

## Management Framework for Disposal of Dredged/Excavated Sediment

### Introduction

This practice note is issued to provide information on the management framework for dredged/excavated sediment disposal under the Dumping at Sea Ordinance, Cap. 466 (DASO). It states the requirements for justifying the need for dredging and provides guidance for the authorized persons/registered structural engineers (AP/RSE) on how to obtain information on the sediment, which can then be used for supporting the permit application by the contractors and/or other parties responsible for the disposal. It also describes the classification of sediment into three categories based on their contaminant levels, outlines the procedures for assessing sediment quality and explains the marine disposal arrangements for the different sediment categories.

2. This practice note applies to all private projects which involve the marine disposal of dredged/excavated sediment and whose dredging/excavation work for which mud dredging/excavation proposals have not yet been agreed by the Marine Fill Committee (MFC). For dredged/excavated sediment disposal proposals previously approved in accordance with the requirements in Practice Note for Authorized Persons and Registered Structural Engineers No. 252 issued in May 2001 or No. 155, if the time lapse between commencement of sampling and commencement of construction works is more than three years, then re-testing of sediment in accordance with this practice note will be required, unless waived by the Director of Environmental Protection (DEP). Examples of projects include reclamation, construction of marinas and deep excavation for basement construction where the excavated sediment is of such quantity that marine disposal has to be adopted.

### Rationale for Dredging

3. The allocation of sediment disposal space at sea will not be considered until the need for removal of the sediment has been satisfactorily demonstrated. The rationale for sediment removal must therefore be provided to the Secretary of MFC for agreement, as early as possible, preferably at the Environmental Impact Assessment Stage, if one is conducted. Volumes of Category L sediment (see Appendix A) below 50,000 m<sup>3</sup> are exempted from this requirement.

4. Dredging of sediment will be allowed without justification in the following cases:

- (a) emergency dredging for safety reasons or averting environmental hazards;
- (b) maintenance/deepening of the harbour fairways, berths, anchorages, navigation channels or approaches; and

/(c) .....

- (c) maintenance (but not construction) of watercourses, rivers, stream courses, drainage channels or outfalls.

5. In all other cases, AP/RSE should plan their projects on the assumption of keeping the mud in place. Time for consolidation of mud, with treatment if necessary, and consequential programme constraints should be allowed for in programming. Additional time required for consolidation of mud left in place will not be accepted as justification for mud dredging. MFC will scrutinise applications for exemption taking into account factors including the practicality of performance specifications, completeness of risk management strategies, and comprehensiveness of option assessments including consideration of new technology. Where cost is considered, the estimation must include a fair and complete estimate of all cost components, including the actual cost of mud disposal (obtainable from MFC Secretariat) and necessary dredging and transportation, disposal management, monitoring and other associated activities.

### **Classification of Sediment**

6. DEP, as the Authority under the DASO, will classify sediments based on their contaminant levels with reference to the Chemical Exceedance Levels (CEL) laid down in Appendix A.

### **Determination of Sediment Quality**

7. Guidelines on the initial data assessment, the sampling and testing procedures, the biological test criteria, and the submission requirements are set out in Appendix B. DEP may waive the sediment sampling and testing requirements in cases of:

- (a) emergency dredging for reasons of safety or averting environmental hazards; and
- (b) for small scale dredging works of maintenance nature and involving dredging volumes of less than 5,000 m<sup>3</sup> *in situ*.

Previously obtained data or known history of the sediment in the vicinity should be submitted to DEP for consideration of the most appropriate arrangements for handling these materials.

8. Upon agreement of the rationale for sediment removal by the Secretary of MFC, the AP/RSE must, in consultation with DEP, assess whether the existing data can conclusively demonstrate that the sediment is suitable for open sea disposal. If no such conclusion can be drawn, the AP/RSE must submit proposals for sampling and chemical testing of the sediment to DEP for approval. The proposals shall be copied to the Secretary of MFC, together with details of the anticipated disposal requirements.

