7. WASTE MANAGEMENT AND MUD CONTAMINATION

7.1 Introduction

The proposed DGA will involve marine based construction activities, such as dredging and filling for the breakwater construction. Waste arisings include dredged marine sediment and general construction wastes. Potential sources of waste during the operational phase comprise dredged marine sediment from maintenance dredging and sewage discharged from the vessels. This section identifies the types of waste that are likely to be generated during the construction and operation of the proposed DGA, evaluates the potential environmental impacts arising from these waste arisings and recommends appropriate mitigation measures.

7.2 Environmental Legislation and Standards

7.2.1 Marine Sediment

The procedures to be adopted in the dredging and disposal of marine sediments are detailed in *Works Branch Technical Circular No. 22/92, Marine Disposal of Dredged Mud.* The Circular outlines the steps that must be followed when applying for licensed disposal of dredged marine materials at sea.

Sediments are classified according to their level of contamination by toxic metals as stipulated in the *Environmental Protection Department Technical Circular No. 1-1-92, Classification of Dredged Sediments for Marine Disposal.* The contamination levels presented in the Technical Circular serve as criteria for determining the disposal requirements of the dredged sediments.

Three classes of contamination are categorized in accordance with the table given in EPD TC 1-1-92 (Table 7.1) and the classes are defined as follows :

Class A Uncontaminated or mildly contaminated material for which no special dredging, transport or disposal methods are required except those which would normally be applied for the purpose of ensuring compliance with EPD's Water Quality Objectives, or for protection of sensitive receptors near the dredging or disposal areas.

Class B Moderately contaminated material which requires special care during dredging and transport, and which must be disposed of in a manner which minimizes the loss of pollutants either into solution or by resuspension.

Class C Seriously contaminated material which must be dredged and transported with great cares, which should not be dumped in the Gazetted marine disposal grounds and which must be permanently isolated from the environment upon final disposal.

For sediments to be identified within a particular class, it should be noted that only the concentration of one metallic species needs to exceed the specified contamination criteria. The EPD contamination criteria delineating these three classes are shown below in Table 7.1

Table 7.1 Classification of Sediments by Metal Content (mg/kg dry weight)

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Class A	< 0.9	< 49	< 54	< 0.7	< 34	< 64	< 140
Class B	1-1.4	50-79	55-64	0.8-0.9	35-39	65-74	150-190
Class C	1.5 or more	80 or more	65 or more	1 or more	40 or more	75 or more	200 or more

Source : EPD Technical Circular 1-1-92

The current policy relating to the dumping of construction and demolition (C&D) material is documented in the *Works Branch Technical Circular No. 2/93, 'Public Dumps'*. In order to dispose of the inert portion of C&D material (alternatively named as public fill) in a public filling area, a license is required which is issued by the Civil Engineering Department (CED). The Works Branch Circular states that C&D material suitable for use as fill material should not be disposed of to landfill, but placed in public filling area or reclamation and land formation projects. The Public Filling Sub-Committee (PFSC) together with Project Departments are responsible for considering the suitability of a site as a public filling area.

In addition to the Works Branch Circular, EPD and CED have produced a leaflet titled *'New Disposal Arrangements for Construction Waste'* which states that construction waste with less than 20% by volume of inert material will be accepted at landfill. If the material contains more than 20% inert material, the waste must be sorted with suitable material and sent to public filling area and non-inert waste sent to landfill for final disposal.

7.2.2 Chemical Waste

The Waste Disposal (Chemical Waste) (General) Regulation provides for the control of the storage, collection, transportation and disposal of chemical wastes in Hong Kong. Under the Regulation, a chemical waste includes any substance which is a scrap material or by-product arising from industrial/trade activities, as specified under Schedule 1 of the Waste Disposal Ordinance, in such form, quantity and concentration that it will cause pollution or constitute a danger to health or risk to the environment. A complete list of such substances is provided under the Ordinance. A chemical waste producer will be required under the Ordinance to register with the Director of Environmental Protection and to dispose of chemical waste to a licensed treatment facility such as the Chemical Waste Treatment Centre (CWTC) located at Tsing Yi, which was commissioned in June 1993 and is designed to treat most of the chemical waste from the territory. In addition, any contractor employed for the collection of chemical waste must be a registered chemical waste collector under the Ordinance.

7.3 Survey Methodology

A vibrocoring survey was conducted in February 1998 for 10 locations, namely VC1-VC10, to determine the level of contamination in the marine sediments at the breakwater locations of the proposed DGA. The locations of the vibrocores are shown in **Figure 7.1**.

