental issues associated with the openwater disposal of contaminated sediments relate to the bioaccumulation of toxins in aquatic organisms.

There are no formal U.K. guidelines for the open water disposal of contaminated dredged materials. The Dutch have, however, developed a comprehensive set of guidelines. In both the intertidal and terrestrial environments in particular, the impacts of contaminated dredged material disposal are potentially very complex because of the composite influence of many parameters.

Concerns in respect of the terrestrial disposal of contaminated dredged materials centre both on the possible toxicity to plants and animals and on potential surface and ground water contamination. Again the entry of contaminants into the food chain is a major concern.

There are no U.K. guidelines governing onland disposal of contaminated dredged material. If contaminated materials are disposed of in the intertidal environment, the wetting and drying action can lead to oxidation and subsequently to biomagnification.

The treatment of contaminated dredged material can be very expensive. An alternative option is offshore disposal where the sediment is capped with clean material. U.S. experience suggests that the beneficial use of such areas for habitat creation may be viable.

7.1.7 Methodological Framework

The study identified a methodological framework for decision making in respect of potential beneficial uses for dredged materials. Technical and economic viability criteria are highlighted, ecological desirability is explored, and site characteristics, management implications and socio-political controls are discussed.

A thorough baseline survey and rigorous ongoing monitoring of habitat creation sites are critical in controlling habitat development and improving future applications of beneficial use techniques.

Work in the United States indicates that careful planning and controlled implementation are also essential prerequisites to successful habitat creation.

7.1.8 Case Study

A case study of Holes Bay in Poole Harbour, Dorset, investigated the physical, chemical and biological characteristics of the sediments in order to determine possible viable beneficial uses should the area be dredged.

The results of the preliminary survey carried out demonstrated a chemically "clean", sandy silt. This material would potentially be suitable for the creation of intertidal habitats such as marshes or mudflats, if the habitat creation site is in a low energy environment, close enough to the dredging site to ensure that transport costs are not prohibitive.

7.1.9 General Conclusion

Overall, the report concludes that there is significant potential to use clean dredged material for coastal habitat creation in the U.K. and that, with careful planning, opportunities to use contaminated dredged material beneficially also exist.

7.2 Recommendations

7.2.1 Development of Habitat Creation Initiatives

There is little precedent for habitat creation using dredged material in the U.K. and it is therefore recommended that experimental pilot projects are established. It is essential, however, that any organisation attempting to develop habitats using dredged material should document physical, chemical and biological conditions throughout the development phases. Sufficient data should be collected to identify and develop successful establishment techniques for future applications in the U.K. (Sections 1.1 and 3.1.1).

There is insufficient knowledge in the U.K. about the processes operating in many coastal areas. It is therefore recommended that detailed research is undertaken to develop an understanding of the physical, chemical and biological characteristics of existing coastal habitats, notably mud and sand flats. This information can then be used to improve the likelihood of success of habitat creation initiatives using dredged material (Section 3.4.2).

A pilot study is required to establish the potential feasibility of using trickle feeding techniques to develop or sustain coastal habitats.

7.2.2 Guidelines and Policies Applicable to Beneficial Uses of Dredged Material

There is an urgent need for the development of U.K. guidelines (or quality standards) in respect of the disposal of dredged material. Such guidelines should include not only disposal but also beneficial use options. Quality standards should be drawn up for chemical characteristics and guidance should also be provided on physical and biological parameters. The guidelines should be widely available and strictly adhered to in order to prevent environmental degradation.

In the longer term, once the beneficial use option has been proven through pilot studies in the U.K. and assuming guidelines for dredged material disposal have been compiled, there will be a need for a strategic policy on dredged material disposal concentrating on exploiting options for beneficial use. Ideally this policy would ensure that every application for the disposal of dredged material had considered the potential for the beneficial use of the material.

7.2.3 Technical Data

The success of the majority of habitat creation initiatives will be dependent, to some extent, on technical criteria. It is therefore recommended that research be undertaken to establish the tolerance limits (e.g. chemical content, physical disturbance) of the species of plants and/or animals which it is hoped to attract to a particular habitat.

The qualitative diversity and quantitative availability of reactive constituents in sediment emphasises the need for further research on a number of topics including chemical changes in the disposed dredged sediment and biological uptake potential. There is a particular need to establish the rate of uptake by aquatic (marsh) flora and hence the likelihood of bioaccumulation in certain species of flora and fauna.

7.2.4 Recommendations for Further Study

In order to assess the environmental impact of both placement of dredged material, and the actual dredging activity, it is recommended that recolonisation rates of invertebrates to areas which have been disturbed both by dredging and by the placement of material are investigated. Such a study would complement similar ongoing research by MAFF in respect of marine dredged aggregates.

Once habitat creation is further advanced in the U.K., a valuable potential study will exist to compare the characteristics of created habitats with those of natural habitats.

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