9. Upon completion of the sampling and chemical testing, the AP/RSE shall submit a Preliminary Sediment Quality Report (PSQR) to DEP and copy to the Secretary

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of MFC. This report shall include the sampling details, the chemical testing results, quality control records, proposed classification and delineation of sediment according to Appendix A, and the information and/or records as specified by DEP in his approval of sediment sampling and testing plan.

10. If Category M sediment and/or certain Category H sediment are found in the sediment, the AP/RSE will be required to carry out a biological screening in accordance with Section 3 of Appendix B, and submit a formal Sediment Quality Report (SQR) to DEP for approval. This must be done at least 3 months prior to the dredging contract being tendered or at least 2 months prior to the works order for maintenance dredging being issued. In cases where biological screening is not required, subject to the approval of DEP, the PSQR will be deemed to be the formal SQR.

11. At the time of approval of the SQR, DEP will specify the period beyond which the reliability of the SQR data must be reviewed. This period starts on the actual date of commencement of sampling and will be not less than three years. The AP/RSE shall obtain DEP's prior agreement to the review methodology and sampling locations. Depending on the review finding, further sampling and testing to update the data of the SQR may be required.

12. The AP/RSE must schedule the preparation of the SQR or its subsequent review in such a way that the SQR will still be reliable for a reasonable period of time after the award of the contract, to allow the contractor to apply for a dumping permit. The AP/RSE must also include a particular specification clause in the contract to draw the contractor's attention to the requirement that the SQR must still be reliable at the time of applying for a dumping permit under the DASO. The clause should also state the expiry date of the reliability period of the current SQR and that it is the contractor's responsibility for carrying out, at his own expense, any work required to extend the reliability period of the SQR should he fail to apply for a dumping permit before the expiry date.

#### **Allocation of Sediment Disposal Site**

13. MFC will determine the most appropriate open sea or confined marine disposal site on the basis of the chemical and biological test results and formally allocate disposal space in accordance with the flow chart in Appendix C. For projects with disposal requirements of less than 50,000 m<sup>3</sup> Category L sediment, the allocation of disposal space has been delegated to DEP. The AP/RSE may request the Secretariat of MFC to provisionally indicate an appropriate marine disposal site or sites after the rationale for sediment removal has been agreed. An estimate of the volume and quality of sediment to be dredged, supported by available ground investigation and testing data, should be provided to the Secretary of MFC at the time of submission of the request. The contract document must include the disposal requirements from MFC & DEP, and relevant guidelines given under Notes (1) to (6) in Appendix C.

14. For private projects allocated with marine disposal space, there will be a charge per cubic metre as measured *in situ* at the dredging site and as certified by the AP/RSE.

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15. The MFC Secretariat maintains a database on fill requirements and surplus materials of civil engineering projects in Hong Kong to facilitate the planning and management of fill and disposal resources. The AP/RSE of private developments shall ensure that details of any fill requirements or disposal requirements, and the subsequent updates, are sent to the MFC Secretariat using the form downloaded from <http://www.info.gov.hk/ced/eng/services/fm/imsweb/pdf/blank.pdf> preferably via electronic transfer, copied to Buildings Department.

#### **Application for Marine Dumping Permit**

16. DEP controls dumping at sea by means of DASO permits which are issued to contractors or other parties responsible for the disposal of dredged/excavated sediment. The contractor who will be undertaking the works must make a formal application to DEP for a dumping permit, and if the permit is granted, it will be the contractor's responsibility to ensure that the permit conditions are met to DEP's satisfaction.

17. Any queries regarding this practice note should be directed to the MFC Secretariat (Tel. no.: 2762 5397) or the Waste and Water Management Group of EPD (Tel. no.: 2835 1287).