7.4 Baseline Conditions

Existing Sediment Characteristics (Findings of Vibrocoring Survey)

A preliminary investigation of marine sediment quality has been carried out at the breakwaters of the proposed DGA and the results of the sediment sampling and analysis are given in Table 7.2. The results indicate that seriously contaminated, Class C material, was found at three vibrocore locations along the south-west breakwater of the proposed DGA. This is due to the exceedance of the specified Class C contamination criteria of the element Cu at the vibrocore locations VC2, VC3 and VC4. It is noted that the Cu concentration at VC2 (65 mg/kg) and VC3 (66 mg/kg) just exceeds the Class C contamination criteria of 65 mg/kg or more and that contaminated sediment was found at one depth interval only in the these core samples. At vibrocore VC4, a high Cu concentration of 120 mg/kg was recorded at the second depth interval. This high concentration appears to be localized as a value of 41 mg/kg (Class A) was recorded in the upper depth interval and a value of 10 mg/kg (Class A) in the bottom depth interval. The majority of the marine sediment along the other proposed breakwaters is classified as Class A, uncontaminated material. Class B, moderately contaminated material, was found at vibrocores VC5, VC7 and VC10.

The successful Tenderer (detailed design stage) would be required to undertake a detailed sediment quality assessment to identify precisely the location and extent of sediment contamination along the proposed breakwaters.

As described in Section 3.6.1, it is not anticipated that nutrient levels in the sediment will be of concern as the proposed DGA site is located offshore and there are currently no sewage effluent discharges in the area. For the sediment quality analysis undertaken for the Tsuen Wan Bay Further Reclamation EIA study, the PCB and PAH concentrations in the composite sediment samples were all found to be less than 100 μg/kg and 0.3 mg/kg respectively. It is anticipated that the levels of organic pollutants and trace organics in the sediment will be less than the above values recorded in Tsuen Wan Bay as the proposed DGA site is located away from industrial areas, and thus these potential pollutants will not be of concern.

Future Conditions

With the implementation of the Water Pollution Control Ordinance (WPCO), the Waste Disposal (Chemical Waste) (General) Regulation, Sewerage Master Plans for Tuen Mun, Tsuen Wan, Kwai Chung and Tsing Yi, and the Livestock Waste Control Scheme, the indiscriminate discharge of effluent will be brought under control. This will reduce the pollutant load to Hong Kong waters, particularly the North Western Waters, Western Buffer and Victoria Harbour. As a result, it is anticipated that further deterioration in sediment quality in the nearshore areas will in general be prevented.

As described in Section 3.3.2, with the significant population increase on Ma Wan from the future residential developments and the proposed theme park to the north of the Lantau Link, there will be a substantial increase in wastewater discharges and associated pollutant loadings. Therefore there is the potential for a reduction in marine water quality in the Ma Wan area and an associated deterioration in sediment quality. The new sewage treatment plant to be constructed at Pak Wan on northern Ma Wan will serve the committed future developments and thereby reduce the pollutant load into the marine waters.

7.5 Sensitive Receivers

These are the same sensitive receivers for water quality and ecological impacts described under Chapter 3 and 9 respectively.

7.6 Construction Phase Assessment

7.6.1 Potential Sources of Impact

The marine-based construction activities will result in the generation of a variety of wastes which can be divided into distinct categories based on their nature and ultimate method of disposal. The types of waste include:

- marine sediments;
- construction waste;
- chemical waste; and
- general refuse

The definitions for each of these categories, and the nature of their arisings and potential impacts are discussed in the following section.

7.6.2 Prediction and Evaluation of Impact

Marine Sediments

Dredged marine sediments will arise from the construction activities and it is estimated that a total of approximately 1,731,447 m^3 of dredged materials will be generated. The estimated volumes of dredged marine sediment at the different regions of the breakwater of the DGA are given in Table 7.3. As mentioned in Section 7.4, the marine sediment at the south-west breakwater of the proposed DGA are seriously contaminated (Class C). It is anticipated that a total of approximately 171,792 m^3 of Class C sediment will be dredged during the construction of breakwater foundation (Table 7.3). For the north, east and north-west breakwaters, the sediments are clean or moderately contaminated (Class A or B) and a total of approximately 1,559,655 m^3 of these sediments will require to be dredged. The potential environmental effects of the removal and disposal of these sediments comprise water quality impacts and indirect adverse effects on marine biota, as discussed in detail in Section 3.6 and 9.6 respectively.