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Building Authority

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Dredged/Excavated Sediment – Disposal of



**Sediment Quality Criteria for the Classification of Sediment**

Contaminants	Lower Chemical Exceedance Level (LCEL)	Upper Chemical Exceedance Level (UCEL)
<b>Metals (mg/kg dry wt.)</b>		
Cadmium (Cd)	1.5	4
Chromium (Cr)	80	160
Copper (Cu)	65	110
Mercury (Hg)	0.5	1
Nickel (Ni)*	40	40
Lead (Pb)	75	110
Silver (Ag)	1	2
Zinc (Zn)	200	270
<b>Metalloid (mg/kg dry wt.)</b>		
Arsenic (As)	12	42
<b>Organic-PAHs (µg/kg dry wt.)</b>		
Low Molecular Weight PAHs	550	3160
High Molecular Weight PAHs	1700	9600
<b>Organic-non-PAHs (µg/kg dry wt.)</b>		
Total PCBs	23	180
<b>Organometallics (µg TBT/L in Interstitial water)</b>		
Tributyltin*	0.15	0.15

\* The contaminant level is considered to have exceeded the UCEL if it is greater than the value shown.

The sediment is classified into 3 categories based on its contaminant levels:

- Category L: Sediment with all contaminant levels not exceeding the Lower Chemical Exceedance Level (LCEL). The material must be dredged, transported and disposed of in a manner which minimizes the loss of contaminants either into solution or by resuspension.
- Category M: Sediment with any one or more contaminant levels exceeding the Lower Chemical Exceedance Level (LCEL) and none exceeding the Upper Chemical Exceedance Level (UCEL). The material must be dredged and transported with care, and must be effectively isolated from the environment upon final disposal unless appropriate biological tests demonstrate that the material will not adversely affect the marine environment.
- Category H: Sediment with any one or more contaminant levels exceeding the Upper Chemical Exceedance Level (UCEL). The material must be dredged and transported with great care, and must be effectively isolated from the environment upon final disposal.

### **Guidelines for Sediment Assessment**

The purpose of these guidelines is to set out the requirements for assessing, sampling, testing and categorising the sediment. The sampling and testing procedures are critical to the accurate evaluation of the sediment contamination, and close supervision by the AP/RSE is therefore necessary. All project departments or the AP/RSE must comply with these requirements when notifying Director of Environmental Protection (DEP) and Marine Fill Committee (MFC) of an intention to dredge/excavate and dispose of the sediment.

The sampling and testing procedures and the subsequent submission of a Sediment Quality Report normally require 8 months to complete.

A list of accredited laboratories capable of carrying out biological testing stipulated under these guidelines is kept and updated by DEP.

#### **1. TIER 1 - Review of Existing Information for Site Contamination Assessment**

The purpose of Tier I screening is to review available information to determine whether the sediment belongs to Category L material suitable for open sea disposal. If the AP/RSE considers that there is insufficient information to arrive at such a conclusion, the AP/RSE may proceed directly to Tier II screening.

##### **(a) Submission requirements**

The AP/RSE shall submit a formal proposal to DEP and copy to the Secretary of MFC in the Civil Engineering Department. The proposal should contain the following information:

- (i) project name;
- (ii) plan showing detailed location and boundary of the dredging/excavation site;
- (iii) estimated volume of dredged/excavated sediment requiring disposal;
- (iv) timetable for dredging/excavation operation and the corresponding disposal space required;
- (v) previous dredging/excavation history of the site;
- (vi) previous use of the site; and
- (vii) other available site specific information (e.g. sediment grain size, total organic carbon (TOC), geotechnical data and previous testing results).

**(b) Necessity to proceed to Tier II - chemical screening**

DEP will examine the submission and advise whether:

- (i) the information is sufficient to conclude that the sediment is suitable for open sea disposal and the submission can be accepted as a formal Sediment Quality Report; or
- (ii) Tier II - chemical screening is required.

**2. TIER II - Chemical Screening**

Tier II screening is designed to categorise the sediment based on its chemical contaminant levels, and to determine whether the sediment is suitable for open sea disposal without further testing.