Table 7.3 Estimated Volume of Dredged Sediment at the Breakwaters of the Proposed DGA

Locations	Approximate Volume (m^3)	
	Contaminated Dredged Sediment (Class C)	Clean/Moderately contaminated Dredged Sediment (Class A and B)
North-west Breakwater	0	70,686
North Breakwater	0	79,212
South-west Breakwater	171,792	671,352
East Breakwater	0	738,405
Total	171,792	1,559,655

In order to minimize any potential adverse impacts arising from the dredged marine sediments, the sediments should be disposed of in a manner which minimizes the loss of pollutants into solution or by resuspension, as detailed in the mitigation measures stated in Section 7.8. It is anticipated that, provided all these recommended mitigation measures are enforced, including the measures recommended in Section 3.8 for dredging activities, no unacceptable impacts will result from the dredging, transport and disposal of the marine sediments.

Construction Waste

During construction activities carried out by the contractor, wastes including materials packaging and equipment wrappings, may be generated. As the volume of construction waste generated will be dependent on the Contractor's operating procedure and practices, it cannot be quantified.

Introduction of these waste arisings from the construction activities into the sea should not be permitted as they have a potential to cause water pollution and indirect impacts on marine biota .

Chemical Waste

Chemical wastes likely to be generated by construction activities will mainly arise from the maintenance of equipment. Waste arisings from these activities may include cleaning fluids, solvents, lubrication oil and fuel. The cumulative effect of a potentially large number of small spillages during maintenance operations by faulty equipment, accidents, and carelessness may be significant.

Chemical wastes arising during the construction phase may pose serious environmental, health and safety hazards if not stored and disposed of in an appropriate manner as outlined in the Chemical Waste Regulations. These hazards include:

- toxic effects to workers;
- adverse impacts on water quality from spills and associated adverse impacts on marine biota; and
- fire hazards.

General Refuse

General refuse may include food wastes and packaging, waste paper, etc and have the potential to cause impacts on water quality. Release of general refuse into marine waters should not be permitted as introduction of these wastes is likely to have detrimental effects on marine biota in the area.

The amount of general refuse which is likely to arise cannot be quantified at this time as it will be largely dependent on the size of the workforce employed by the contractor and the implementation of practices on board the works vessels.

7.7 Operational Phase Assessment

7.7.1 Potential Sources of Impact

During the operation of the proposed DGA, waste arisings will typically consist of:

- dredged marine sediments from maintenance dredging; and
- sewage discharged from the vessels anchored within the DGA.

The potential impacts associated with these waste categories are evaluated in the following section. It should be noted that seepages or discharges of petroleum products from vessels moored within the

DGA would not be permitted under the licensing conditions and would be controlled by the relevant authorities.

7.7.2 Prediction and Evaluation of Impact

Dredged Material from Maintenance Dredging

The DGA area must maintain a sufficient depth to allow for turning and manoeuvring of vessels anchoring within the DGA. Therefore, sediments deposited through siltation must be dredged to maintain this depth between the vessels and the seabed. As described in Section 3.7.2, a preliminary siltation assessment[1] has been carried out to give an initial estimate of the likely sediment deposition rate within the DGA. Based on the findings of the preliminary siltation study, the estimated volume of dredged material is minor in scale on comparison to the construction phase dredging.

It is anticipated that the potential for impacts on water quality through sediment resuspension, and associated adverse direct and indirect impacts on marine biota, may be minimized with the use of an appropriate low impact dredging technique and the observation of good operational practice. Details of mitigation measures recommended to minimize potential impacts arising from maintenance dredging are discussed in Section 3.8.2.

Sewage Discharges

As discussed in Section 3.7.2, the dispersion modelling of bacteria generated from sewage discharges predicted minimal *E. coli* concentrations at the two beaches on eastern Ma Wan. *E. coli* concentrations at the Ma Wan mariculture zone were shown to be almost undetectable. Therefore, no unacceptable environmental impacts are anticipated to result from the discharge of raw sewage from the vessels moored within the DGA.

7.8 Mitigation of Adverse Impacts

7.8.1 Construction Phase

Marine Sediments

In order to minimize any potential adverse effects from marine sediment disposal, the Hong Kong Government has allocated gazetted marine disposal areas which are allocated by the Fill Management Committee (FMC) and EPD, depending on the quantities and the levels of contamination of the spoil to be disposed (*Works Branch Technical Circular (WBTC) Nos. 22/92* and *6/92*).

The dredged marine sediments will be loaded onto barges and transported to designated disposal sites depending on their level of contaminants. As discussed in Section 7.6.2, the marine sediments at the south-west breakwater fall into Class C seriously contaminated material. The mud dredged at this area shall be transported with great care and disposed at the East Sha Chau Contaminated Mud Pits which is designated for the disposal of seriously contaminated muds. Since the dredged sediments at other parts of the breakwaters of the DGA are identified as Class A or B, they will be suitable for disposal at a gazetted marine disposal ground.

During transportation and disposal of the dredged marine sediments, the following measures shall be taken to minimize potential impacts:

[1] Siltation Assessment for the Tang Lung Chau Dangerous Goods Anchorage, MCAL. October 1998.

- Bottom opening of barges shall be fitted with tight fitting seals to prevent leakage of material. Excess material shall be cleaned from the decks and exposed fittings of barges and hopper dredgers before the vessel is moved.

- Monitoring of the barge loading shall be conducted to ensure that loss of material does not take place during transportation. Transport barges or vessels shall be equipped with automatic self monitoring devices as specified by the Director of Environmental Protection (DEP).

General Construction Waste

In order to minimize adverse impacts on the environment, it is recommended that comprehensive waste management procedures and appropriate staff environmental training be employed to ensure that waste arisings during the construction works do not enter surrounding waters. Care should be taken during the transportation of construction wastes by barge to the disposal site to ensure that no impacts on water quality arise from spillages.

Chemical Waste

The chemical waste produced shall be sent to the CWTC located at Tsing Yi which is the point of disposal for chemical wastes in the Territory. Disposal of chemical wastes at the CWTC will ensure that environmental and health and safety risks are reduced to a minimum, provided that correct storage procedures are instigated on the marine vessels.

The contractor should contact the EPD and the contractor operating the CWTC, who offer a chemical waste collection service. The CWTC operator will only supply standard containers no larger than 200 litres. Other storage would have to be provided by the contractor. In addition, the contractor shall check to ensure that the handling and disposal methods for the wastes in question are appropriate, and that separation of chemical wastes from other waste arisings is conducted.

General Refuse

General refuse generated on the vessels shall be stored and collected separately from other construction and chemical wastes by approved contractors. The contractor will be responsible for the removal of waste generated on the works vessels. A private waste contractor may be commissioned by the contractor to remove any general refuse generated. It is important that defined waste management practices including appropriate staff training be employed to ensure that refuse arising during the construction works do not enter surrounding waters in order to minimize adverse impacts on marine biota in the area.

With the appropriate handling, storage and removal of solid and liquid waste arisings during the construction of the DGA as defined above, the potential to cause adverse impacts on water quality and marine flora and fauna will be minimized. No solid nor liquid wastes (other than sewage discharges) shall be allowed to enter the marine waters at the works site. Nomination of an approved personnel, such as a site manager, to be responsible for good site practices and effective arrangements for collection and disposal to an appropriate facility of all wastes generated at the works area is recommended.

Monitoring and audit of waste management practices, as outlined in Section 10.2, will be necessary to ensure that the correct handling and disposal requirements for the various waste arisings are being implemented.

7.8.2 Operational Phase

Marine Sediments

Mitigation measures to minimize potential impacts arising from maintenance dredging on water quality will be as recommended in Section 3.8 for dredging works during the construction phase.

The measures recommended above to minimize potential impacts during the construction phase from the transportation and disposal of the dredged sediments are also applicable for the maintenance dredging activities.