**(a) Submission requirements**

The AP/RSE shall submit for approval a test proposal to DEP and copy to the Secretary of MFC. The proposal should contain the following information:

- (i) project name;
- (ii) plan showing detailed location and boundary of the dredging/excavation site;
- (iii) estimated volume of dredged/excavated sediment requiring disposal;
- (iv) the anticipated timetable for taking the sample, carrying out the tests, and producing the Sediment Quality Report for chemical & biological screening;
- (v) a plan showing the area to be dredged, the locations to be sampled and their Hong Kong metric grid coordinates;

In general, the following sampling arrangement should be adopted:

<b>Expected contamination level</b>	<b>Recommended Sampling Arrangement</b>
Low	200 x 200 m grid, surface sample only
High	100 x 100 m grid, vertical profile of samples
Very high (e.g. near outfalls, or nullahs)	50 x 50 m grid, vertical profile of samples



When biological screening is anticipated, samples of reference sediment should also be taken. Reference sediment required for the test may be collected from reference sites in Hong Kong waters designated by DEP from time to time. Alternative reference sites may be used. However, these alternative sites should be outside the influence of previous disposal operations but close enough to reflect similar natural environmental characteristics (e.g. grain size and TOC) of potential disposal sites. The AP/RSE should furnish information on these alternative sites to show that their sediments are clean and are of similar natural characteristics to that of the disposal sites.

- (vi) a schedule of the types of samples to be taken (e.g. grab samples, gravity coring, piston samples, vibrocores, etc.) with their locations and depths;

Where vertical profiles of samples are to be taken, samples should be continuous, and the top level of the sub-samples should be the seabed, 0.9m down, 1.9m down, 2.9m down, and then every 3m to the bottom of the dredged layers.

The size of samples collected should be adequate for this tier of chemical testing as well as the next tier of biological testing described in subsequent sections.

Parameters to be tested	Sample size*
Metals and metalloid	0.5 litre
Organic	0.5 litre
Biological response	6 litres

\* Quantity to be confirmed by testing laboratory. The quantity of reference sediment to be collected needs to be separately worked out for each case, especially if biological dilution tests are anticipated.

- (vii) a schedule of tests to be carried out on the samples.

Unless otherwise specified, all samples shall be tested for all the contaminants (except Tributyltin (TBT)) stated in Table 1 - Analytical Methodology at the end of this Appendix. Analysis for other contaminants, such as TBT, Dichloro-diphenyl-trichloroethane (DDT), other organo-chlorine compounds, and other hazardous chemicals which arise from specific industrial discharge or spillage, may also be required by DEP in areas where contamination by such compounds is suspected. The composite samples for



biological testing should also be tested for moisture content, grain size ( $\% < 63 \mu\text{m}$ ), TOC and ammonia (as mgN/L) and salinity in porewater.

**(b) Sampling and testing requirements**

**(i) Sampling practice and sample storage**

All sampling bottles should be labelled with the station number, sample length, diameter and depth, sampling date and time, together with a full description of the sample.

The recommended types of sampling bottle and pretreatment methods are:

Parameters to be tested	Sampling bottle	Pretreatment Procedure#
Metals and metalloid	High density polyethylene bottles*	USEPA SW-846 + Chapter 3
Organic	Wide mouth Borosilicate glass bottles with Teflon lined lid	USEPA SW-846 Chapter 4
Biological response	Wide mouth Borosilicate glass bottles with Teflon lined lid or high density polyethylene bottles *	USEPA SW-846 Chapter 3 or Chapter 4 as appropriate.

\* Heavy duty plastic bags may be used for the storage of sediment sample for testing metals, metalloid and biological response.

# Other equivalent methods may be used subject to the approval of DEP.

+ Test methods for evaluating solid waste: physical/chemical methods, SW-846, 3rd edition, United States Environmental Protection Agency.

The samples should be kept at 4°C in the dark and should not be frozen. All samples should be promptly analysed. If this is impractical, the recommended maximum holding time is:

Sample type	Maximum holding time
Chemical test	2 weeks
Biological test	8 weeks

**(ii) Analytical methodologies for chemical screening**

The analytical method used for detecting each contaminant should be in accordance with the methodology described in Table 1 - Analytical Methodology at the end of this Appendix.

**(c) Quality assurance/quality control (QA/QC) requirements**

All tests must be conducted by laboratories accredited by Hong Kong Laboratory Accreditation Scheme (HOKLAS) or, in case of overseas laboratories, by equivalent national accreditation for these tests.

**(d) Necessity to proceed to Tier III - biological screening**

There is no need to proceed to Tier III for Category L sediment. However, the AP/RSE must proceed to Tier III for further analysis of Category M and certain Category H sediment. For the latter, Tier III screening is only required if one or more contaminant levels exceed 10 times the Lower Chemical Exceedence Level (LCEL).

**3. TIER III - Biological Screening**

The purpose of Tier III screening is to identify the most appropriate disposal option for Category M and certain Category H sediments.

**(a) Submission requirements**

The AP/RSE shall submit for approval a test proposal to DEP and copy to the Secretary of MFC. The proposal should contain the following information:

- (i) the number of biological tests;
- (ii) the arrangement for preparing the composite samples; and
- (iii) the test species and test conditions.

In general, all biological tests should be conducted on composite samples. Composite sample is prepared by mixing up to 5 samples of the same category (M or H) which are continuous in vertical or horizontal profile.

Sediment classified as Category M shall be subjected to the following three toxicity tests (to be considered as one set) on each composite sample:

- a 10-day burrowing amphipod toxicity test ; and
- a 20-day burrowing polychaete toxicity test; and
- a 48-96 hour larvae (bivalve or echinoderm) toxicity test.



Sediment classified as Category H and with one or more contaminant levels exceeding 10 times LCEL shall also be subjected to the above three toxicity tests but in a diluted manner (dilution test). The samples shall be prepared prior to toxicity testing as follows:

Sediment characteristics	Preparation method
Category H sediment ( > 10 x LCEL)	Sample to be mixed with 9 portions of reference sediment
Category M sediment or Category H sediment (> 10 x LCEL) suspected of ammonia contamination	Additional set of sample (after dilution for Cat. H sediment) to be purged <sup>#</sup> for ammonia removal (for amphipod test only).

# If the ammonia concentration in the overlying water of the test system is  $\geq 20$  mg/L, purging of sediment is required. This is performed by replacing the overlying water at a rate of 6 volume replacements/24 h for 24 hours, and repeated once only if the ammonia level still exceeds 20 mg/L.

#### (b) Testing requirements

The test endpoints and decision criteria are summarized in Table 2 at the end of this Appendix. The sediment is deemed to have failed the biological test if it fails in any one of the three toxicity tests.

Only ecologically relevant species should be used for carrying out the biological screening tests. The species to be used for each type of test can be selected from the following:

Test Types	Species	Reference Test Conditions*
10-day burrowing amphipod toxicity test	<i>Ampelisca abdita</i>	U.S.EPA(1994)/PSEP(1995)
	<i>Leptocheirus plumulosus</i>	U.S.EPA(1994)
	<i>Eohaustorius estuarius</i>	U.S.EPA(1994)/PSEP(1995)
20-day burrowing polychaete toxicity test	<i>Neanthes arenaceodentata</i>	PSEP(1995)
48-96 hour larvae (bivalve or echinoderm) toxicity test	Bivalve: <i>Mytilus</i> spp.	PSEP(1995)
	<i>Crassostrea gigas</i>	PSEP(1995)
	Echinoderm : <i>Dendraster excentricus</i>	PSEP(1995)
	<i>Strongylocentrotus</i> spp.	PSEP(1995)

\*U.S.EPA (U.S. Environmental Protection Agency) 1994. Methods for assessing the toxicity of sediment-associated contaminants with estuarine and marine amphipods. Office of Research and Development. U.S. Environmental Protection Agency, Cincinnati, OH. EPA/600/R94/025.