7.9 Definition and Evaluation of Residual Impacts

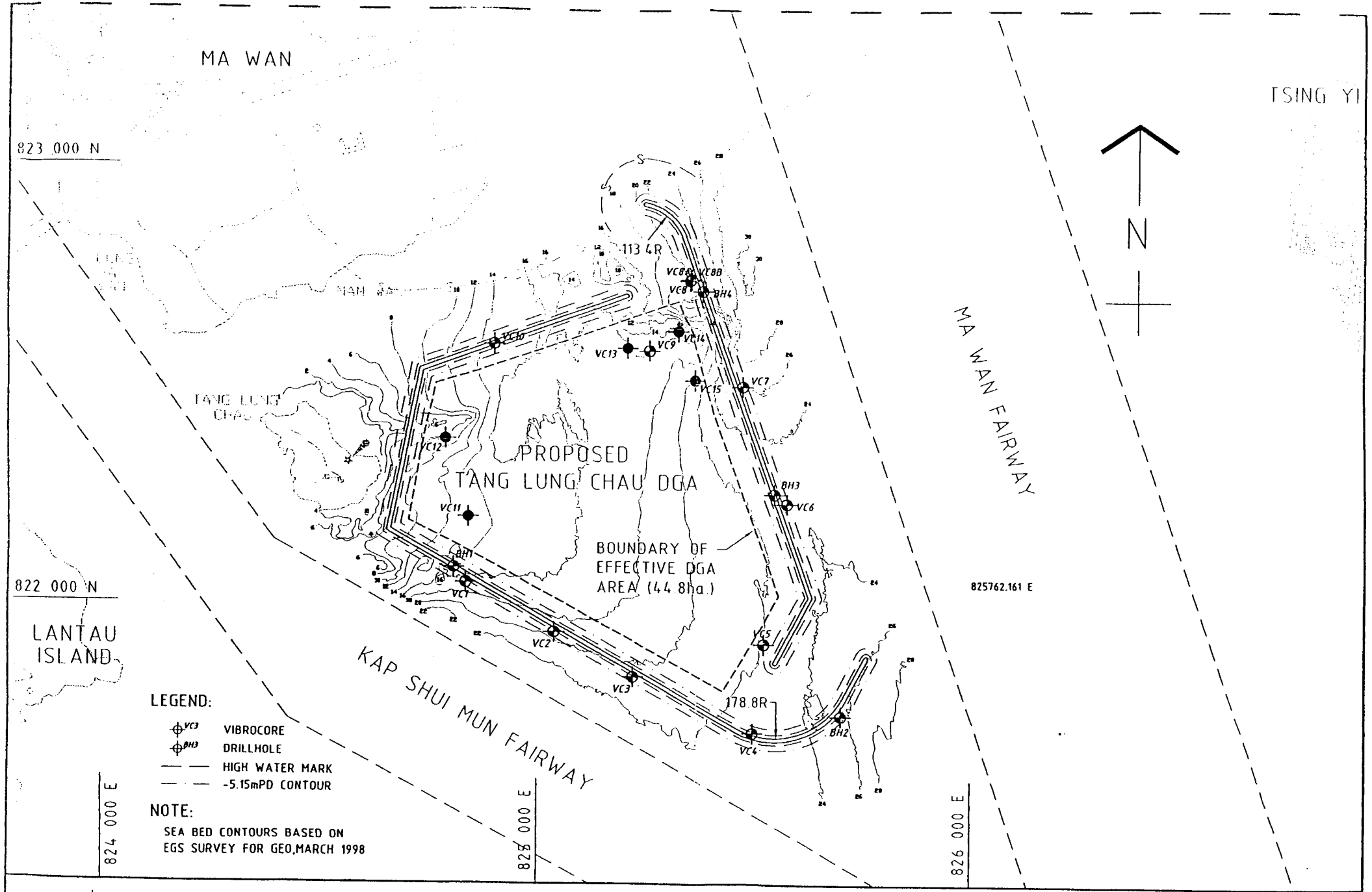
No unacceptable residual impacts are anticipated provided that the recommended mitigation measures on waste management practices for the construction and operational phases of the TLCDGA are fully and strictly implemented. In addition, it is considered that no adverse environmental effects will result from the employment of the recommended mitigation measures for waste management and dredged sediment disposal during the construction and operational phases of the DGA, as described in Section 7.8.

7.10 Conclusions

It is considered that the potential impacts of the dredging works and associated dredged sediment disposal will be minimized provided that the recommended mitigation measures, including the procedures detailed in *Works Branch Technical Circular No. 22/92 'Marine Disposal of Dredged Mud'*, are strictly implemented. The dredged sediment, identified as seriously contaminated Class C material, shall be disposed at the East Sha Chau Contaminated Mud Pits. The dredged sediments classified as Class A and B shall be disposed at a gazetted marine disposal ground.

Provided that construction and operational waste arisings are handled, transported and disposed of using approved methods and that no solid or liquid wastes (other than sewage discharges) enter surrounding marine waters, adverse environmental impacts are not anticipated. It should be noted that during the operational phase, the only issue with respect to waste management will be the transportation and disposal of marine sediment from maintenance dredging.

EM&A will be necessary to ensure that the correct disposal requirements for the various wastes generated from the construction works and maintenance dredging are enforced, as detailed in Section 10.2.



TSUEN WAN BAY FURTHER RECLAMATION, AREA 35

TANG LUNG CHAU DGA - SEABED CONTOURS AND SITE INVESTIGATION

FIGURE 7.1

SCALE AS SHOWN