PSEP (Puget Sound Estuary Program) 1995. Recommended guidelines for conducting laboratory bioassays on Puget Sound sediments.

**(c) Quality assurance/quality control (QA/QC) requirements**

All biological tests must be conducted by laboratories with appropriate accreditation.

The biological test shall include appropriate quality assurance/quality control such as:

- (i) Negative Control
- (ii) Positive Control

**4. Reporting Requirement after Completion of Chemical & Biological Screening**

**Submission requirements**

Upon completion of each stage of screening (chemical and biological), the AP/RSE shall submit to DEP and copy to the Secretary of MFC a report on the results covering all tests conducted so far. The report should include the following information where appropriate:

- (i) plans showing the delineation of each of the 3 categories of dredged/excavated material and the corresponding types of disposal required based on the chemical and biological screening results, and
- (ii) the following information :
  - Name and location of the testing laboratory
  - Location of samples and source of reference sediments, method of collection, handling, preservation and storage, dates and times of sample collection and receipt at the testing laboratory

**(For chemical screening)**

- Dates of analysis
- Analytical methods and detection limits



- Tabulated sample results with units, including reporting basis (e.g., wet, dry, TOC normalized)
- QA/QC results
- Explanations for all departures from the standard protocols and discussion of possible effects on the data

**(For biological screening)**

- Test species information such as the source, size, history and age of test organisms
- Source of control seawater and control sediment used, including any pretreatment
- Preparation procedures for test sediment sample and test organisms
- Test conditions for each test including any deviation from standard procedures and discussion of possible effects on the data
- Water quality measurement during testing
- QA/QC results
- Effect measurements, end point results and their statistical significance

**Table 1 - Analytical Methodology**

Parameters	Preparation Method US EPA Method	Determination Method US EPA Method	Reporting Limit
<b>Metals</b> (mg/kg dry wt.)			
Cadmium (Cd)	3050B	6020A or 7000A or 7131A	0.2
Chromium (Cr)	3050B	6010C or 7000A or 7190	8
Copper (Cu)	3050B	6010C or 7000A or 7210	7
Mercury (Hg)	7471A	7471A	0.05
Nickel (Ni)	3050B	6010C or 7000A or 7520	4
Lead (Pb)	3050B	6010C or 7000A or 7420	8
Silver (Ag)	3050B	6020A or 7000A or 7761	0.1
Zinc (Zn)	3050B	6010C or 7000A or 7950	20
<b>Metalloid</b> (mg/kg dry wt.)			
Arsenic (As)	3050B	6020A or 7000A or 7061A	1
<b>Organic-PAHs</b> (µg/kg dry wt.)			
Low Molecular Weight PAHs+	3550B or 3540C and 3630C	8260B or 8270C	55
High Molecular Weight PAHs++	3550B or 3540C and 3630C	8260B or 8270C	170
<b>Organic-non-PAHs</b> (µg/kg dry wt.)			
Total PCBs+++	3550B or 3540C and 3665A	8082	3
<b>Organometallics</b> (µg TBT/L in interstitial water)			
Tributyltin	Krone et al. (1989)* - GC/MS UNEP/IOC/IAEA**	Krone et al. (1989)* - GC/MS UNEP/IOC/IAEA**	0.015

Footnotes: (i) The reporting limits shown in this table are the most stringent limits which will be specified by DEP. APs/RSEs should consult DEP on the required limits in the preparation of proposals for sampling and chemical testing of the sediment.



(ii) Other equivalent methods may be used subject to the approval of DEP.

+ Low molecular weight PAHs include acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, and phenanthrene

+ + High molecular weight PAHs include benzo[a]anthracene, benzo[a]pyrene, chrysene, dibenzo[a,h]anthracene, fluoranthene, pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, indeno[1,2,3-c,d]pyrene and benzo[g,h,i]perylene

+ + + The reporting limit is for individual PCB congeners. Total PCBs include 2,4' diCB, 2,2',5 triCB, 2,4,4' triCB, 2,2',3,5' tetraCB, 2,2',5,5' tetraCB, 2,3',4,4' tetraCB, 3,3',4,4' tetraCB, 2,2',4,5,5' pentaCB, 2,3,3',4,4' pentaCB, 2,3',4,4',5 pentaCB, 3,3',4,4',5 pentaCB, 2,2',3,3',4,4' hexaCB, 2,2',3,4,4',5' hexaCB, 2,2',4,4',5,5' hexaCB, 3,3',4,4',5,5' hexaCB, 2,2',3,3',4,4',5 heptaCB, 2,2',3,4,4',5,5' heptaCB, 2,2',3,4',5,5',6 heptaCB (ref: the "summation" column of Table 9.3 of *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual (The Inland Testing Manual)* published by USEPA).

\* Krone et al. (1989), A method for analysis of butyltin species and measurement of butyltins in sediment and English Sole livers from Puget Sound, Marine Environmental Research 27 (1989) 1-18. Interstitial water to be obtained by centrifuging the sediment and collecting the overlying water.

\*\* UNEP/ICO/IAEA refers to IAEA's Marine Environment Laboratory reference methods. These methods are available free of charge from UNEP/Water or Marine Environmental Studies Laboratory at IAEA's Marine Environment Laboratory. Interstitial water to be obtained by centrifuging the sediment and collecting the overlying water.

**Table 2 - Test Endpoints and Decision Criteria for Tier III Biological Screening**

Toxicity test	Endpoints measured	Failure criteria
10-day amphipod	Survival	Mean survival in test sediment is significantly different ( $p \leq 0.05$ ) <sup>1</sup> from mean survival in reference sediment <b>and</b> mean survival in test sediment < 80% of mean survival in reference sediment.
20-day polychaete worm	Dry Weight <sup>2</sup>	Mean dry weight in test sediment is significantly different ( $p \leq 0.05$ ) <sup>1</sup> from mean dry weight in reference sediment <b>and</b> mean dry weight in test sediment < 90% of mean dry weight in reference sediment.
48-96 hour larvae (bivalve or echinoderm)	Normality Survival <sup>3</sup>	Mean normality survival in test sediment is significantly different ( $p \leq 0.05$ ) <sup>1</sup> from mean normality survival in reference sediment <b>and</b> mean normality survival in test sediment < 80% of mean normality survival in reference sediment.

<sup>1</sup> Statistically significant differences should be determined using appropriate two-sample comparisons (e.g. *t-tests*) at a probability of  $p \leq 0.05$ .

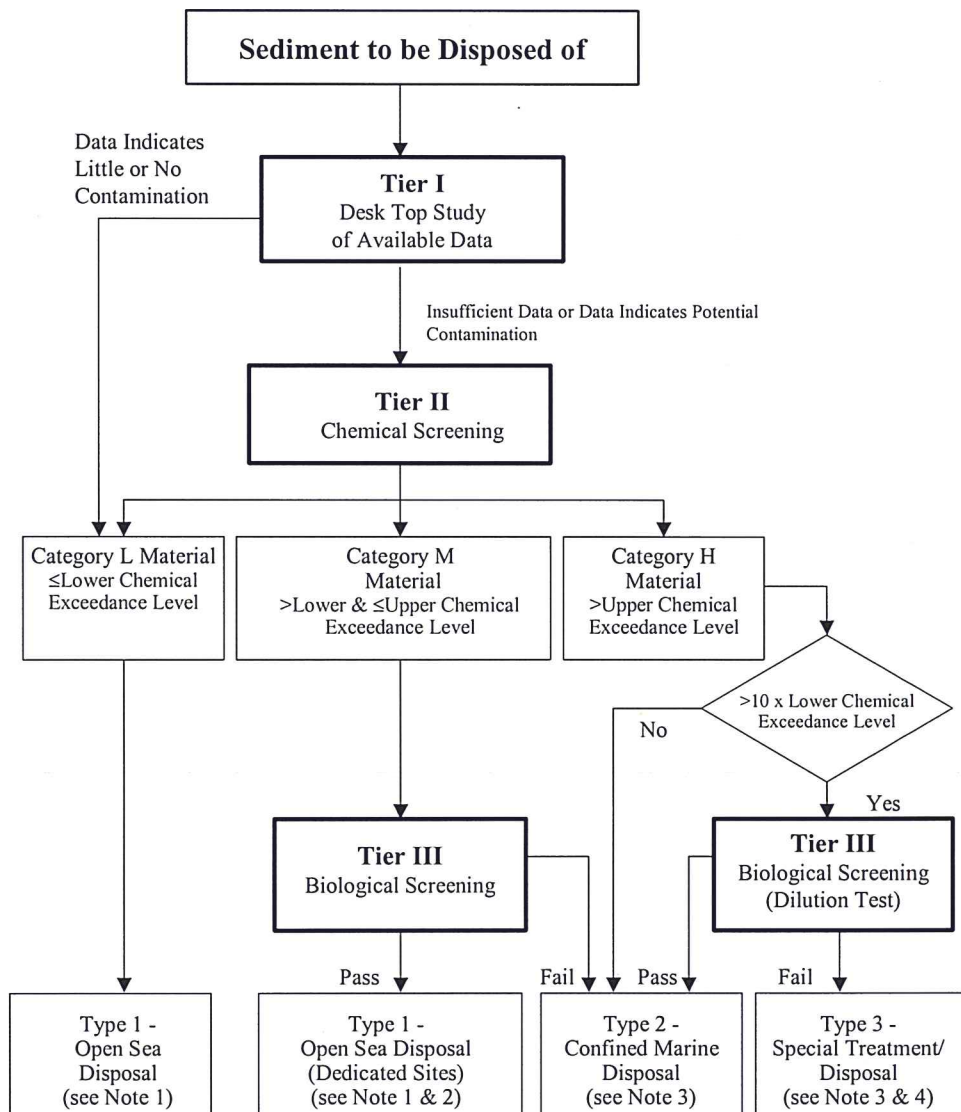
<sup>2</sup> Dry weight means total dry weight after deducting dead and missing worms.

<sup>3</sup> Normality survival integrates the normality and survival end points, and measures survival of only the normal larvae relative to the starting number.

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## Notes

- (1) Most open sea disposal sites are multi-user facilities and as a consequence their management involves a flexibility to accommodate varying and unpredictable circumstances. Contract documents should include provisions to allow the same degree of flexibility should it be necessary to divert from one disposal site to another during the construction period of a contract.
- (2) Dedicated Sites will be monitored to confirm that there is no adverse impact.
- (3) For sediment requiring Type 2 or Type 3 disposal, contract documents should state the allocation conditions of MFC and DEP. At present, East Sha Chau mud pits are designated for confined marine disposal.
- (4) If any sediment suitable for Type 3 disposal (Category H sediment failing the biological dilution test) is identified, it is the responsibility of the AP/RSE, in consultation with DEP, to identify and agree with him/her, the most appropriate treatment and/or disposal arrangement. Such a proposal is likely to be very site and project specific and therefore cannot be prescribed. This will not preclude treatment of this sediment to render it suitable for confined marine disposal.
- (5) The allocation of disposal space may carry a requirement for the project proponent to arrange for chemical analysis of the sediment sampled from 5% of the vessels en-route to the disposal site. For Category M and certain Category H sediment, the chemical tests will be augmented by biological tests. Vessel sampling will normally entail mixing five samples to form a composite sample from the vessel and undertaking laboratory tests on this composite sample. All marine disposal sites will be monitored under the general direction of the Civil Engineering Department. However, exceptionally large allocations might require some additional disposal site monitoring. These will be stipulated at the time of allocation.
- (6) Trailer suction hopper dredgers disposing of sediment at East Sha Chau must use a down-a-pipe disposal method, the design of which must be approved in advance by DCE. The dredging contractor must provide equipment for such disposal.

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